2018 CoNECD - The Collaborative Network for Engineering and Computing
Diversity Conference: Crystal City, Virginia Apr 29

Black Engineering and Computing Doctoral Students' Peer Interaction that Foster Racial Isolation

Dr. Monica L. Ridgeway, Vanderbilt University

Monica L. Ridgeway is a first year Post-Doctoral Research Fellow apart of the Academic Pathways Program at Vanderbilt University. She has joined the Explorations in Diversifying Engineering Faculty Initiative (EDEFI) research team lead by Drs. Ebony McGee and William H. Robinson. Monica has recently received her Ph.D. in Science Education from the University at Buffalo. As a former science educator, Monica is concerned with science, technology, engineering, and mathematics (STEM) teaching and learning for historically and contemporarily marginalized students of color. Her research focuses on the role of identity, racialized experiences, and marginalization in K-12 and Higher education STEM spaces. Her work seems to challenge and problematize traditional notions of STEM teaching and learning and present solutions for marginalize groups to have access

Dr. Ebony Omotola McGee, Vanderbilt University

Ebony O. McGee is an Associate Professor of Diversity and Urban Schooling at Vanderbilt University's Peabody College and a member of Scientific Careers Research and Development Group at Northwestern University. She received her Ph.D. in Mathematics Education from the University of Illinois at Chicago; and she was a National Academy of Education/Spencer Foundation Postdoctoral Fellow and a National Science Foundation Postdoctoral Fellow. As a former electrical engineer, she is concerned with science, technology, engineering, and mathematics (STEM) learning and participation among historically marginalized students of color. Her research focuses on the role of racialized experiences and biases in STEM educational and career attainment, problematizing traditional notions of academic achievement and what is mean to be successful yet marginalized, and STEM identity and identity development in high-achieving students of color. She is currently the PI on two studies funded by NSF, the first of which investigates the causes behind why African Americans remain one of the most underrepresented racial groups in engineering faculty positions. The second study is working toward the design of a holistic racial and gender attentive mentoring program for engineering PhD students of color.

Dr. Dara Elizabeth Naphan-Kingery,

Dara Naphan-Kingery is an interdisciplinary social psychologist and postdoctoral researcher at Vanderbilt University with the Explorations in Diversifying Engineering Faculty Initiative (EDEFI) group. She is interested in understanding the racialized and gendered experiences of historically marginalized engineering scholars. She is particularly interested in how mental health and identity management strategies mediate the relationship between discrimination experiences and academic and career outcomes, and the role that social responsible engineering and social justice in engineering can play in attracting and retaining underrepresented students to the field.

Amanda J Brockman, Vanderbilt University

Amanda is a doctoral student in the Department of Sociology at Vanderbilt University.

**Black Engineering and Computing Doctoral Students' Peer Interactions that Foster Racial
Isolation and Impostor Feelings**

Monica L. Ridgeway
Amanda J. Brockman
Ebony O. McGee
Dara Naphan- Kingery

Vanderbilt University

Abstract

Black graduate students in engineering and computing experience isolation due to their underrepresentation. In this manuscript, we analyzed how Black engineering and computing doctoral students' experiences of isolation and impostor syndrome were exacerbated by negative interactions with their Asian international peers. Data were collected through semi-structured interviews with 23 Black PhD students regarding their doctoral experiences. Across the interviews, participants expressed similar experiences in their programs: 1) Feelings of racial isolation from underrepresentation among their peers, 2) Perceptions that Asian peers were positioned to be in STEM which made Black students feel as though they were impostors in their academic fields 3.) Interactions with Asian peers that challenged their sense of belonging in their departments and programs, leading them to feel increased isolation and minimal support. This research affirms the need to create and employ initiatives at the institutional or departmental level to make engineering and computing programs more inclusive spaces for diverse students and to combat the types of exclusionary practices that hamper and damper the experiences and potentially the outcomes of Black PhD engineers and technologists.

Keywords: engineering education, peer interactions, Black students, Asian students, impostor syndrome

Introduction

Engineering and computing undergraduate students in higher education have traditionally been predominantly White, male, and middle class (National Science Board, 2012) because historical and contemporary social processes have constructed a racialized hierarchy of students' academic abilities. In science, technology, engineering, and math (STEM) academic spaces, White and Asian students are positioned at the top of the ladder and Black, Latinx, and Native American students are positioned at the bottom. Asian students experience strain from being held to the standards of the "model minority" myth (Sakamoto, Takei, & Woo, 2012; Sue, Bucceri, Lin, Nadal, & Torino, 2007; Sue, Capodilupo, et al., 2007) that assumes all Asians are high achieving, naturally gifted, extremely hardworking, and "meant" to enter STEM fields (Lee, 1994; Trytten, Lowe, & Walden, 2012). On the other hand, this hierarchy makes academic life difficult for Black and Latinx students (McGee, 2016) by constantly responding or reacting to doubt about their qualifications to succeed as STEM college professionals (Martin, 2009) and feel intellectually inadequate.

Engineering graduate education environments have been described as unwelcoming, exclusive, and isolating for students of color (McGee & Bentley, 2017; Ong, Wright, Espinosa, & Orfield, 2011; Tate & Linn, 2005). In the current study, we examined how Black engineering and computing students make sense of their interactions with their non-Black peers through in-depth interviews. This work extends the literature of the Black-Brown-White paradigm of racialized experiences by looking in-depth at the experiences of Black doctoral and computing students and their interactions with their non-Black peers asking: how do interactions with non-Black peers in engineering and computing departments in Predominantly White Institutions (PWI's) impact the experiences of Black doctoral students?

Literature Review

When underrepresented students of color (i.e., Black or African American, Latinx, and Native American students) progress from undergraduate to graduate school, a majority of their engineering and computing peers are international students. In fact, about 55% of all science, technology, engineering and math (STEM) graduate students in the U.S. are international, which is the highest concentration of international students across disciplines (16% of graduate students in the arts and humanities are international; Okahana, Feaster, & Allum, 2016). The proportion of international students in STEM graduate programs has historically been particularly high in engineering and computing (Okahana & Allum, 2015). A recent study found that international students account for a majority of students in eight engineering disciplines, most notably in electrical and petroleum engineering, in which 81% of students are international, and in computer science, in which 79% of students are international (National Foundation for American Policy, 2017). Chinese and Indian students comprise the largest share of international graduate students in the U.S., and engineering is the most popular field of study for international graduate students in the U.S. (Okahana & Allum, 2015). Thus, since the 1970s, Asian graduate students have comprised a majority of international graduate students in engineering (National Research Council, 2005).

A recent article from the *New York Times* (Wingfeld, 2017) quoted an international engineering graduate student in New York University's Tandon School of Engineering who shared her experience, "You're comfortable everyone is going through the same struggles and journeys as you are…it's pretty exciting" (Wingfeld, 2017). This is reassuring for international doctoral students, because doctoral training is a solitary endeavor to begin with (Jones, 2013), and without integration and support, doctoral students can experience social isolation, a major

contributing predictor of attrition (Ali & Kohun, 2007). Despite their distance from home

international students' critical mass in engineering and computing doctoral programs enables

them to connect with peer groups within which they develop a *sense of belonging*, which is a

consequential resource for finding support to thrive in demanding doctoral programs.

Sense of belonging is the feeling that one has stable relational bonds with the individuals

in the social groups with whom they live or work, and it is a fundamental human need that

positively affects mental health and well-being (Baumeister & Leary, 1995). A lack of sense of

belonging can have suboptimal outcomes such as poor psychological wellbeing and performance

deficits (Walton & Cohen, 2007). Individuals who are already marginalized tend to be

particularly sensitive to belonging, because connection to a group can provide important

resources such as psychosocial and instrumental support (Walton & Cohen, 2011). Greater sense

of belonging predicts both entry into and retention in academic and professional fields

(Dasgupta, 2011; Wilson, Spring, & Hansen, 2008). Research has shown that sense of belonging

predicted persistence toward undergraduate degree completion in a sample of African American

students (Hausmann, Ye, Schofield, & Woods, 2009), however, we found no research exploring

the relationship between belonging and persistence among African American graduate students.

Students of color at PWI's can oftentimes feel like uninvited guests in a strange land

(Parker & Scott, 1985), and this is especially so for Black doctoral students in engineering and

computing. While African American engineering and computing graduate students, particularly

those in PWI's, are minoritized[1] in undergraduate education, they may feel further minoritized in

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[1] We use the word *minoritized* to refer to the outcome of exclusionary practices resulting from historical and contemporary racism (Gillborn, 2005).

graduate school because they are American English-speakers in a context that has become increasingly international. Unlike many of their international peers who can turn to one another for support, Black engineering doctoral students are highly underrepresented; comprising about 3.2% of all U.S. engineering doctoral recipients (Yoder, 2016). Thus, paradoxically, international students, who are in fact visiting students, may be more likely than American students of color, including Black Americans, to feel a sense of belonging in their doctoral programs.

Stereotype-based Interactions

In addition to their likelihood of experiencing a lack of belonging due to their underrepresentation, Black PhD students in their engineering and computing programs are likely to experience interactions with both faculty and peers that are based on racial stereotypes— sweeping assumptions about individuals based on their perceived racial group membership, which are shaped by historical and contemporary forms of racism. Even more than numerical underrepresentation, stereotype-based interactions can challenge underrepresented students' sense of belonging in their respective engineering and computing fields. One form of such an interpersonal interaction based on a racial stereotype is a *racial microaggression*. Racial microaggressions are brief, everyday exchanges that derogate individuals for their membership in a particular racial category, a phenomenon originally conceptualized Chester Pierce, whose African American psychiatric patients reported demeaning interactions with White people that seemed to have cumulative, negative effects (Pierce, 1975). They may be verbal, non-verbal, or environmental (Nadal et al., 2013), and often, they are subtle and ambiguous, and have negative effects.

Illustrating several examples of racial microaggressions in engineering and computing contexts does not require a thorough review of research. Examples may include students of color

being ignored or shut out of group activities, being offered unsolicited help, or being delegated non-essential tasks in group activities. Due to their subtlety, they may often go unchallenged. However, when they are addressed, faculty or students from majority racial groups may deny the existence or effects of perpetrated discrimination and resulting inequality, which further invalidates and ignores the experiences of underrepresented students of color. These interactions are rooted in stereotypes about racially minoritized students' intellectual competence in their field, despite demonstrated achievement evidenced by their status as doctoral students.

Effects of Stereotype-based Interactions

Individuals can preserve their psychological well-being when faced with more overt forms of discrimination because they can more clearly attribute the behavior to prejudice and discrimination, rather than personal performance (Major & O'Brien, 2005). However, the intentionality behind most micro-aggressions can often be ambiguous, and sometimes individuals may question whether their own behavior or their group membership is responsible for negative social feedback (Sue et al., 2007). The cumulative effects of microaggressions can have a range of affective and behavioral consequences. For example, racial microaggressions can decrease work productivity (Dovidio, 2001) and school performance (Solórzano, Ceja, & Yosso, 2000), and increase anxiety, stress, and depression (Huynh, 2012).

Due to the constant possibility of experiencing interactions based on stereotypes, Black engineering and computing doctoral students may also experience decrements in psychological wellbeing and performance due to *stereotype threat*—a phenomenon in which individuals experience anxiety in situations in which they could confirm a negative stereotype about one of their social groups (Steele & Aronson, 1995). When students are anxious about *not confirming* negative racial stereotypes—which is even more common among individuals with higher

identification with the stereotyped group (Schmader, 2002)—this detracts their attention from the task in front of them, and can lead to decreased performance on achievement or performance-related tasks (Steele, 1997; Steele, Spencer, & Aronson, 2002).

However, as McGee and Martin (2011) point out, stereotype-based interactions or the threat of confirming a negative racial stereotype does not invariably or automatically result in impaired wellbeing or performance. Because students of color experience recurring instances of negative, stereotype-based interactions throughout their lives, they can often learn to recognize the permanence of racism, and choose to not expend psychological energy ruminating over such interactions. To compensate for discrimination and obstacles to success that often define minoritized students' experiences in engineering and computing spaces, many engage in *stereotype management* (McGee & Martin, 2011). This strategy refers to "both a process and a learned competency that enables Black and Latino/a students to recognize and negotiate social-psychological threats to their identities in ways that aid their STEM achievement" (McGee & Martin 2011).

Theoretical Framework

Minoritzed (Black, Latinx, and Native American) students who are grossly underrepresented within engineering fields often experience feelings of being a fake, or fraud within their departments (McGee, Robinson, Bentley, & Houston, 2015;McGee, Houston, Botchway, & Naphan-Kingery, 2017), a phenomenon called the "impostor phenomenon" (Clances & Imes, 1978). Impostor phenomenon can affect students through the "normalization of being perceived as a fraud in spite of high achievement in their academic domains" (Vinnicombe & Singh, 2011; Young, 2011). Regardless of ascribed attributes like race or sex, individuals can

feel that they are frauds and that others have mistaken their ability despite repeated demonstrations of success.

Many programs and policies focus on recruiting underrepresented students, but many do not focus on inclusion or fostering a sense of belonging. In fact, students from majority groups (i.e., White and Asian students) might not perceive underrepresented students and faculty as legitimate members of their scientific community. Rather, they may perceive them and interact with them as if they were *tokens*—representatives of their racial groups so their department can appear diverse (Steele, 1992; Truax, Cordova, Wood, Wright, & Crosby, 1998). Tokenism can further perpetuate impostor feelings when students of color internalize racialized experiences (e.g., attribute their achievement to external rather than internal factors) and begin to believe the opinions of others (Dancy & Jean-Marie, 2014). As a result, in addition to unwelcoming institutional climates, racial discrimination, and institutional and social barriers in their departments, underrepresented engineering and computing students of color may struggle with diminished mental health and academic performance (Cole & Espinoza, 2008; Malone & Barabino, 2009; McGee & Stovall, 2016; Robinson, McGee, Bentley, Houston, & Botchway, 2016). For example, Black graduate students may fear being exposed as intellectually fraudulent by their peers, students, and professors, which can decrease their in-class participation and increase their anxiety when interacting with undergraduates (Brookfield, 2005, 2015).

Data Sources and Methods

Participants

The data for this study are taken from a larger three-year study that attempts to understand the challenges and opportunities facing: 1) Black engineering PhD students, candidates, and postdocs in STEM; 2) Black engineering faculty; 3) directors of minority engineering programs,

and 4) engineering administrators (e.g., deans, associate deans). Participants were recruited

through: 1) pre-existing professional connections, 2) recruitment of faculty members working in

institutions with ten or more tenure-track or tenured Black faculty members (as of 2012), and 3)

recruitment during a national engineering/computer-related conference. For the current analysis,

we examined interview data collected from PhD students and post-doctoral researchers from

PWI's who participated in one-on-one interviews. The majority of participants were affiliated

with institutions in the eastern and central time zones (see Appendix 1 for participant

descriptions).

Data Collection

Interviews were conducted between 2014 and 2015 at participants' universities, on the

phone, or at a national engineering conference. A twenty-five dollar incentive was offered for

participation. Interviews were semi-structured using an interview protocol which allowed

flexibility with the topics covered, giving the interviewee agency to decide what to discuss (Yin,

1998). These interviews ranged from 45 minutes to just over 2 ½ hours in length. The audio-

recording of each interview was professionally transcribed.

Data Analysis

Our aim was to describe and better understand the lived experiences of participants, thus

our analytical approach was phenomenological (e.g., Moustakas, 1994). This method informed

our data analysis process by directing us to foreground the participants' perceptions and

meaning-making processes with respect to their lived experiences (Strauss & Corbin, 1998). The

data analysis team began this process by reading through the transcripts and discussing potential

themes in a series of meetings which spanned three weeks. We followed Dey (1993)'s

description of theme development by writing all key patterns that emerged from freely

considering the data to generate meaning (Miles & Huberman, 1994). The research team then wrote memos to annotate distinctions and comparisons across the data, which formed the basis of the coding process and the conversation around potential themes. This conversation ultimately centered on the omnipresent theme of impostor syndrome across transcripts, as well as participants' interactions with Asian, international peers. Thus, the concept of impostor syndrome served as the starting point for the analysis of these transcripts. After conceptualizing a definition of impostor syndrome, the research team focused on this theme within the transcripts and clustered units of meaning to form themes and inductive codes (Groenewald, 2004). This resulted in a coding architecture with four main themes related to impostor syndrome and multiple corresponding codes (Appendix 2).

These codes were created within NVivo, a computer-assisted qualitative data analysis software platform used to store and retrieve data and document the process of analyzing the data. Due to the rich coded data regarding Black students' perceptions of who belongs and has the legitimacy to fully engage and be accepted (who is *not* the impostor), the research team decided to focus on this theme. While a question centering on this idea was not explicitly asked in the interviews, the research team was struck by the fact that this theme emerged from the data organically within each of the 23 interviews. From here, the research team divided the data into two core themes: how perceptions about positioning of Black students and non-Black students (impostor syndrome) and how specific stereotype-led peer interactions affected the participants' experiences. Fourteen of the 23 participants vividly described direct stereotype-based interactions with other students, who they believed did not experience this form of self-questioning and were rarely made to feel like impostors; these others were mainly international students of Asian descent, and more generally men and traditional students (i.e., young, single,

without children). While these negative interactions experiences can and do occur in faculty-student interactions as well, the focus of this paper is on *peer* interactions, because peers serve as a comparable source of social comparison from which to determine their status as a valid member of their field, or an imposter. This broad theme encompasses the focus of this paper.

Findings

The results of the analysis revealed two main themes- that the participants' underrepresentation and stereotype-based interactions with their Asian, international peers contributed to feelings of being an imposter. First, 22 out of 23 participants (96%) who were interviewed described being underrepresented and/or isolated in some way within their engineering environment. This racial isolation can reify feelings of being an impostor, wherein students observe who is fully part of the community and who is on the margins. Ultimately, being the only one from one's racial group can cause students to question their sense of belonging within the field. While Asian students are also minoritized in engineering and computing disciplines (e.g., McGee et al., 2017), this is not the perception of many of the Black students in this study. As we describe below, the participants in this study expressed that Asian international students' tight-knit, exclusive cliques contributed to their feelings of isolation.

Furthermore, the results reveal that while the impact of being racially isolated takes a toll on Black students, it is not just their underrepresentation that is problematic. Fourteen out of 23 participants (61%) during their semi-structured interview detailed experiences of interacting with peers which were discernably based on negative stereotypes about Black people. These interactions with their non-Black peers communicated to the participants that engineering and computing spaces are not intended for them. Specifically, Black students mentioned their Asian peers as being in the majority. Black students attributed stereotype-based interactions, including

being shut-out of group activities, having to prove their intellect, and being dismissed by their

non-Black peers, to racial discrimination, which added to the hostile and exclusive learning

communities for Black students. Again, we did not set out to focus on Asian international

students, but 8 out of the 14 participants (57%) explicitly described stereotype-based peer

interactions with Asian or international peers. We felt this was significant due to the semi-

structured nature of the interviews that participants brought up this topic. Thus, the findings in

this paper will focus on this theme along with the aforementioned theme of feelings of

underrepresentation and isolation.

Isolated by Blackness: Doctoral students' feeling of underrepresentation

The gross underrepresentation of minoritized populations within engineering and

computing disciplines has been well documented and discussed. This fact does not fly under the

radar of the students both within and outside of those populations. In this study, the participants,

all of whom were Black doctoral students in engineering and computing disciplines, expressed in

a variety of ways how they were aware of their underrepresented status within their department,

which fostered the illusion that engineering and computing programs are not intended for Black

students. For example, Aubrey, a second-year PhD student in biomedical engineering,

recognized the infrequency of her interactions with Black people in the department. She realized

Black people were underrepresented and described the infrequency of her interactions as "far and

few between" at her predominately White institution. While Aubrey was assessing the frequency

of her interaction with Black people, Taylor, a first-year Ph.D student in operations research,

actually counted the number of Black students and faculty. Taylor frankly queried "where *ARE*

all the Black people" ("are" is capitalized and italicized for emphasis) in both the student and

faculty body when she stated, "*We have 180 students in our department, which is huge, and like*

60 faculty members. And we have two Black students and no Black faculty. Like none. Where are

they?" Taylor's response described how she recognized Black people were underrepresented, but

was in disbelief Black people were so scarce in the department. Perhaps, Taylor is wondering

this because she interacts with Black people outside of her department and notices the

underrepresentation is not due to the lack of Black people at her institution.

Taylor continued with her reasoning of why she wanted more representation. While she

does not overtly describe herself as being racially isolated, this fact can be inferred from her

hyperawareness of the underrepresentation. She stated, "*I mean there is something that comes*

with seeing people who look like you, and being able to go to someone and talk about those

struggles or have someone who's similar to you." Taylor believed having representation of Black

faculty would provide her with a source of support to discuss her racialized experiences.

Approaching faculty for social and emotional care to cope with racial isolation is outside of the

traditional role for faculty members. However, Black students described the need to connect with

Black faculty in this capacity. This could be to ease their discomfort of feeling as if they do not

belong, meaning, if they were to express to a Black faculty member that they felt like they did

not belong in the department, this would reduce their feelings of being an impostor and/or their

feelings of being the only Black person. In addition, it could validate the students' assumptions

that they might have otherwise toiled with privately. This can even consume the thoughts of

Black students to a point that mentally fatigues them, because being Black is something about

them they cannot change.

"Asian students belong": Black students' perceptions of Asian peers in engineering and

computing

"I think if I was maybe Asian or Indian, it'd be different" (Shanice, a sixth-year student in biomedical engineering). Shanice's brief statement revealed the belief that as a Black woman within her department her experiences would be different if she were Asian. Her use of the word "different" needs close attention, because she later disclosed that she would have a stronger sense of belonging because she would match the representation within her department. Shanice, like the other Black engineering and computing students, is cognizant of the racialized climate within her department. She recognizes which groups are present and which groups are extremely underrepresented. Shanice continues to divulge that, "*Well,...there's a lot more of them [Asian students] when it comes to engineering programs... Everybody I worked with were, you know, Asian or Indian...really Indian at that institution. So...um, yeah.*"

Also, Jacob echoed Shanice when describing his experiences at Southern Technical University 1: *"When I first got to grad school... my cohort, the PhD students were all Asian, it was like 16 Asians and me. So [laughs]...Yeah, so...yeah, soon as I got there, it was...it was really weird."* Both Jacob and Shanice experienced the overrepresentation of their Asian international peers and resultantly, being racially isolated. Based on their experiences of isolation vis-à-vis Asian students, Black students believed that Asian students were overrepresented within their departments, and therefore experienced less racial isolation. This racial isolation can intensify students' sense of not belonging.

In sum, Black students in engineering and computing disciplines have described the overrepresentation of their Asian peers. They describe their Asian peers in ways that uncover the positioning of Asian students in engineering and computing disciplines. Black students are hyperaware of their own underrepresentation, and this can impact their sense of belonging. If students feel as if they do not belong in their environment, this could lead to heighted feelings of

being an impostor since students would observe how their peers are navigating in the same

terrain. ***Peer Interactions: Mechanisms by which isolation is reinforced***

This study focuses on the participants' narration about Asian students to better

understand the dynamics of their interactions. Stereotype-based interactions with Asian peers

challenged participants' sense of belonging within their departments. These interactions

reinforced the extreme isolation Black students can experience in engineering and computing

departments. Kelley, a third-year PhD student in biological and agricultural engineering, stated,

> *I can't walk into my suite and hear English unless I'm the one speaking it …But I'm very*
>
> *lonely and I really kind of hate it… I think I'm definitely in the minority as a domestic*
>
> *student. You will have Chinese students who won't pay any attention to you. And I tried*
>
> *to learn Chinese just so I could, you know, talk to them… They just look at you like*
>
> *you're crazy. So I stopped… But I'm telling you, the only time I hear English is when I'm*
>
> *a TA and a student is in my office. Or my professor is in my office. And that is the only*
>
> *time that there is English spoken in my suite. So I spend a lot of time behind a closed*
>
> *door.*

In this excerpt, Kelley describes being racially and linguistically isolated and feeling positioned

outside of the peer groups that surrounded her. She felt as if her peers had a sense of community

that she did not get to experience, despite her efforts (e.g., learning some Chinese to build

community). It also appears as if Kelley is missing out on being embraced by her learning

community that she observed is capable of interacting among themselves, just not with her. And

on the other hand, her peers are also missing out on benefiting from Kelley being in the learning

community as well. This added to her frustration and feeling of exclusion because Kelley

desperately wanted to have a sense of community within her department as well.

Black students working in groups with Asian peers. When instructed to work in group in the laboratory, Mykisha, a sixth-year PhD student in material science, described her experience as isolated and uncomfortable. Mykisha did not feel embraced by her peers and did not feel safe to share her thoughts about topics unless she was certain. This could be because of the negative way in which being incorrect can affirm stereotyped assumptions that non-Black peers have about Black students. This description was common among the participants within this study. Black students have did not have the freedom to brainstorm with their peers. Mykisha:

… everything about that group was horrible. I mean, I shouldn't say all of them. But [Asian Students] were kind of condescending a bit. Um, if I an had one issue with one of them I would have them like come and confront me in the lab with other people around like, by my desk, and say things like…I don't even…oh…it's like I put a lot of that stuff out of my mind. But just things that would make me seem like I wasn't capable of doing things properly… And I was learning a lot of new techniques, but they…they treated me like I didn't know what I was doing.

Like many Black doctoral students, Mykisha is distressed about working in groups and group formation. Mykisha had her intellect questioned by her peers in a way that she found uncomfortable or more frankly, rude. Perhaps there lies a disconnect in communication between different cultural groups. Mykisha felt outside of the peer group when they confronted her as a whole because of the issue she had with one Asian students. Despite being outside of the peer group, Mykisha is being forced to work within the group. The experience of isolation is exacerbated when Black students did not feel they were embraced by their peers.

In different example, JaMil, expressed his anxiety with having to select a group to work with when he stated, "*…when you're doing group work for the instructor and they let you go*

pick partners, and it's very much, like okay, let me get...in this person's group and that person's

group. And nobody has proven anything academically yet, or any type of ability. ... you can see

there's some of those things going on." Like a majority of the participants, JaMil describes being

stressed with selecting which group he will work in. He thought that this stress was not felt

among his Asian peers since they often came into class working as a group.

To intensify Black students' racial isolation, they also had to encounter stereotyped-based

interactions which occurred through microaggressions and other blatant forms of discrimination

with peers during small group work. Students often are exhausted from trying to determine if

race was a factor in microaggressions, like when Tatum, a third-year student in material sciences,

described,

> *...when someone [Asian peer] you know says something offensive. And you know they*
>
> *might not understand what they said. And so I try to give them the benefit of the doubt at*
>
> *least that it's subconscious. That it's not active. But, oh, they're actively trying to, you*
>
> *know, go against me because I'm Black or something? ...And you know, I try to*
>
> *generally...whenever possible, I try to let the work speak for itself rather than trying to*
>
> *speak up against it, unless...I mean, I have been in a situation that it's been egregious,*
>
> *so...*

Students like Tatum describe experiencing more overt acts that cause them to be discriminated

against. Tatum also raises an additional point when he said *they may not understand what they*

said, this could also be attributed to a cultural disconnect between the Black and Asian students.

However, regardless of the possible disconnect, the interaction was hurtful to Black students

nonetheless. This can also make coalitional building more of a challenge.

Experiences with social media*.* Kaila, a fourth-year industrial systems engineering PhD student described a social media experience with an Indian international student at Southern State University 1.

Kaila,

> *So I think it was a new student. And I don't even really think I knew him, but he asked to*
> *be my friend on facebook, so okay, why not. I think he was from India and it was like a*
> *list of things that you should do before coming to America or something like that. And it*
> *was just like random stuff that I guess they feel like Americans are known for and then it*
> *said "Learn Nigga lingo," and I was like "What?" So of course I like de-friended him. But*
> *I never saw him again on campus 'cause I was just like "Who is this person?" Um, so that*
> *really offended me. 'Cause like what are you, what are you talking about…*

Kaila perceived this as a public display that presented Black people in an oppressive and offensive way and it worried her that he could potentially be one of her peers in a future class. It also communicated that Black students need to be "talked to" in a different way and therefore positioned Kaila outside of the engineering and computing populace. This is an example where Black and Asian students are not culturally connecting which can prevent coalition building.

In a different situation, Shanice felt as if her Asian peers doubted her intellect and would look to affirmation from a White man in the same group, as if the White man held more knowledge above all others within the group. In this excerpt Shanice is re-telling another Black woman's experience that she felt resonated with her and demonstrated how Black people are not included as intellectual peers within the group. Shanice stated,

> *…she mentioned about how someone questioned her and how, when she was explaining*
> *something on how to use an instrument properly, the...I think it was a Asian, or whatever,*

whoever, I think it was Asian, he would look to the White guy to make sure she was doing

it right. And I was like, "What! That's crazy. So I think she'd be...you know, she'd

probably be more helpful, because she's in a bigger lab setting, whereas to me, my lab is

just me. So that's just sorry, a side note. And I was thinking about that... wow...

This example demonstrates that Asian peers held the White man's knowledge above their own and most importantly above hers. This positioned Shanice's friend at the bottom of the perceived racial hierarchy of academic ability, and confirmed that in the racial hierarchy, White people (especially men) are at the top with Asians, while Black people are on the bottom. These shared experiences among Black students reinforce the societal issues that create their discomfort and lead them to question if they are supposed to occupy these engineering and computing spaces. In the above example from Shanice, she does not question her Black peers' intellect and found it outlandish that her friend's suggestions where dismissed; she valued the expertise and knowledge her Black peer was trying to share with others.

When Black students were not excluded from study groups' altogether, their inclusion was contingent upon repeatedly confirming their intellect and assuring that the group could benefit from their contributions. Their underrepresentation and opposition and resistance from their peers positioned them as intellectual imposters, and caused them to work harder to prove their intellectual worth. Such individual efforts to both succeed and combat institutionalized racism are psychologically taxing and can ultimately detract from focusing on the academic work at hand and even increase attrition from these academic spaces.

Conclusion

This research presents an analysis of qualitative interviews exploring the experiences of Black engineering and computing doctoral students as they describe their non-Black peer

interactions in higher education. While we did not set out to focus our analysis on Asian

students, the interactions between Black and Asian students became salient and of importance for

Black students to discuss. We believe this work provides culturally diverse student population

dynamics to better support a diverse student population. Without supporting a more diverse

student population and instating measures that ensure a sense of belonging amongst all students,

engineering and computing spaces can harmful to Black students who are already extremely

underrepresented and marginalized. Also, future work is needed to provide insight into the

cultural connections and disconnections between marginalized groups to aid in creating

supportive and collaborative communities. This work is intended to expand the conversations

about inclusive communities for marginalized students. For example, we encourage faculty

within engineering and computing departments to thoughtfully group students and create

activities that allow students to build, connect, and encourage collegiality (e.g., instead of

allowing students to choose their own group members, thoughtfully assign students groups).

Also, underrepresented students benefit from having spaces that are racially affirming where

they are able to gather. For example, in the event there are no faculty of color, institutions can

look across departments to help connect students and faculty of color. This work provides insight

into the social interactions between students which can impact how students engage with each

other during and even after their doctoral programs.

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Appendix 1

Participants and Organizational Affiliations

Individual Institutions	PhD Students/Postdoctoral Scholars		
	Male	**Female**	**Totals by Institution**
Southern technical university 1	2	3	5
Eastern state university 1	1	1	2
Southern private university 1	1	0	1
Midwestern state university 2	0	1	1
Northern state university 1	1	0	1
Northern private university 2	1	0	1
Western state university 1	0	1	1
Southern private university 2	0	1	1
Southern state university 1	1	3	4
Southern state university 4	2	0	2
Midwestern private university 2	3	1	4
Column Totals	**12**	**11**	**23**

Appendix 2

Partial Version of the Coding Architecture

Themes	Codes
Self-imposed feelings of being an impostor	Feelings developed as a result of the following: 1. Being associated with diversity initiatives or "affirmative action" 2. The departmental racial makeup (no one looks like them) 3. Stress and anxiety 4. A constant, inescapable, and/or inherent sense of inadequacy or incompetence
Racial stereotypes and biases that engendered a sense of impostorism	1. Shifting between self-imposed feelings of being an impostor and the result of stereotypes and biases 2. Experiencing overt racial messages that permeate the department 3. Experiencing covert racial messages that permeate the department 4. Receiving overt gendered messages that permeate the department 5. Receiving covert gendered messages that permeate the department

	6. Perceiving the demographic landscape as racially and gender biased
Perceptions and messages pertaining to who is not considered an impostor	1. Implicit and explicit messaging in courses describing certain student demographics (e.g., gender, race) as inherently smarter and more talented, harder-working, or otherwise destined for success 2. Implicit and explicit messaging in research settings describing certain student demographics (e.g., gender, race) as more competent, harder-working, or innately destined for success 3. Departments set up to better support "traditional" students in the field (e.g., characteristics: single, no children, specific socioeconomic backgrounds, flexible schedules, certain age, prior experiences) 4. Implicit expectations and requirements for certain student demographics to demonstrate competency but not for others 5. Unequal access to and discouragement from opportunities based on gender, race, or other externally defined and/or subjective boundaries

Factors and influences that mediate impostorism	1. Affirming their own personal commitment to succeed despite any obstacles
	2. Rehearsing to themselves their demonstrated competence and reminding themselves of their worthiness
	3. Focusing their efforts on working harder/performing at a high level
	4. Attending outside conferences and workshops that bolster their academic confidence
	5. Drawing encouragement from seeing other people who look like them (whether peers or older role models)
	6. Receiving support from peers (e.g., a supportive lab environment)
	7. Receiving support from advisors and minority engineering program directors