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Racism camouflaged as impostorism and the impact on black STEM doctoral students

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ABSTRACT

Black doctoral students in engineering and computing fields experience racialized stress, as structural racism in STEM takes a toll on their sense of belonging and acceptance as intellectually competent in comparison to White and some Asian peers and faculty. Black doctoral students are often told by campus administrators that the source of this racialized stress is impostorism and it is curable. In this article, we employ phenomenological analysis to examine how 54 Black engineering and computing students experience racism marketed as impostor syndrome (syndrome meaning in their heads). Results show that 51 of our study participants understood their experiences as both impostorism and racism, as some realized that racism created the conditions for being racially positioned as an impostor. We problematize impostorism peddled by campus administrators as a cover for racism, once again placing onus on students and claiming they have irrational but curable behaviors, while institutional and individual racism in STEM runs rampant by design.

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Black students in engineering and computing doctoral programs are often viewed as having reached the pinnacle of academic opportunity and success. To achieve such heights, these students must navigate a long history of racial bias and perceived intellectual inferiority, often perpetuated by the very people, such as professors, responsible for ensuring their success. Hence, Black students mayemploy self-protective mechanisms to manage multiple forms of racism (e.g. structural, institutional, every day, colorblind) that cause them stress that takes a high emotional, psychological, and physical toll (McGee 2020a; Gómez 2015; Versey et al. 2019). Moreover, despite their achievements and constant need to prove themselves intellectually, some Black students are unable to fully internalize their success within racially hostile engineering and computing environments. They may question their academic ability as racialized beings and view themselves as impostors (Elon and Christopher Brown 2011).

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Impostor phenomenon or impostor syndrome is described as an individual's intellectual self-doubt and fear of failure, which is characterized by concern that others have overestimated their talents or abilities and therefore feel defrauded (Clance and Imes 1978).[1] Research on the psychosocial influences of impostor phenomenon and their implications (e.g. Bernard et al. 2017; Bernard, Hoggard, and Neblett 2017; Craddock et al. 2011) has found that the phenomenon has the potential to impact students' educational persistence and achievement (e.g. Villwock et al. 2016). However, present conceptualization of impostor phenomenon is problematic because it tends to focus only on psychological processes associated with impostorism while generally failing to consider how these processes are shaped by interactions and structures, as mechanisms that allow impostorism to thrive. And since these structural conditions create a host of negative outcomes, usage of the term 'impostor syndrome' ignores and grossly minimizes institutional factors, policies, and practices that cause Black students to logically respond with distress and frustration. Group therapy, workshops, and webinars on impostor syndrome, such as one called 'Banishing your Inner Impostor' are grounded in the work of Clance and Imes (1978) and frequently offered at colleges and universities (Landis, n.d.). However, this approach places undue responsibility on Black students to breathe, yoga pose, meditate, and affirm their own ways to cope with environments that were established and maintained for white middle to upper class males. Then, impostor syndrome sets up these Black students to believe they are out of touch with their own emotions and experiences, and have the power to solve the injustices they endure single-handedly, through adjusting their own internal state. We are calling fraud on impostor syndrome as it relates to Black students and quite possibly other marginalized students, as well.

Moreover, STEM fields have been unwilling to grapple with the larger political, ideological, and racialized context of education in these fields that makes those spaces impostor-ish (Vakil and Ayers 2019) and how it differs from spaces that perpetuate racism and other forms of discrimination. Reform after reform in STEM education is marketed as a move toward equity and inclusion, but these so-called reforms do little to interrogate the anti-Blackness Black STEM learners have to endure (Berry et al. 2014; Holly 2020; Martin 2019). The fraudulence of these efforts is what Martin (2019) describes as, 'delusion rooted in the fictions of white imaginaries, contingent on appeasing white logics and sensitivities, and characterized at best by incremental changes that do little to threaten the maintenance of racial hierarchies inside or outside of mathematics education (pg. 459).'

We are expanding the empirical research challenging how the impostor phenomenon is applied to Black engineering and computing doctoral students (Ewing et al. 1996), who recognize and manage what they are often told is impostor syndrome within a context of structural and interactional racism in their doctoral programs. In this paper, we present a phenomenological analysis of interviews with 54 Black engineering and computing doctoral students, 51 of whom described being positioned as an impostor in their field due to racism. We posed two research questions: *(1) How do Black engineering and computing doctoral students respond to the experience of workshops and professional development that introduces impostor syndrome as curable and separate from racism? (2) To what extent do these students connect their experiences of structural and everyday*

racism with the socialized notions and definitions of impostorism? Although three students describe feelings closely associated with the classic indicators of impostor phenomenon (defined as in their heads and not grounded in reality), we aim to understand the extent to which Black PhD students and recent graduates in engineering and computing resist being stereotyped and positioned as marginalized, a positioning grounded and founded in racism. To provide a foundation for our analysis we begin with an overview of the research on Black STEM graduate students.

Background

Crisis-level underrepresentation of Black people in engineering and computing

Black men and women are grossly underrepresented in engineering and computing programs at U.S. higher education institutions.[2] According to 2018 estimates from the U.S. Census Bureau, Black people represent 13.4% of the U.S. population, which does not include individuals who may identify as multiracial (U.S. Department of Commerce 2018). However, according to the annual Survey of Earned Doctorates (National Science Foundation 2017), of the 9,843 doctoral degrees granted by U.S. engineering schools in 2017, only 169, or 1.7%, identified as Black or African American. The numbers are similar in computing and information science, with 32 (1.6%) of the 1,987 doctoral degree recipients identifying as Black or African American. Black people are also critically underrepresented on engineering and computing faculties; as of 2017, only 2.3% of the tenured/tenure-track engineering and computing faculty in the U.S. identified as African American, a decrease from 2.5% in the previous year. Further, 83 (35%) of the 235 Black tenured/tenure-track faculty worked at Historically Black Colleges and Universities (Yoder 2017).

This critical lack of Black faculty in engineering and computing can be problematic for Black students enduring imposterism, especially in light of the American Psychological Association's number one recommendation for graduate students suffering from impostor phenomenon: 'Talk to your mentors' (Weir 2017). If a Black engineering and computing doctoral student does not have a Black mentor/advisor with similar experiences or an mentor/advisor who not only understands but advocates against anti-Blackness (National Academies of Sciences, Engineering, and Medicine, 2019), they may be forced to turn to unsupportive advisors who buy into the false colorblind and meritocratic narrative that surrounds STEM (McGee 2020a). However, and more importantly, even the best mentorship cannot solve structural racism, which we argue is at the heart of impostor syndrome in Black students in STEM. A focus on the broader STEM environment will illuminate more fully the ways that Black graduate students experience marginalization.

The marginalization of Black graduate students in STEM education

The history of scientific research in the United States portrays Black people as biologically and intellectually inferior to whites, a framing reified in STEM education (Kurtz-Costes, Beth, Andrews Helmke, and Ülkü-Steiner 2006; Carter, Razo Dueñas, Mendoza, 2019; Patton 2004). The cultures in university STEM

departments often reproduces status quo beliefs that white and Asian males are the key stakeholders in STEM higher education (Vakil and Ayers 2019). Meanwhile, Black, Latinx, and Indigenous men and women from all racial groups are often considered unsuited for the STEM disciplines (Esposito 2011; McGee and Bentley 2017).[3] The notion that Black people are unfit for the intellectual rigors of STEM is signaled to Black students through a host of racialized behaviors, practices, and policies (Harper 2012; Harper and Hurtado 2007; Lipsitz 2006; McGee 2016) that prompt cultural and intellectual marginalization (Gay 2004).

The process of racializing and minoritizing students and faculty in U.S. historically white colleges and universities has created spaces where Black students see few faculty members who resemble them phenotypically or have had similar experiences (Winkle-Wagner and McCoy 2018).[4] The percentage of African American engineering faculty members has remained stagnant at between 2% and 2.5% for the last nine years (Roy 2019). Furthermore, according to the American Society for Engineering Education (Roy 2019), of the 298 reporting engineering schools, 36.9% of institutions do not have *any* African American faculty members and only 28.2% have at least three.

Participation in doctoral education by underrepresented U.S. citizen or permanent resident students has been increasing, but only by miniscule amounts. From 2010 to 2019, Hispanic or Latinx doctorate recipients increased from 1,842 to 2,848. As a result, the proportion of doctorates earned by this group grew from 6% to 8% during this period while the number of Black/African American doctorate recipients increased from 1,939 to 2,512, and the proportion of doctorates they earned increased from 6% to 7%. The number of American Indian or Alaska Native doctorate recipients changed little, from 117 in 2010 to 120 in 2019, remaining less than 1% (National Center for Science and Engineering Statistics 2019).

The lack of underrepresented minoritized faculty members in STEM can leave Black doctoral students feeling that no one from their demographic group belongs in that setting (Eagan and Garvey 2015; Zambrana et al. 2015). Black STEM college students also face disproportionately greater financial challenges than their white and Asian peers, as well as a lack of personal and professional support and a higher rate of delayed program completion (Eagan, Hurtado, and Chang 2010; Gutiérrez Y Muhs et al. 2012; Herrera and Hurtado 2011). These statistics highlight the importance of our study because Black peoples' severe underrepresentation in engineering and computing departments at the student and the faculty level is exacerbated through institutional racism and racist interactions, that produce stressors like racial battle fatigue (Smith, 2014).

Racial bias at historically white institutions (and sometimes but much less often at historically Black institutions with large numbers of non-Black STEM faculty) are likely to increase Black students' overall stress levels (Harrell 2000) and make it difficult for them to have a sense of belonging, which can affect their STEM career trajectories (Robinson et al. 2016; Winkle-Wagner and McCoy 2018). To be a Black doctoral student in a STEM discipline comes with the challenges of being questioned, devalued, and confronted with racist attitudes (Berry et al. 2014; Martin 2019). This environment fosters second guessing and perceiving oneself as a fraud, two primary characteristics of impostor phenomenon.

Theoretical framework

Structural racism as the true source of impostor syndrome of Black STEM students

Less-overt forms of racism, such as structural and institutional racism, constitute the most impenetrable barrier to underrepresented, minoritized (URM) students in STEM fields (McGee 2020b; Margolis et al. 2017). Structural racism rests unseen at the foundation of society, often literally so, given that enslaved Black people constructed the grand buildings of some of the country's oldest institutions of learning. For instance, university administrators, board members, department chairpersons, faculty, and staff are almost uniformly white, and this demonstrates structural racism. In this structure Black, Indigenous, and Latinx STEM workers are not only missing from the higher ranks, but they are also paid less than white people doing similar jobs. This is structural racism again.

Researchers unearthed evidence of systemic racialized barriers at the institutional level – even in historically Black institutions – and layers of conscious and unconscious bias that sap the motivation of the most determined and well-prepared URMs (McGee et al. 2019; Thomas et al. 2018). This is significant because researchers rarely problematize the stress associated with STEM success for the Black academic community. It is no wonder STEM programs have not resulted in a more diverse student body because the programs' designers do not deeply understand the problem. They are largely ignorant or willfully ignore the toxic cost of STEM achievement for Black students (McGee & Stovall, 2016). Meanwhile, universities lose time, money, and effort used to educate highly competent students who abandon STEM education, leaving them feeling personally responsible for their failure to persist. Black STEM researchers have a deep appreciation for Black students and graduates who persist in spaces where negative beliefs about their ability prevail (Ellington and Frederick 2010; Jett 2019; Martin 2019).

Structural racism at U.S. universities leads to the following experiences for minoritized students in STEM: (1) Too few students and faculty of color due to institutional and social barriers; (2) URM students' difficulty envisioning themselves as part of the STEM workforce in the face of racially-charged STEM academic environments; (3) Unwelcoming institutional STEM climates (Leath, and Chavous 2018; McGee 2020); (4) racial/ethnic stereotyping (McGee 2016; O'Brien, Blodorn, Adams, Garcia, and Hammer 2015); (5) stagnating growth in the numbers of Black engineering and computing faculty, remaining around 2.5% and 2%, respectively, over the past 10 years (McGee, Brockman, Park 2020; Robinson et al. 2016; Zweben and Bizot 2011-2019); (6) anti-blackness in STEM (Holly 2020; (7) witnessing the 'revolving door' of minoritized faculty who serve as role models to students of color (Settles, Jones, Buchanan, and Dotson 2020; Zambrana et al. 2015).

Clance and Imes (1978) first coined the term 'impostor phenomenon' to describe anxiety characterized by apprehension about whether others have mistakenly overestimated the talents or abilities of middle- and upper-middle-class, high-achieving women with doctorates and thus feel defrauded (Chrisman et al. 1995). In their initial study, Clance and Imes described 150 white women who suffered from impostor syndrome. According to these women, their conceptions of themselves as fraudulent took a socioemotional toll, and most reported having frequent 'generalized anxiety, lack of self-confidence, depression, and frustration related to the inability to meet self-imposed

standards of achievement' (p. 2). More recently, scholars have explored the relationship between race and impostor phenomenon among Black undergraduate college students. Bernard, Hoggard, and Neblett (2017), for example, found an association between racial and gender discrimination and impostor phenomenon, which predicted adverse mental health issues. Similarly, Cokley et al. (2013) found that perceived discrimination predicted increased depression among those who reported impostor feelings, and Cokley et al. (2013) found that impostor feelings and stress caused by minority status also led to negative mental health outcomes. However, these studies do not examine how the impostor syndrome label is sometimes falsely applied to Black students in STEM as a synonym for structural and institutional racism that results in emotional, mental, academic, and professional distress.

In this qualitative study, we explore how Black engineering and computing doctoral students discuss impostorism in the context of racism. We seek to determine whether they identify these feelings as the result of classical definitions and characterizations of impostorism or a result of historically persistent and dynamic forms of marginalization that stem from the structural underpinnings of race and racism.[5] We then discuss ways these Black students may recognize, manage, and negotiate their feelings.

Data and methods

Methodology

Between 2014 and 2016, we conducted in-depth interviews or focus groups with 62 Black engineering and computing (EC) doctoral students and postdoctoral researchers. We recruited study participants in three ways: (1) by leveraging the principal investigators' professional connections; (2) by contacting administrative leaders at institutions with five or more tenured or tenure-track Black EC faculty members (as of 2012, according to the American Society of Engineering Data Management System); and (3) by recruiting at national EC conferences. Within this sample of 62 participants, 54 of them detailed instances of racialized marginalization in EC. We define racialized marginalization as instances where participants felt they were treated as outsiders or illegitimate participants in EC contexts because of their race. The remaining participants' (n = 8, 12.9%) narratives did not reference racialized marginalization.

All participants self-identified as African American or Black; 37 identified as men and 25 as women; collectively, they were studying at 13U.S. engineering schools. We conducted 35 total interviews; this is not representative of the total number of participants because we interviewed them either individually (n = 23) or in focus groups that had from two to six participants (n = 12). All participants in the focus groups attended the same institution and were at various stages in their doctoral studies. We offered participants a 35 USD stipend for completing the interview.

The interviews took place at students' universities, at a national engineering conference, and by phone. Interviews lasted from 45 minutes to just over 2.5 hours and were guided by a semi-structured protocol designed to cover an array of student and postdoctoral experiences (Yin 2018). All individual and focus group interviews were audio-recorded and professionally transcribed. For the focus groups, researchers used field

notes to aid in the transcription process and identify the speakers (Groenewald 2004; Rudestam and Newton 2007).

A phenomenological approach to data analysis relies heavily on in-depth interviews for data collection and is useful for investigating insider perspectives to describe an ongoing phenomenon (Creswell and Poth 2018; Miles, Huberman and Saldaña 2014). In this study, we interrogate the phenomenon of racialized marginalization as experienced by Black EC graduate students. The participants in the study act as 'insiders' because of their intersectional identities as Black EC graduate students. First, we reviewed all interview transcripts and wrote memos outlining patterns and themes in the data using NVivo, a qualitative-analysis software. Miles, Michael Huberman, and Johnny (2014) describe theme development as a tactic for generating meaning from data, which aligns with our initial inductive approach. We held bimonthly coding meetings to compare our annotations and discuss emergent themes, and to establish index codes and code subcategories relative to the literature on Black graduate student experiences in STEM. The racialized marginalization index code and its subcategories provide the basis of the analysis below.

We use the term 'racialized marginalization' to describe the instances and patterns of social exclusion in participants' narratives where they reported being treated or perceived as outsiders in EC due to their racially minoritized status. We sought to understand how the participants made sense of these exclusionary practices and how they navigated sometimes hostile academic and professional contexts. In subsequent coding, we explored the relationship between participants' descriptions of racialized marginalization, and to whom or what they attributed their feelings of exclusion. This led us to posit two coding subcategories:

1. Experiences with racialized marginalization and feelings of exclusion that participants described as self-attributed.
2. Experiences with racialized marginalization and feelings of exclusion attributed to the way the participant was positioned, i.e. through a racially marginalized lens.

These codes distinguish between narratives that describe participants' feelings of exclusion as internal (self-generated) or external (stemming from the actions and social positioning of others).

Positionality statement

Researcher subjectivity is part of any study. We are aware that the larger project was motivated by our particular research interests and personal experiences in STEM and higher education in relation to our participants (Moradi and Grzanka 2017). We are part of a multidisciplinary research team made up of social scientists, engineering and computing educators, and former engineers. We have investigated multiple forms of data to investigate and interrogate institutional, technical, social, and cultural factors affecting decision-making, career choices, and career satisfaction for EC doctoral students, candidates, postdoctoral researchers, and faculty members who have been marginalized by race or race-gender dynamics. Two of the authors of this paper identify as Black women, two as Black men, and two as white women. We share the belief that racial discrimination is systemic and that it affects both students and faculty of color.

Our identities and lived experience influence how we interpret Black students' perspectives within this dataset, which stimulated dialogue throughout the analytic process where we advanced various interpretations. Therefore, in the data-analysis meetings we held throughout the project, we used memos to acknowledge our biases and assumptions and examined our interpretations of participants' narratives for evidence of those feelings. While we remain aware of how shared and different characteristics influence our subjectivity, we also recognize that sharing some characteristics can be a strength in this study. For example, participants' willingness to share sensitive information about their racialized experiences was likely a product of our shared social identities.

Findings

Of the 62 participants interviewed, 54 (87.1%) described racialized marginalization experienced in academic and professional EC contexts. Upon closer analysis of these fifty-four participants' narratives, we found that all discussed feelings of impostorism that resulted from experiences of social exclusion. Although no interview questions explicitly asked about impostor phenomenon, 19 of the 54 participants used the term to describe their experiences. The other thirty-five participants did not use the term and instead discussed anxiety, depression, disappointment, frustration, and low self-confidence, which related to their feeling – or being made to feel – that they didn't belong or were not valued in their EC departments.

Only three participants (5.6%) described their experiences through the lens of self-attributed impostorism. These three related their feelings of exclusion to a sense of inferiority and perfectionism, which they attributed to deficits in themselves and to their being unprepared for the highly competitive and challenging nature of their doctoral programs. They felt like impostors and perceived these feelings of impostorism as a mental barrier they couldn't overcome. The remaining fifty-one (94.4%) participants attributed their feelings of exclusion to how race and racism positioned them as impostors. Some rejected social positioning that portrayed them as impostors by naming the structural and institutional racism embedded in U.S. society and in EC contexts. In the next section, we detail how students embodied the more classic definition and operationalization of impostor phenomenon in their self-attributed feelings of marginalization.

Belief in impostorism: students' embodying classic impostor phenomenon

Darrel, Mariah, and Rebecca shared the belief that they did not belong in their EC doctoral programs. They either did not or would not attribute their feelings of inferiority and perfectionism to external social forces but instead to deficits in themselves and their lack of STEM preparedness. Mariah, a fourth-year electrical and computing engineering doctoral student, described feelings of self-doubt and a lack of confidence in her abilities. However, she normalized her feelings by saying that they are the same as anyone else's in a graduate engineering program. She portrayed her feelings as temporary and tasked herself with overcoming them:

> Everyone kind of experiences this in the PhD program. It's not just African Americans, it's not just Caucasian or Asian. Everyone has that self-doubt, and sometimes, you know, that imposter

> syndrome. And by hearing that, by going to different workshops, by having people talk at seminars and realizing it's not just me . . . it's just like, "Oh, that's just a phase. Keep going."

Mariah learned about impostor syndrome through a workshop, where the coordinator explained this syndrome is common and that one can minimize or eliminate such feelings with positive thinking, or by realizing that one is not alone. Mariah pointed to a relationship between students of different races that she interpreted as a resource and motivation. She appeared to believe the issue of not belonging was in her head and held herself responsible for 'overcoming' feelings of impostorism. She saw working on herself as the solution.

Darrel, a fifth-year biomedical engineering doctoral student, also named impostor syndrome as something he struggles with, but he confidently expressed that it is unrelated to his race:

> I've had, you know, that imposter syndrome that we probably all know about in general. But, no, not because of my race. I've known too many people and I know how smart I am. I refuse to bring my race on [as] a possible deficit. That doesn't make any sense to me, no.

In his narrative, Darrel described several encounters he perceived as racist. However, he seemed unwilling to question whether he might be framed as incompetent or inferior to peers. The critical feature of these three students is they self-identified as experiencing impostor syndrome and attributed it to their feelings rather than to racialized experiences resulting from being marginalized and minoritized. However, the other 51 student participants challenged being positioned as impostors, attributing feelings to racist, discriminatory, and biased environments of their programs.

Positioned as an impostor: grounding the impostor label in racism

Fifty-one participants in our analysis described how colleagues, faculty members, and society at large positioned them as impostors. Participants described how this positioning was grounded in racialized marginalization by detailing how racism shaped others' assumptions and contributed to their racialized trauma. This builds on the acknowledgment that structural and everyday racism can force Black STEM scholars to repeatedly demonstrate their intellectual abilities in order to prove their worth (McGee 2016).

These participants highlighted the fact that their racial identities are under attack in their EC academic environments. We found two major distinctions among the participants who cited external factors in explaining perceptions of being viewed as intellectually inadequate: we believe that a large number (n = 33) of the fifty-one students appeared to be going through an awakening where they transitioned away from describing their experiences in terms of the classical definitions of impostor phenomenon and began to question the role that racism plays in positioning them as imposters. The remaining students (n = 18) explicitly rejected classic impostor phenomenon employing critical understandings of racism and intersectionality to interrogate this positioning in their academic environments.

Narratives in stages of racial awakening

Thirty-three (61.1%) of the fifty-four participants described encountering explicit and implicit messages that positioned them as impostors during their academic career, and

said they initially blamed themselves for it. These interactions made them feel isolated, leading them to question their abilities. However, 30 participants were quick to mention that, as they matured in their academic and personal lives, they began to recognize institutional and systemic forces that created obstacles to their progress and contributed to their positioning as an impostor.

Aubrey, a second-year biomedical engineering doctoral student, described her trajectory as one of persistent self-doubt despite academic success. However, as she unpacked the reasons for her self-doubt, she speculated on the pervasive stereotype linking Blackness with low intelligence:

> I don't know if it's growing up in Alabama or what it represents, but no one has ever directly told me [that I can't achieve in STEM]. I have always gotten *A*s. But its the surprise that other races would have at my intelligence, and even from other people in the Black community, and like, "Why are you so smart?" kind of thing is from equating low achievement with race. I used to think it was just me but I know better.

Aubrey appears to understand and link the shock others have regarding her excellence in STEM to a legacy of deep-rooted racial stereotyping that would question her intelligence, despite having grades and accolades that in normal circumstances would more than verify her right to be confident in her STEM achievements. She struggled in the past with self-doubt and 'maybe all these smart white people were right' insecurities, but recently transitioned into understanding the racialized structures and impediments challenging abilities of Blacks succeeding in STEM.

Richard, a fourth-year engineering doctoral student, expressed similar initial feelings of inadequacy, despite having academic qualifications equivalent to white and Asian peers. Richard is multiracial, and he acknowledged that the rules of colorism have afforded him benefits in his department because he presents more phenotypically white than other Black students. However, he also expressed uncertainty about the roots of his self-doubt:

> I don't feel like I have to try harder to convince people [of my intelligence]. But I always feel like the intellectual midget in the room, because I don't have that legacy . . . my dad doesn't have a degree. My dad can barely type a text to me, because he has a hard time reading. You all seem very intelligent and articulate, and not the way that I am. Like I have to stumble through words to get them out. So I have this . . . this kid inside of me. But I don't know if it's based on race or if it's based on economic, my economic background. But . . . but I definitely feel like I have to try harder than other people to . . . to seem smart enough, to seem like I'm worthy of sitting in a room with, you know, fifth-year PhDs who clearly know more than I do.

Richard's explanation of the social comparisons he makes with his peers, and even with those in his focus group, indicates pain, and not knowing the true source of that pain seems to add to his anguish. Richard appears to note the intersectional nature of race and class in his experience and how it shapes an image of intellectualism that excludes individuals of racially minoritized status or those who have a socioeconomic background similar to Richard's. We believe that Richard's reference to 'this kid inside of me' reveals insecurity about being a first-generation student in a graduate engineering program. Richard is fighting against a societal narrative that first-generation college students do not have academic capital crucial for navigating the college process in general, including specific ways of communicating involved in an advanced degree program.[6]

Chike, a fifth-year chemical and biomolecular engineering doctoral student, embodied self-confidence but realized that peers and faculty did not have the same confidence in his abilities, a notion he attributed directly to race. Chike described a peer who initially was in disbelief that a Black student was in a chemical engineering class:

> When I walked into my first dynamics class, an individual who I'm really good friends with now, later told me that he thought to himself, "Who is this Black kid coming in this classroom?" [laughs] I applaud him for being open and honest enough to tell me that. But what that tells me is that this negative perception of us [Black people achieving in STEM] still exists. And maybe I need to realize that it doesn't really matter how hard I work or how much I accomplish. They have to change their own opinion, let them know I'm not an impostor, I guess, from education. But even then, I guess, that may not—because it's not something logical. It's something that you're probably taught, and once you're taught that at a young age, it's hard to [change].

Chike laughed at his friend's disbelief while recounting the story, but he recognized the initial perception of his peer as racist, and as a sobering reminder of the racial stereotypes pervading his academic life. Chike concluded this interaction exposed systemic and deeply entrenched perceptions that cannot be remedied by hard work. He wondered if onus for change should be on his friend who held racist beliefs or if he should indict entrenched racialized systems that socialize members of society to learn and preach racist ideology.

Rejecting the impostor label and confronting racism

Eighteen (33.3%) of the fifty-four students showed two emerging characteristics: (1) an awareness of being racially marginalized in EC education, and (2) a willingness to identify the individual and societal factors that are the sources of their marginalization – racism, sometimes gendered racism, and classism. These participants discussed racist interactions that had occurred in their labs, their classrooms, and at EC conferences, workshops, and professional events. They noted that they did not walk into those spaces feeling like an impostor but realized they had to contend with peers and faculty doubting their abilities. They left those spaces bearing the residue of impostorism.

Saleem, a seventh-year computing science doctoral student, shared a number of experiences where other students at national computing conferences, or similar events, showed openly disbelief that he was a doctoral engineering student:

> I always get this weird feeling shortly after I walk in, into a group of, like, technical people and I'm the minority there. It's always this stare of, like, "Oh, are you sure you're in the right place?" [laughs] Um, and, honestly, I feel like that's pretty normal. Like, I used to get upset before, but I thought, you know what, these guys haven't seen a lot of people, so that's actually a valid question. It's like, "Are you sure you're a professional or are you like the waiter, are you the person to help set up the equipment?" So, for me I feel like it actually motivates me positively to make sure that what I know, I know it well. And then if there's anything I look forward to, it's how I can have a team of, like, all these guys that think, "Are you sure you know what you know?" and I'm like, "Yup, I know it, and I'm your boss, so . . . "

Saleem discussed several instances when he was perceived as being a janitor rather than a worthy contributor to his field. We know there is great value and dignity in working-class employment and that, due to structural racism, African Americans have a long history of service-oriented employment (Becker 2009). However, Saleem wanted to be

seen as a rising computing-science scholar and have his academic identity affirmed. Biased assumptions about Saleem's academic status – or lack thereof – were so routine that he concluded it must be normal for majority-group members of his computing community to express surprise at his presence due to underrepresentation of Black engineers and scientists. It is critical that he resisted rather than accepted these pejorative interactions. Saleem displayed a common approach Black students in STEM employ in these situations: he reframed it as a mission to prove people's assumptions wrong by excelling in his role, whereby he represents other Black computing engineers in a positive light (McGee 2017). However, as McGee (2016) has demonstrated, the unspoken requirement by whites that Black STEM students must repeatedly prove themselves in academic spaces, which assumes that Black students do not belong there, causes significant mental and physical damage.

Even meeting traditional markers of success, such as high test scores, did not prevent study participants from being positioned as impostors because racist stereotypes seemed to follow them everywhere. Celine, an electrical and computing engineering postdoctoral fellow, described interactions where she had to cope with her peers' low expectations of her competence and disbelief about her academic performance:

> I've had situations where individuals come to me and say, "Oh, how did you do so [well]?" I'm like, "I studied." Do you expect me as a student not to be able to open a book and read it? I think a lot of that is a component of being a woman. *But I think it's more so being a Black woman*, because I look at my female counterparts that are of the mainstream culture and I don't see them having the same level of resistance that I had. (our emphasis added)

Celine perceived her intersectional identity as a Black woman to be a significant factor in shaping her peers' expectations of her performance. Rather than internalizing her peers' assumptions, Celine displayed appropriate frustration and refused to internalize their stereotypes, but was still hurt by them. She also recognized that her intersectional identity differs from her white female peers. Celine concluded that a combination of racism and sexism was inherent in her EC community, causing others to question her academic competence which she rejected.

Some participants encountered situations they described as blatantly racist. Nicolás, a fourth-year material science doctoral student, described two situations of having to confront openly racist attitudes of international colleagues:

> I had a gentleman who's from Egypt literally say to me, "Why are you getting a PhD? You guys don't get PhDs." I kid you not! And I had to pause and say, "What are you talking about?" Well, I was trying to see where he's getting this from. And then he realized what he said, so he tried to play it off. [He] said, "Not many Americans," which is invalid, because there are other Americans—White Americans—in my lab as well getting PhDs. But then I just began to realize that, you know, from what he sees, probably from where he came from, that just wasn't the case. And not that it makes it acceptable, but it makes it a little more understandable that sometimes it can come from ignorance. [I] had another gentleman, he's from India, and [he] feels the need to go into some sort of hip-hop mode when he talks to me.

Research on STEM higher education rarely acknowledges that some international students have been socialized in home communities to negatively stereotype African Americans (McGee 2016). Nicolás recognized his international peer's attempt to cover up his blatantly racist question with watered-down racism, and although he cleverly

questioned his colleague, he also questioned his ability to withstand the constant stereotyping throughout his STEM studies and future career. Nicolás also alluded to another colleague's appropriation of some version of African American Vernacular English and hip-hop culture when they interacted. Nicolás knew his colleague's 'talking [in] hip-hop mode' only happened when the two of them engaged in conversation, which caused him to perceive this as cultural appropriation. Nicolás felt his colleague's cultural appropriation reflected endorsement of negative cultural and societal stereotypes prevalent in the U.S. that have made their way into the international community (Steele 2010).

The three participant groups we outline in our findings – (1) those who reference classic understandings of impostor phenomenon and attribute their feelings to internal processes, (2) those whose narratives exhibit stages of racial awakening and questioning of how structural and institutional racism contribute to feelings of impostor phenomenon, and (3) those who reject the impostor label and confront racism. This third group highlights important distinctions between self-identifying as an impostor and articulating the sociohistorical context, systems, and interpersonal interactions that exclude Black EC students in doctoral programs. Although feelings are similar in all three groups, disbelief and anger were more openly communicated in the third group. Participants with varying stages of racial awakening questioned why they felt like impostors and the extent those feelings could be attributed to external factors. Participants who rejected the impostor label were willing to confront racist ideologies positioning them as 'other.' Saleem and others were galvanized by their hostility to try to change the culture of EC by increasing representation and achievement levels of Black people in those fields. Our findings show overwhelmingly that just about every impostor syndrome narrative is grounded in the racist structure of STEM and is not simply a race-neutral phenomenon located in participants' heads.

Discussion

The content of these interviews originally led us to conclude that Black doctoral students are experiencing a form of racialized imposter phenomenon. However, findings demonstrate that racism exposes imposter syndrome to be a myth, a cover to mask relations of power and privilege in STEM fields. In other words, if structural, institutional and everyday racism in STEM were eradicated, impostor syndrome would likely no longer exist. Scholars have described impostor syndrome as 'a pop-psychological diagnosis' that is frequently used to explain underrepresentation in STEM fields (Simmons 2016), but which ignores the role of the environment in explaining these 'irrational' feelings (Slank 2019). Imposter syndrome is an incorrect diagnosis of the underlying cause of Black students' feelings of otherness in STEM spaces. Feelings of impostorism are associated with self-deception, and irrationality, but when we account for the racist structures in STEM, we can see that our participants are not irrational at all. Our anonymous reviewer reminded us that, 'One of racism's most devastating effects is to distort and deny the unique potential of Black students throughout their educational histories. Questioning one's ability because one is meant to feel inferior on the basis of race is qualitatively different than imposter syndrome many privileged students feel (sometimes rightly) because of the entitlements or images of self these students hold.'

While it is possible some Black STEM doctoral students are experiencing relational distress within their programs, we argue that the culture of STEM departments gives rise to Black students' feelings of imposterism. This culture is a breeding ground for projecting Black inferiority, racial stereotypes, and other forms of racialized bias. STEM departments are key sites of the construction and legitimatization of a culture in which the vulnerability of the Black body and mind is met with skepticism, while simultaneously offering universal pretensions, testimonials to neutrality, and colorblind ideologies. The participants' Blackness in a scientific and technological world of Whiteness means the very things that make these students unique were not allowed to flourish because of students' persistent relegation to a subordinate status (Martin 2019). The participants in this study expressed distress and anxiety because others (e.g. peers, faculty members, conference participants) erroneously perceived them as intellectual impostors, making them uneasy about taking risks and pursuing challenges (Jett 2019). Most of our participants did not feel academically or socially integrated into the EC community. This is problematic because research shows that academic and social integration has greater influence on retention of doctoral students, and development of diverse scholars, than academic ability (Gardner 2008a, 2008b).

The participants who actively rejected the impostor label described being positioned as outsiders because they had been continuously made to feel they did not belong. These students strongly condemned racist interactions and systemic oppression. Research confirms that individuals cope with stressors more effectively when they have an understanding of the structural barriers impeding their full participation, both in STEM and in the human community at large (McGee 2020b; Brondolo, Gallo, and Myers 2009; Major, Quinton, and Schmader 2003). Identifying and naming the sources of their marginalization enabled some students to attribute negative feelings and experiences to that system, rather than their own perceived deficiencies (Benard, et al., 2017; Fleming, Lamon, and Welburn 2012). Although the majority of students did not perceive themselves as intellectual phonies, being treated as such still caused them to experience stress, anger, anxiety, and isolation (Major, Kaiser, and McCoy 2003). Understanding mental and physical health implications associated with being positioned as an impostor is desperately needed in order to foster the holistic well-being of minoritized students in EC.

We would be remiss if we did not highlight reactions to impostor phenomenon that led students to work tirelessly to prove themselves, including the perfectionist tendencies demonstrated by many participants (McGee,Griffith, and Houston, 2019). However, it is important to note that, while individuals who experience impostor syndrome may work hard to ensure that people do not discover who they really are (i.e. intellectual frauds; Clance and Imes 1978), most of the participants described working hard so people *will* discover who they are and how much they can contribute. The pressure to perform well to avoid confirming a negative stereotype about one's group is psychologically taxing, particularly for people who feel like a representative of their race or a token group member (McGee 2018; Schmader and Johns 2003; Steele and Aronson 1995). Many of the participants described feeling like racial representatives of Black people and that they had to respond continually to peers' perceptions of incompetence (Baber 2012). Constantly reaffirming one's ability in the face of invalidating, race-based academic

assaults is akin to 'slaying an invisible ghost' that majority-group members cannot see and ultimately does not alter systemic forms of oppression (Steele 2010).

Much of the research on impostorism locates the problem and solution at the individual level. The women studied by Clance and Imes (1978) presented with internalized feelings of inferiority and were unable to attribute achievements to internal factors such as intelligence or ability. However, this description does not encompass experiences of those aware of how systemic oppression operates to marginalize them.

Participants whom we categorized as displaying classic impostor phenomenon also appeared to have lower levels of racial identification. Individuals who identify less with a stigmatized group are less likely to notice discrimination and attribute what otherwise might be seen as discriminatory behavior to external factors (Major, Quinton, and Schmader 2003). Future research could follow in the footsteps of researchers like Lige, Peteet, and Brown (2016) by further exploring the interrelationship between racial identity, impostor syndrome, and colorblindness.

We argue that impostor phenomenon among Black students in EC doctoral programs is inaccurately diagnosed and 'treated' erroneously since it assumes that the problem is in the students' heads, that it is driven internally. The impact of impostor phenomenon on Black EC doctoral students is racialized stress and strain, which can interfere with or disrupt their EC career and employment trajectories (Cokley et al. 2013; McGee et al 2019). Cooley ((1902)1964)) 'looking-glass self' image posits that individuals develop a sense of self based on how others interact with them, suggesting that individuals positioned as impostors run the risk of eventually internalizing how others see them. Suggested solutions for classic impostor phenomenon, such as talking to mentors, saying positive affirmations in the mirror, building confidence in one's expertise, and realizing that perfection is an unachievable goal (e.g. Roché 2014; Vinnicombe and Singh 2003; Young 2011), focus on the efforts of individuals and do not address the environmental pressures that foster impostorism, especially among underrepresented racially minoritized people in academic settings. If Black students are experiencing feelings of impostorism within their EC departments, their school leaders should recognize this as a sign that their STEM culture is fostering a racially hostile environment. We unequivocally state that if Black students in EC have an inferiority complex or imposterism, it is highly likely has been induced.

Conclusion

A host of new and revised policies, practices, and workshops that detail a commitment to diversity in STEM education and employment lack adequate understanding of why particular groups of students continue to be underserved in these fields (Vakil and Ayers 2019; Martin 2019). Impostor phenomenon is often managed through conferences and university workshops, where students are instructed to believe that first they are crazy, second they can think or breathe their way out of it – as if Black students must take responsibility for developing the right mindset in order to function within a system replete with racial barriers that are harmful to their health and well-being (Jett 2019; McGee 2016). It is imperative that the larger STEM community recognize that racial bias

and related attitudes about who is competent (and who is not) permeate the STEM fields, to the detriment of Black students, who have been made to feel like impostors, rather than competent professionals who contribute to scientific and technological advancement.

Notes

1. Clance and Imes avoided the word 'syndrome' because syndrome is often associated with a disease or disorder; instead they called it the 'impostor phenomenon.'
2. We use the term 'Black' in reference to all Black people of the African diaspora, including African American, Afro Caribbean, and Black Africans.
3. We use the term 'Latinx' to decenter the patriarchal nature and gender binary within the terms 'Latino' and 'Latina,' and to cover all the LGBTQ+ possibilities.
4. The word 'minoritized' acknowledges a system of actionable policies and practices that racialize people of color, which is in contrast to the passive term 'minority,' which implies an inherent (and normalized) state of affairs (Harper 2012). In this context, minoritized is useful in describing racism as a framework for understanding experiences of Black students.
5. A meta-analysis by Paradies et al. (2015) employed a definition of racism as individualized, interpersonal, and systemic within societies, causing the inequitable distribution of power, resources, social and economic capital and capacities, and opportunities within and across racial or ethnic groups. The authors describe these forms of racism as manifesting in a multitude of ways through the enactment of entrenched beliefs, stereotypes, and prejudices.
6. In 2015, roughly half of Black engineering doctoral students had at least one parent who earned a post-secondary degree (National Center for Science and Engineering Statistics 2017).

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