

Negotiating Doctoral STEM Studies: An In-depth Look at the Black Woman Impostor

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This qualitative study investigated how the impostor syndrome influenced Black women's experiences pursuing terminal degrees in science, technology, engineering, and mathematics (STEM) at a research institution in the southwestern United States. As a Black female researcher engaging with participants through one-on-one interviews, I used Collins's (2006) Black Feminist Thought (BFT) tenets to collect and analyze data to understand the participants' doctoral journey. Race and gender regularly intersected to shape how they experienced the impostor syndrome during their doctoral journey. Findings revealed participants with low or moderate impostor feelings tended to have positive experiences while those who had frequent or intense impostor feelings had a more tumultuous academic journey. This study does not only highlight the need for continued research on reducing the impostor syndrome's influence on doctoral women in STEM fields but challenges higher education institutions to make concerted efforts to address their needs.

Keywords: impostor syndrome, Black women, Black feminist thought, STEM doctoral students

Introduction

Advocates such as Atkinson and Mayo (2010) believe that the key to equaling American educational achievement to other first-world countries is to increase student interest and participation in science, technology, engineering, and mathematics (STEM). However, researchers have noted women's paucity, principally minority women in STEM Ph.D. programs (Espinosa, 2008; Mann & DiPrette, 2013; Ong, 2011; Sagebiel & Vazquez-Cupiero, 2010); and the heightened efforts to increase student interest and involvement in these fields highlight students of color's underrepresentation, especially in higher education. STEM climates have been chillier and unwelcoming for minority students because of exclusionary practices that deliberately alienate them and undermine their achievement (Harper & Hurtado, 2007; Hirschfield & Joseph, 2012). This environment can potentially result in feelings of alienation, marginalization, and isolation (Fetzer & Czerniejewski, 2014; Green & Glasson, 2009; Perna, et al., 2010; Peteet, et al., 2015). This unfavorable climate can present Black students challenges, causing them to feel like impostors as they negotiate their doctoral studies.

The impostor syndrome continues to be a commonly researched area, but studies documenting how it affects Black women's experience in higher education remain minuscule

(Bravata et al., 2019). In an extensive review of literature on the impostor syndrome, only six of the 284 titles examined by Bravata et al. (2019) documented Black women's experiences. Out of the six titles, only one study examined graduate Black women's experience with no focus on STEM fields. The limited research shows the lack of studies on the experiences of Black women and the impostor syndrome and draws attention to the need for studies that address this deficit. A recent study by McGee et al. (2019) called for continued research on how stressors such as the impostor syndrome, influence Black students' doctoral experiences. It is essential to highlight Black women's experiences with intersecting oppressions, particularly the impostor syndrome. Calling attention to ways their intersectionality generates impostor feelings exposes the canon of discriminatory practices while highlighting the need for solutions to minimize its presence.

Despite the advances made by women today, they continue to be marginalized and totter on male-dominated fields (Broido et al., 2015; McGee et al., 2019; Perna et al., 2009). Intersecting oppressions of race and gender further marginalize Black women (Collins, 2016; Crenshaw, 1993). They encounter discriminatory practices such as racialized and gendered microaggressions where their competence is questioned and undermined (Wilkins-Yel et al., 2019). While microaggressions may be inconsequential, the fact that it is pervasive, constant, and accepted normal by the dominant group (Sue et al., 2007) may cause them to feel like impostors in STEM fields. Situated within a Black feminist thought (BFT) framework, this investigation focused on practices and gathered evidence to deliberate how the impostor syndrome influenced the doctoral journey of Black women in STEM fields at a research institution in the southwestern United States.

Black feminist thought proved to be an adequate framework to explore the experiences of Black women as they undertook their doctoral studies in STEM fields. It allowed the researcher to examine their lived experiences as a criterion of meaning. The use of dialogue, the ethic of caring, and the ethic of personal accountability explained feelings of inadequacy experienced by minority women while pursuing graduate studies in STEM disciplines. This study examined how the impostor syndrome affects Black women students' experience completing postgraduate studies in STEM fields. The research questions guiding this study are as follows:

1. What characterizes the levels of the impostor syndrome reported by Black women STEM Ph.D. students?
2. How does intersectionality influence the experiences of Black women in STEM Ph.D. programs who feel like impostors?

Review of Literature

Women of color in STEM fields

The passing of Title IX resulted in a significant shift in women's experiences in the United States (Broido et al., 2015). They have made notable advances in the workforce, education, and political arena (Broido et al., 2015). Women established a significant presence in higher education. Snyder et al. (2019) noted that women's enrollment surpassed men's enrollment at the bachelor's, master's, and doctoral levels. While women are conspicuous in education, nursing, and social work, they remain a minority in historically male-dominated fields such as law and STEM (Ward, 2008). There are however, distinctions within the gender category that differentiates the experiences of minority women. Researchers highlight women of color's position in STEM as outliers who constantly question their rightful place in the academy (Ireland et al., 2018; McGee & Bentley, 2017; McGee et al., 2020; Ong et al., 2020). Black women are subject to hegemonic institutions of power and privilege within STEM education that shape their experiences.

Black women inhabit an intersection of oppressive structures due to their race and gender (Collins, 2000; Crenshaw, 1993). Within the social constructions of race and gender, they continue to reside on the periphery. Black feminist writers such as Collins (2000), Crenshaw (1989), hooks (1989), and Lorde (2012) noted the nuances of the gender category situate women of color in a web of racial, gender, and class oppressions which privileges White women over them. The dominant narrative that defines a woman counters a Black woman's reality. Throughout history, society carved the Black woman in a negative light, be it as the mammie, matriarch, welfare mother, welfare queen, Jezebel, and the Black lady (Abdullah, 1998; Davis, 2011; Ernst, 2008; Kohler-Hausman, 2007; Woodard & Mastin, 2005). When she takes on post-secondary education in STEM, those images coupled with negative stereotypes may influence her experiences at an institution of higher learning.

A 2018 report by the National Science Foundation (NSF) detailing doctorate degrees received by women in science and engineering indicated that the proportion of Black women receiving doctoral degrees in science and engineering in 2015 was 2.75%; this number sharply contrasts to the 21.6 % of White women who earned similar degrees. These statistics reveal that very few Black women attain terminal degrees in STEM disciplines.

Black women in STEM

Historically Black women have been denied access to STEM disciplines resulting in their small numbers (Joseph et al., 2017; Malcolm et al., 1976; Ong et al., 2011). Consistently intertwined within a double bind of marginalized race and gender identity, they remain outliers in male-dominated STEM fields (Alexander & Herman, 2016; Ong et al., 2011). In their extensive literature review on Black women in STEM, Ireland et al. (2018) demonstrated the pervasive presence of racist and sexist narratives that exclude them from the dominant STEM narrative. Wilkins-Yel et al. (2019) attested to Black women's invisibility in STEM fields that often overlook their success and presence. This practice maintains hegemonic ideologies of deficiency that use the hypervisible race and gender narratives to discredit their intelligence.

Oppressive racial and gender disparities embedded within the U.S. educational system impede Black girls' pathway to a successful STEM future (Collins et al., 2019; Ireland et al., 2018). These inadequacies foster Black girls' failure to assume science identity from the onset of the elementary education, a foundation necessary for successful post-secondary education in these fields (Joseph et al., 2017; Young et al., 2017a). Situated within their dual identities, Black girls often do not have access to classrooms that nurture their success in mathematics (Young & Young, 2018). Researchers indicated that compared to White girls, Black girls have less access to computers and technology at an early age leading to less interest in STEM fields (Fisher, et al., 2011; Perna et al., 2009). Furthermore, this decreased exposure to science, technology, engineering, and math may leave Black girls underprepared to succeed in these fields at the undergraduate level (Espinosa, 2008; Johnson, 2011; Perna et al., 2009; Young et al., 2017c). To successfully traverse the STEM pipeline, some educators create intentional spaces for Black girls (King & Pringle, 2019; Scott et al., 2017; Thomas et al., 2017).

Factors influencing Black women's STEM pathways

Black women's minority or socioeconomic status often challenge their college dreams (Hawkins, 2011). Some factors that negatively impact African American students' education noted by Moses-Snipes and Snipes (2005) include teacher expectations and beliefs, cultural

awareness, testing, and equity in the classroom. Other researchers noticed that an inferior education, lack of in-school and community resources, obsolete curricula and teaching methods, dilapidated facilities, and inexperienced teachers are commonplace in predominantly low-income Black communities (Anderson, 2002; Kozol, 1991; Oakes, 1990; Perry, 2003). These challenges often make higher education less accessible for Black women. A Black woman may not be adequately prepared to pursue an undergraduate college degree (Ireland et al., 2020; Steele, 1997). A terminal degree is even more of an illusion for some of these women. There are a few, however, who have overcome those barriers and enroll in Ph.D. programs. Their journey has not been comfortable, and they are continually positioned not as doctoral students but as Black women (Ewing et al., 1996; McGee & Martin, 2011).

Although proponents of STEM education maintain that is an equitable field that welcomes every capable individual, researchers demonstrate that the opposite is, in fact, correct (Brickhouse et al., 2000; Lopez, 2018; Margolis et al., 2015; Rincón & George-Jackson, 2016). The socially constructed entities of race, gender, and science identity rather than incompetence intersect to impede a Black girl's successful transition to a STEM career (Johnson, 2011). Factors such as gender stereotypes, pedagogical techniques, and science curricula converge to counter women's willingness to develop and maintain an interest in science and develop a science identity (Brickhouse et al., 2000). Situated within their dual identities, Black girls often do not have access to classrooms that nurture their success in mathematics (Young & Young, 2018). Other researchers demonstrated that compared to Whites, Black girls have less access to computers and technology at an early age leading to less interest in STEM fields (Fisher, et al., 2011).

As Black girls traverse elementary school to high school, these elements merge, contributing to the historical underperformance of Black girls in STEM (Barton et al., 2008; Chappell & Varelas, 2019). This deficit leads to a notable decline in their attitudes to science and academic gains (Barton et al., 2008). In high-poverty urban schools where most students belong to minority groups, Oakes (1990) identified a deficiency of rigorous and high-level science courses, lack of science equipment, inappropriate role models, and unqualified science teachers. As they move on to high school, these factors continue to impede STEM higher education (Johnson, 2011; Ko et al., 2013; McGee & Bentley, 2017) Furthermore, this decreased exposure to STEM may leave Black girls underprepared to succeed in these fields at the undergraduate level (Espinosa, 2008; Johnson, 2011; Perna et al., 2009; Young et al., 2017c).

When Black students major in STEM degrees in college, issues such as the STEM curriculum's academic rigor, social isolation, and economic difficulties at times obstruct their successful attrition (Buzzeto-More et al., 2010; Charleston et al., 2014). Research indicated that a supportive environment in STEM fields where these factors are minimal is pivotal to student success and retention in those fields (Palmer et al., 2011). Supportive structures are exceptionally vital for Black women who may not have had adequate academic preparation from the inception or possibly influenced by the stereotype that girls are not as successful as boys in those fields (Espinosa, 2008; Johnson, 2011; Perna et al., 2009).

Researchers illustrated that a minority STEM student's decision to leave college is sometimes related to their economic situation (Hurtado et al., 2007; Maton & Hrabowski, 2004). Although college costs steadily rose over the last two decades, family income has not increased (Jaquette et al., 2016). Increased tuition hinders the persistence of low economic minority students who, at times, undertake off-campus employment to fulfill their financial obligations (Allan,

2011). Off-campus employment may affect a student's ability to succeed academically, resulting in increased minority dropout rates (Allan, 2011; Xu, 2019). Financial aid, while it contributes to the successful retention of minority students, can also be a deterrent (Allan, 2011). When students receive grants and scholarships, they are more likely to persist in those fields (Brown et al., 2017; Swail, 2003). However, rising tuition costs sometimes make those resources insufficient to meet their financial obligations, encouraging the need for a loan (Perna et al., 2009). Loans discourage minority students' persistence in STEM fields (Baker et al., 2017; St. John, 2001).

It is important to highlight counternarratives detailing Black women's success in STEM fields who challenge dominant discourse. Solórzano and Yosso (2002) note that counternarratives are pivotal to “exposing, analyzing, and challenging the majoritarian stories of racial privilege” (p. 32). Increasingly, researchers introduced interventions and instructional practices geared to enhancing Black girls' interest and identity in STEM. They created spaces through out-of-school programs to strengthen science interest through dance (Allen-Handy et al., 2020), design-based engineering and computer science activities (Erete et al., 2020) as well as various STEM summer camps (King, 2017; King & Pringle, 2019; Scott et al., 2017, Thomas et al. 2017). Enrichment programs focused on Black girls effectively maintain their interest in STEM (Young et al., 2017b). Developing a science identity in middle and high school fosters a successful STEM college enrollment and graduation (Charleston et al., 2014).

Effective mentoring serves a critical role in supporting Black students' success in STEM fields and reducing negative experiences (Blake-Beard et al., 2011; National Academies of Sciences, Engineering, and Medicine, 2019). Several studies indicated that effective mentorship characterized by psychosocial and academic support assisted Black women in STEM (Borum & Walker, 2012; Collins et al., 2019; McGee & Bentley, 2017; Syed et al., 2011). Culturally responsive pedagogy remains an effective strategy (Ladson-Billings, 2009; Gay, 2018) for increasing Black girls' student interest in STEM in the early grades setting them on the path to higher education (Collins et al., 2019; Young et al., 2017). The increase in culturally responsive pedagogical approaches has significantly contributed to Black girls' interest in STEM (King & Pringle, 2019; McKinney et al., 2017; Scott et al., 2017, Thomas et al., 2017; Young et al., 2017a).

Black women in graduate STEM programs display academic resilience and persistence in response to the microaggressions (Joseph et al., 2017; Lane & Id-Deen, 2020; McGee et al., 2019). Drawing on Masten and Powell's (2003) definition of resilience, Black women's resilience in a STEM context refers to positive adaptive techniques enacted to succeed in the unfavorable conditions they encounter in their academic environment. Thoman et al. (2020) demonstrated in their case study of undergraduate women in STEM that resilience was pivotal to their success and persistence in these fields. Other researchers also concluded that resilience was a salient part of the experience of Black women who continued to graduate programs in STEM (McGee et al., 2019; Ong et al., 2020). The need for continued resilience and the constant need for strength the counter microculture at times leaves Black woman drained within these isolated STEM spaces (Ireland, et al., 2018; McGee et al., 2019; Wilkins-Yel et al., 2019). The added stressors combined with racialized and gendered experiences can potentially materialize into the impostor phenomenon.

The Impostor Syndrome

The term impostor phenomenon, also referred to as impostor syndrome, describes the internal struggle individuals have about their intelligence (Clance & Imes, 1978). The

researchers hypothesized that these feelings are common in high-achieving persons who doubt their intellectual abilities and negate personal responsibility for their achievements. Impostors may be diligent, hardworking, feel like fakes, or be charming and perceptive so that they gain the approval of others. The writers noted that individuals might display some characteristics, but rarely does an individual indulge in all these behaviors. They observed that women who experienced the impostor phenomenon did not internalize success, became anxious, lacked self-confidence, or became depressed and frustrated when the goals they set for themselves were unattainable. The writers reported that successful women continue to deny their accomplishments and dread failure. These women convinced themselves that they were not intelligent and did an excellent job of leading others to believe this fallacy.

Harvey and Katz (1986) estimated that about 70% of the general population possesses impostor feelings concerning their work during their career paths. Women of color are particularly vulnerable to the impostor phenomenon. Ewing et al. (1996) argued that racial identity and Afrocentricity play a pivotal role in predicting women of color's impostor syndrome. Different factors contribute to the impostor syndrome in Black students (Harvey and Katz, 1986; McGee et al., 2019; Ong, 2011; Young, 2011). They include new role adjustments, achieving an unusually high level of education relative to one's family background, having a negative self-image, and being one of a kind or atypical in one's surroundings.

The Impostor syndrome and Black women in STEM

McGee and Martin (2017) noted the participants' increased psychological stressors in their study when racial and gender bias undermined their academic achievement. In their research on Black women's experiences at a predominantly White institution (PWI), Leath and Chavous (2018) discovered differences between STEM majors and non-STEM majors. Non-STEM majors expressed less doubt, were more confident about their ability to persist in their major, and reported higher academic achievement than their peers pursuing STEM majors. Chakraverty (2020) concentrated on sources of the impostor syndrome revealed by the women in her study. One participant noted impostorism began when she did not see other Black women in her program; others listed a lack of belonging resulting from their first-generation status as the catalyst; and some participants highlighted that microaggressions and stereotypes contributed to feelings of insecurity.

Allan (2011) reported that an institutional climate is pivotal in racial and ethnic minority college students' experiences and STEM outcomes. Some writers noted that the STEM climate is particularly unwelcoming for Black women (Hall & Sandler, 1984; Lord et al., 2009). Classroom atmospheres sometimes alienate students of color, reducing the feeling of belongingness (Harper & Hurtado, 2007). Minority students' unease relating to people outside of their racial or ethnic group affects their desire to persist in STEM fields (Byars-Winston, 2008). Some students have few role models in STEM-related areas and do not receive support from their families or communities to advise them on successfully navigating a STEM pathway (Davis-Lowe, 2006). Working in research projects at the undergraduate level is essential and helps transition in graduate programs (Hurtado et al., 2007). Many Black women do not get the opportunity to participate in undergraduate research.

Peteet et al. (2015) reasoned that the "othering" of African American undergraduate students contributed to the relationship between impostorism and psychological distress. Robinson (2013), an African American faculty member, described exhaustion from the academy,

left her feeling alone, discouraged, and disillusioned. Her feelings mirrored the same views expressed by the African American college women in Jackson's (1998) study, who often had to prove themselves to contend negative stereotypes. Black women in STEM fields may have an identity made of multiple marginal identities, and these challenges often make women of color feel like impostors in their atypical environment.

Theoretical Lens

Feminist writer, Patricia Hill Collins (2000), outlined four core themes to explore Black feminist epistemology or Black feminist thought (BFT). They are the lived experiences as a criterion of meaning, the use of dialogue, the ethic of caring, and the ethic of personal accountability. The first theme explores ways different encounters influence the attainment of knowledge. Colonized individuals of African descent, especially women, experience a journey of suppression and oppression, which started when they first came to this country up to this present day. As a result, they view the world differently and possess knowledge and wisdom, which can only come from these experiences. This tenet allowed me to investigate how race and gender shaped participants' experiences and influenced their worldview. Engaging in this tenet required an analysis of participant discourse for incidents where their positionality as a Black woman invoked impostor feelings or affected their doctoral experience.

The use of dialogue shows that marginalized groups, through discourse, establish bonds that empower the group. When they share their experiences, Black women realize that though they go through different courses in their lives, racial and gender oppression is a poignant aspect. Using one-on-one interviews, I engaged participants in the use of the dialogue. Empowered by a common Black feminine bond, participants engaged in respectful discourse outlining their individual doctoral experiences. As highlighted by hooks (1989), dialogue during the study embodied personalized narratives free of subjectivity when the women in the study relayed their stories. These narratives barred discriminatory practices while simultaneously empowering participants to resist repressive practices. United within their double bind, they connected and stood in solidarity with each other through verbal and non-verbal exchanges.

Collins (2000) stressed that personal expressiveness, emotions, and empathy, components of the ethic of caring, are central to validating knowledge claims. I ensured that these elements verified the findings of the study. Although all the participants pursued STEM doctoral degrees, I strived to maintain an atmosphere where they detailed their personal beliefs about their experiences. This atmosphere was equally conducive to those who passionately expressed their views and those who held a composed demeanor during their interviews. There was also the ebb and flow of emotions as they discussed salient aspects of their experiences. Analyzing participant narratives without focusing on their feelings would have reduced the "thick description" (Geertz, 1973) generated from the study. Empathizing with participants, I encouraged them to narrate their experiences, some of which were very personal. Aware of their positionality as Black women, they freely engaged in discourse on matters that frame their daily experiences.

The ethic of personal accountability sustains Black women's knowledge claims in tandem to the unique individuality. Collins (2000) further stressed that everyone adheres to a belief system rooted in their ethics, character and values and uses their positionality to discuss the issues at hand. Black women in the scientific fields at times become advocates for their race. Collins (2000) believed that while Black women share common traits, their layered intersecting

identities allow them different perspectives to justify their knowledge claims I drew on this tenet by using participants' unique discourse to make conclusions about the study. I give credence to each participant's ideas by using evidentiary sources from the interviews and highlighting the significance of their unique identity when interpreting the data. The participants' narratives served as the foundation for detailing Black women's experiences pursuing graduate degrees in STEM fields.

Researcher positionality

My interest in this topic stemmed from my impostor feelings during my doctoral studies and the doubt and anxiety expressed by my friends in STEM doctoral programs at leading research-intensive institutions. Although I procrastinated, questioned my rightful place in my program, and experienced a cycle of anxiety every time I completed an assignment, they reported similar impostor manifestations to a higher degree. As Black women attending PWI, layered, racialized, and gendered nuances confounded how they felt in what Peteet et al. (2015) call the chilly and isolating STEM environment. Undergirding the study was a reflexive process where the researcher's perspectives and experiences were examined at each research stage to reduce bias and preconceived notions (Berger, 2015). Reflexivity is grounded in acknowledging the researcher's subjectivity concerning the study (Peshkin, 1988).

Berger (2015) noted that a researcher is influenced by his/her "personal characteristics, such as gender, race, affiliation, age, sexual orientation, immigration status, personal experiences, linguistic tradition, beliefs, biases, preferences, theoretical, political and ideological stances, and emotional responses to participant" (p. 220). These factors consistently collide and collude to shape my position as a Black researcher investigating the impostor syndrome and the experiences of Black women in STEM fields. As a Caribbean raised Black woman, my journey to a salient understanding of being a Black woman in the U.S. initially started with disbelief and denial. Still, it ended with a grounded affinity to the global community of Black women. Being a Black girl in STEM was not an anomaly for me during my early education. My high school science and math teachers were all Black women. However, it does not mirror most Black women in the study who started as Black girls in America. King and Pringle (2017) note that many Black girls do not have such a safe space to develop a STEM identity. My understanding of intersectionality came during the first year of my doctoral studies when I read Collins (2006), Crenshaw (1993), Dillard (2000), and Lorde (2012) and gained a thorough understanding of being a Black woman in an American context. Rather than wallow in the anger and disappointment from my newly acquired knowledge, I decided to extend it to scholarship that not only highlights the brilliance that is a Black woman but bare and counter the deficit thinking that seeks to place her in a negative light. Evans-Winter (2019) highlights the importance of engaging intersectionality as a methodological tool to analyze Black women's experiences. I engaged the intersectional lens and my position as a Black woman to analyze and share the women's doctoral experiences. While impostorism remains a salient part of my own experience beyond the doctoral level, my commitment remains to engage critical scholars' work to highlight the dehumanizing privileged, dominant narrative that remains a part of a Black woman's experience.

Methodology

This descriptive qualitative study explored how the impostor syndrome shaped Black women doctoral students' experiences in STEM fields at a PWI in a southwestern state. Using the Clance Impostor Phenomenon Scale to identify the presence of the impostor syndrome and individual interviews, I used thematic analysis to ascertain how the reported level of the impostor syndrome influenced participants' doctoral journey.

Research Context and Participants

Participants pursuing doctoral studies in a STEM discipline were recruited via email. Eligibility for participation in the study was based on the following criteria (1) identify as Black or African American, (2) doctoral student in a STEM field at the research site, and (3) a woman. Purposive sampling identified 10 Black women pursuing postgraduate studies in STEM fields at a public PWI in the southwestern United States. Underscoring its Carnegie classification of high research activity, the institution boasts robust STEM doctoral programs and national accolades. This sampling method allowed for participant homogeneity, an essential component of data saturation (Guest et al., 2006). The fields represented are biology, chemistry, math, psychology, science education, health education, and engineering. All the participants were of the African diaspora; two were born in Africa, one was from the Caribbean, and the others were all American. Participants ranged in ages from 24 to over 50 years old. Three of the participants were married and had children. Five participants pursued their doctoral studies upon completing their undergraduate programs while the rest of them had other careers before pursuing doctoral studies. The oldest participant had been a science teacher for about twenty years. Table 1 is a Bio chart of study participants.

Table 1: *Bio Chart of Interview Participants*

Participant	Impostor Level	Undergraduate Institution	Graduate Institution	Academic Discipline	Year of Study	First-generation Student (Yes/No)
Shanae	Low	HBCU PWI	PWI	Math	2	Yes
Jane	Intense	HBCU	PWI	Engineering	3	Yes
Tiffany	Moderate	International	PWI	Science Education	4	Yes
Janelle	Moderate	PWI	HBCU PWI	Math	4	Yes
Porsha	Moderate	PWI	PWI	Science Education	1	Yes
Allison	Frequent	PWI	PWI	Chemistry	5	Yes
Tasha	Frequent	PWI	PWI	Biology	4	No
Shauna	Frequent	PWI	PWI	Psychology	3	Yes
Carla	Frequent	PWI	PWI	Health Education	3	No
Derricka	Frequent	HBCU	PWI	Chemistry	3	Yes

Data Collection

I conducted face-to-face interviews lasting between 40 to 90 minutes, with each participant to document their narratives. The interviews highlighted participant experiences and perceptions of their doctoral journey. To facilitate code saturation, a critical component in data analysis in a qualitative study, Hennink et al. (2016) recommend at least nine interviews. Before beginning the interviews, participants completed the 20-item Clance Impostor Phenomenon Scale (CIPS) to assess whether they possessed impostor feelings. Developed by Clance (1985), CIPS examines specific attributes such as fear of being evaluated, fear of being unable to repeat success, and fear of being less capable than others (Chrisman et al., 1995). A five-point rating scale scores each of the 20 items on the CIPS. The scores are 1 (not at all true), 2 (rarely), 3 (sometimes), 4 (often), and 5 (very true). The scores add up to produce a total score ranging from 20 to 100; the higher scores are indicative of impostor syndrome characteristics (Gibson-Beverly & Schwartz, 2008). Studies have shown that CIPS contains an internal consistency ranging from 0.85 to 0.96 (Gibson-Beverly & Schwartz, 2008; Holmes et al., 1993; Kananifar et al., 2015; Simon & Choi, 2018)

To ensure consistency across all participants, I used the same interview protocol with all participants. Having all participants in a study respond to the same questions increases data saturation by ensuring the most insight from the data (Guest et al., 2006). The open-ended questions solicited student responses about their academic experiences and evidence of the impostor syndrome. DeMarrais (2004) hypothesized that open-ended questions generate variable responses that address research questions. Participants responded to questions such as, (a) How would you describe your academic journey so far? (b) What parts of your journey do you particularly remember? (c) Do you ever doubt your ability to undertake your graduate studies? When? Why/Why not? With participants' permission, the interviews were audio-recorded and transcribed verbatim. I kept a reflexive journal of all activities and a running record of the research process to critically examine the research process's ethical, procedural, and theoretical aspects.

Data Analysis

I first calculated the scores on CIPS, which ranged from 38 to 84. Respondents with a score of 40 or below possessed very few characteristics of the impostor syndrome (low); those with scores between 41 and 60 were identified as having moderate characteristics (moderate) while those with a score between 61 and 80 classified as frequently experiencing impostor feelings (frequent). Those respondents who scored above 80 possessed intense impostor feelings (intense). I developed a codebook through three cycles of coding, as outlined by Saldaña (2015). The initial cycle involved in vivo and descriptive coding where I mapped participants' words (in vivo) to a word or phrase indicative of the impostor syndrome, or BFT (descriptive coding). For example, I mapped the following in vivo code to the descriptive code "doubt": "Allison: (laughs) Yeah that's all that's in my mind, instead of saying yeah that's such a good opportunity, immediately doubt sets in, like oh my god I'm going to be humiliated they're going to realize how much I really don't know." In the second phase, focused coding, I developed categories based on the generated descriptive and in vivo codes. The descriptive code "doubt" along with codes such as "comparison to other students," "impostor cycle," and "impostor personalities" formed the impostor syndrome category. I ended the coding process with theoretical coding by synthesizing the categories to Black feminist thought tenets. For example, I analyzed the

impostor syndrome category to identify whether participants' responses indicated that race and gender influenced its presence or lack thereof. This process allowed data saturation through the exhaustive exploration of the data (Guest et al., 2006; Hennink et al., 2016). Additionally, the iterative coding process, stable codebook, homogeneous sample, rich data, and categories provided a firm basis for saturation (Hennink et al., 2016).

Trustworthiness and Validity

During this study, I heeded to Ortliip's (2008) advice and continually used my reflexive journal to ensure that I scrutinized my personal beliefs in tandem to the research process. I constantly reminded myself of my foremost duty to protect the participants in the study. This process allowed me to be reflective and reflexive during the investigation. Preissle and deMarrias (2015) indicate that reflexive researchers examine themselves as they study their "topics, participants, and settings" (p. 190). Maxwell (2013) warns that failure to journal reflections could miss important details when reviewing the collected data. I triangulated the interview data with the CIPS results, reflexive journal, and the existing literature. The survey used for the study, CIPS, has been tested and found to have internal consistency, reliability, and construct validity (Chrisman et al., 1995; Mak et al., 2019). To ensure member checking, participants received emailed copies of interview transcripts to ensure accuracy (Lincoln & Guba, 1985). Participants read the transcripts, identified necessary changes, and responded via email indicating their agreement with the transcript's accuracy.

Scheurich (1996) and Koro-Ljungberg (2010), noted accurate reporting of research findings, and the absence of any form of modification reflects trustworthiness during the research process. Respondents' responses were not changed to suit the purpose of the study during data analysis. Preconceived notions did not impact knowledge claims developed during data analysis.

Findings

To demonstrate how the impostor syndrome influenced Black women students' experience completing postgraduate studies in STEM fields study, I present themes that emerged from the data. The themes include (1) the STEM impostor; (2) the lived experience of the Black woman in STEM; (3) impostor narratives, and (4) caring within the Black sisterhood

The STEM impostor

This theme examined levels of the impostor syndrome and how it shaped the respondents' academic journey. One participant expressed a low level of the impostor syndrome based on CIPS. Half of the participants (5) reported experiencing frequent feelings, one participant recorded intense impostor feelings, and three noted that they had moderate impostor feelings. Most participants in the sample, though they pursued different disciplines within STEM fields, harbored impostor feelings.

Shanae, a doctoral student in math, was in the second year of her studies. She had the lowest score on the scale and appeared very calm, self-assured, and poised during her interview. She summed up her choice in the STEM field in this way: "I chose math because I like it; I've always liked it, so teaching it at the college level would be perfect for me." Jane, a third-year, first-generation, engineering student, was the only participant who reported intense impostor

feelings. She made light of everything, laughed a lot, and declared that the students in her cohort were “smarter than her.”

Tiffany, a Ph.D. candidate in science education, and Janelle, a mathematics major, reported moderate impostor feelings. In the fourth year of her program, Tiffany noted there had been challenges during her academic journey. Still, with her unwavering faith in God and the support of her family, she overcame them. Janelle, also in the fourth year of her doctoral studies, was grateful for the support from her department and peers. Despite a few bumps during her studies, she averred that her journey has “been alright; it’s definitely been hard at times.” Porsha, a science education major, expressed moderate feelings. She described herself as anal-retentive and stated that she needed structure to balance things out as she completed her studies.

Most of the participants reported that they experienced frequent impostor feelings. Allison is a first-generation college student in the fifth year of her studies in chemistry. Unsatisfied with her performance, she undermined her achievements and remained convinced that she has made it thus far by sheer luck. For Tasha, a fourth-year biology doctoral student, her journey took an unusual turn when she became a mother during her third year and experienced backlash from her advisor and other faculty. Shauna, also a first-generation college student, is a third-year doctoral student in psychology. She questioned her rightful place in her program and surmised, “Sometimes I think about who am I to be here?” when asked about her academic journey. Carla successfully defended her dissertation at the time of her interview. While this is an admirable feat, she reported a high score on her survey. Derricka, a first-generation student in Chemistry, the most entertaining participant, made fun of everything and laughed with gusto. Despite her cheer, she noted that she experienced frequent impostor feelings in “the very isolating chemistry environment.” Four of these five women were first-generation; they indicated that they procrastinated, refused to accept responsibility for their achievements, and attributed their success to factors outside of themselves.

The lived experience of the Black woman in STEM

The second theme demonstrated how the participants’ lived experiences influenced their awareness of their impostor feelings. The personal narratives of participants like Jane and Janelle, who recognized racist and sexist attitudes in their fields, demonstrate how it reflected their impostor feelings. Janelle expressed the oppressions inherent in intersectionality in this exchange when asked, how do you see yourself in comparison to the other students in your area:

Janelle: And then there’s always those people in the program that are at the exact same step and level that you are so I just feel like... I do feel like sometimes I have to work harder

Interviewer: Umm hmm.

Janelle: because I have noticed that even if it’s because I’m a woman maybe it’s because of my race but because I’m a woman.

Interviewer: So, it’s majority men.

Janelle: It’s majority men.

She underscored the oppressive structures when she talks about her experience. Her lived experience became a criterion of meaning for intersectionality in STEM fields and showed how it influenced her impostor feelings. She questioned her ability because her experience demonstrated she needed to work harder. After all, she was a Black woman. Jane’s disclosure

about a professor undermining her undergraduate degree from an HBCU reflected her meaning-making. The following excerpt highlights her lived experience:

Well I had a professor who refused to work with me because I went to an HBCU. He actually..., he worked with a White girl we took all our classes together like we made our schedules together. He actually told me, you're taking the easy way out, you're taking the easy classes to graduate and I'm like you're working with ... You know,"

Their experiences equipped them with wisdom that they use to negotiate their academic lives. They were fully aware of the absence of White, male protection, and learned how to survive in their fields (Collins, 2000).

Some theorists believed that Black women have two modes of knowing, one within the body and the space around it and the other, which goes beyond a bodily experience (Belenky, 1986; Hartsock, 1983; Smith, 1987). These sources of knowledge allow women to use their lived experiences to make knowledge claims. When Tasha, who had frequent impostor feelings, contended that a Black woman with a newborn "must work extra hard to prove her worth in her STEM discipline," she came from a place of knowing. The subjectivity between the knower and the known rested within her and her encounters. Tasha did not make that claim off a higher authority but substantiated her knowledge based on her own experience. Sharing their experiences allowed the study participants to sustain their awareness of what it means to be a Black woman in a STEM Ph.D. program. Sharing their narratives permitted them to recognize incidents of the impostor syndrome as they described their doctoral experiences.

Impostor narratives

The use of dialogue fosters a connectedness that enables Black women to validate their knowledge claims (Collins, 2000). According to hooks, (1989), conversation denotes a speech exchange between two individuals; it does not include the subjectivity of one person by another via spoken word. This humanizing speech confronts and fights hegemonic practices (hooks, 1989). The exchange between the researcher and the interview participants symbolized the use of the dialogue. The participants had the freedom to relay their narratives in an atmosphere of mutual respect. The exchanges characterized by humanizing speech allowed them to talk about discriminatory practices within their disciplines and empowered them to highlight how they resisted these oppressive structures. Their connectivity as Black women encouraged the exchange of stories, as can be seen in the following discussion with Jane, when she spoke about Black women in academia, most times not having a family.

Interviewer: Like you to choose a career, like we're not allowed to have both worlds.

Jane: I don't think you can necessarily have both like that.

Interviewer: As a Black female or generally?

Jane: I think it's difficult as a woman to be honest.

Interviewer: Umm hmm

Jane: Usually as a woman, you have to pick right?

Interviewer: Umm hmm.

Jane: But then as a Black woman it's difficult, let's just be real.

Interviewer: Umm hmm

Jane: Me finding a husband in this town right now, what are the chances of that?

Interviewer: Umm hmm.

Jane: It's a college town, they young, I took two years off and then I came back.

Interviewer: Umm hmm.

Jane: So, I'm older than these people.

Interviewer: umm hmm

Jane: You know what I'm saying and then it's White, this place is White, you know

Interviewer: Umm hmm.

Jane: Am I attracted to White men, are White men attracted to me? Cuz white people don't approach me, White men don't approach me, I don't want them to approach me anyway but you know what I'm saying. So right now, I'm in a place in my life where I will have to enter a long-distance relationship right? So how do you do that starting off? So, I'm at a point where it's like that whole aspect, this biological clock is ticking is completely having to be suppressed, you know what I'm saying.

Interviewer: It's like you have to choose, you can't do both.

Jane: Yeah.

Interviewer: wow that is just so interesting.

Jane: Yeah

Interviewer: Yeah because I'm a single parent, well you see I made the decision to come here so I'm here with my son, it's just the two of us, his dad is in another state, it's like you said I had to choose because if I had to stay there, I wouldn't be doing what I'm doing. I never thought of it that way, I'm just thinking that I am so much in control of my life but I don't realize... because I think I do want like a family like I wish his dad was here... that's very interesting. So you're saying that those very successful women are single, no kids

Jane: yeah

Interviewer: That they're very successful.

Jane: Yeah. But white people get married though,

Interviewer: Even if they're female or male.

Jane: White people get married.

It was never a case of the interviewee telling all; I shared personal anecdotes to sustain their narratives. Collins (2000) clarified that new knowledge claims advance from dialogue with other members of the community dismantle erroneously perpetuated stereotypes.

Dialogue allows individuals to become empowered within their respective communities (Collins, 2000). The verbal and non-verbal interaction between the speaker and listener where the listener responds to the speaker's words stems from African-based oral tradition (Kochman, 1981). Verbal exchanges between all members of the group tested and validated ideas. When participants or the researcher nodded, laughed, spoke all at once, they were responding to the speaker. The non-verbal hand gestures or head bobbing for agreement or disagreement, smiles, and facial expressions authenticated the information gathered from the interviews. When participants laughed, spoke in a heightened or lowered pitch, continuously said umm hmm, or spoke all at once on a topic such as racial and gender discrimination in response to a speaker, they supported meaning-making through dialogue. The Black women in the study actively participated in the interviews and eagerly talked about their experiences. There were never moments of cajoling respondents into telling their stories, and many times, they addressed the interview questions on the protocol even before that question came up. Belenky (1986) argued that women seek autonomy through connectedness and ground their epistemology in finding a voice, speaking, and listening. Dialogue between Black women afford them ways of knowing

that is supported and pivotal to their survival and resistance to their intersecting oppressions. The ethic of caring most often distinguishes verbal exchanges among Black women.

Caring within the Black sisterhood

The fourth theme explored ways personal expressiveness, emotions, and empathy are central to validating knowledge claims (Collins, 2000). Personal expressiveness concerns the individual uniqueness of Black women. Whereas they are all Black women, they are all uniquely different. When Shanae says she does not “compare herself to anyone because they are all different,” she acknowledges her uniqueness. She did not feel like an impostor; she believed that she belonged in her discipline. Although they were Black women pursuing doctoral studies in STEM fields and shared similar intersecting oppressions, they each had distinct lived experiences. Reflective of their different levels of the impostor syndrome, they expressed their personal beliefs in distinct ways. Emotions were an integral part of the dialogue between the researcher and the interviewees. Jane, the intense impostor was particularly expressive when she told her tale; she laughed heartily, got angry when referencing discrimination, and lowered her voice when she talked about her GPA. Shanae who reported the lowest score, remained poised and relaxed during her interview; she smiled as she spoke calmly and confidently. A lack of emotion would have diminished the meaning derived from the analysis of the participant narratives.

Collins (2000) proposed that without the listener’s empathy, the speaker would find it difficult to relate their story. My ability to empathize with the participants allowed them to tell their stories. As women of color aware of our intersecting oppressions, we understood each other and felt comfortable talking about the impostor syndrome or intersectionality issues. Narratives punctuated with phrases such as “girlfriend” or “sister” and including high fives and hand waves showed the importance of the ethic of caring in sustaining knowledge claims. The use of expression, emotion, and empathy provided an avenue for connected knowing. Collins (2000) elaborated that with connected knowing, personality adds to an individual’s ideas and appreciates the diversity that these personalities bring to a collective understanding within the group. Black women must be accountable for the knowledge claims made through dialogue and sustained through the ethic of caring.

Every idea has an owner, and the owner’s identity is significant in making knowledge claims. Shauna echoed the need for support of minority students in these academic disciplines when she stated, “so, I think that students of color when they’re first-generation, low income, minority all those kinds of things, they need a support system to help them.” She used her own experience as a Black woman with frequent impostor feelings to highlight not only the intersecting oppressions but the consequences and challenges that lie therein. Allison spoke of a prestigious opportunity that she received in her department, yet she doubted her ability to undertake the task. The following excerpt from her interview highlights her impostor feelings:

Like I have this job, my TA duty for the summer, is one that any analytical chemist would kill for. I can’t even believe I got that because it’s not something that’s done. It was my boss who went to the department chair and asked for me to get that assignment.... So, I’m going to be learning how to maintain instruments, how to run samples, sort of an industry like feeling. But all that’s in my mind is oh my God do these people not know that I don’t know these things. I’m going to screw up. I’m going to mess up somebody’s sample; I’m going to give them wrong information.

Black women pursuing doctoral studies in STEM fields substantiate the knowledge claims made in the study. Although many of them feel like impostors, they are respected students within their academic disciplines. The researcher confirmed assertions about the impostor syndrome with evidence derived from data analysis. The participants' narratives sustained the conclusions made about Black women's experiences pursuing graduate degrees in STEM fields.

Discussion

Although Black women have significant advances and have more access to higher education, their racial and gender intersectionality places them in a unique position when they enroll in STEM graduate studies (Chaverkraverty, 2020; Ireland et al., 2018; McGee et al., 2019). At times their minority status intersects with impostor feelings creating emotional, physical, or mental burden during their studies. The study participants, who reported moderate to intense impostor feelings, found it difficult to accept that they were intelligent and possesses similar capabilities as their academic peers. Clance and Imes (1978) acknowledged the impostor syndrome's presence in high-achieving individuals who did not internalize their success. The participants' presence in their respective programs mirrored their academic excellence, yet many disregarded their success. Other researchers indicated that impostor syndrome is a salient part of graduate students' experiences (Mason, 2009; Prata & Gietzen, Young, 2011).

The intersection between race and gender continually shaped their experiences and how they negotiated their doctoral studies. Lord et al. (2009) reported women's hostile environment in the usually male-dominated STEM fields. The demands of graduate STEM education potentially foster doubt and uncertainty (Young, 2011). Moreover, due to the curriculum's rigor, these fields gained the notoriety of recruiting stellar students (Soldner et al., 2012; Tao & Gloria, 2019). Despite this, when Black women enter this sphere, the deficit genetic thinking model deems them academically inferior. McGee and Martin (2011) established that Black women students due to their small numbers in STEM fields, feel the pressure of the stereotypes associated with their race and gender. Young (2011) suggested that one feels like an impostor when they are in an unfamiliar environment. This unfamiliarity creates a breeding ground for developing impostor feelings; a graduate student cannot help feeling like an impostor when everyone around them looks different or undermines their intelligence (McGee et al., 2019; Ong, 2011; Young, 2011). Black women are an anomaly in the STEM playing field, and the results indicate that most of them feel like impostors.

Implications

This study highlights the need to address the racial and gender divide in STEM fields. Black women remain marginalized in those disciplines despite research done on their experiences. Whereas other factors contribute to the impostor syndrome, the study indicated that the oppressive intersectionality of their race and gender promotes impostor feelings in some of the study participants. Continually doubting oneself adds to the stress of completing a doctoral degree. Institutions of higher learning need to enact the general guidelines in their missions that purport equal opportunity and treatment on college campuses. Faculty and staff need to be attuned to Black women's needs and made aware of the overt and covert practices they engage in that sustain the dominant narrative about minority students. Institutional training on harassment and discrimination should provide strategies for minimizing discriminatory practices. In their

effort to recruit minority populations, higher education institutions should also recruit and support faculty of color to serve as mentors and role models for these students. The absence and scarcity of Black and Brown faculty of color reify the dominant deficit way of thinking because they hire a token few. Academic departments need to train faculty in catering to the needs of the students assigned to them as advisees.

This study contributes to the limited research on the experience of Black women in STEM fields with the impostor syndrome. Focusing on it sets the stage for future research examining minority women's academic experiences outside of STEM fields and at the undergraduate level. Ensuring that they feel secure during their undergraduate work will facilitate their successful transition to graduate studies. Providing counternarratives of success will not only minimize their impostor feelings but will reduce the negative feelings fostered by racial and gender oppression. The findings highlight the need for support structures that steer Black girls to a successful STEM pathway in the elementary and middle grades to sustain interest and foster a science identity. Accumulating research indicates that enrichment activities and culturally relevant pedagogy contribute to their interest in STEM (King & Pringle, 2019; Scott et al., 2017; Young et al., 2017b). Making these activities a salient part of their experiences in and out of school contributes to developing a science identity necessary for pursuing STEM disciplines in higher education.

COVID-19 currently threatens STEM education as educators, parents, and administrators struggle to transition to virtual learning or encounter social distancing practices in traditional classrooms. Dorn et al. (2020) used statistical models to reveal the impact of the current pandemic. Black students are among the minority groups encountering the highest learning loss due to a lack of access to a functional remote environment, parental academic support, and technology. The current educational climate adds additional strain to the leaky pipeline to STEM careers for Black women. This study, combined with recent findings, emphasizes the need to deliberately target Black girls to steer them on a successful STEM pathway.

Conclusion

These four tenets of Black feminist epistemology, the lived experience as a criterion of meaning, the use of dialogue, the ethic of caring, and the ethic of personal accountability, provided an avenue to validate the knowledge claims made in the inquiry of how Black women in STEM fields experience the impostor syndrome. Dialogue about the participants' lived experiences gave credence to the conclusions drawn in this investigation. The ethic of caring articulated through personal expressiveness, emotions, and empathy was fundamental to the knowledge validation process. As Black women in doctoral programs, they rejected the dominant oppressive discourse and provided ideas sustained by their character, value, and ethics. Black women produced most of the knowledge claims made in this study. Their unique views contained similarities in perception shared as a group.

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