

# “I AM Capable!” - A Study Examining the Relationship Between Identity and Academic Achievement among STEM Black College Women at HBCUs

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## Abstract

*Black students' persistence in science, technology, engineering, and mathematics (STEM) may be affected by factors, such as their social identities. Though Black college students remain underrepresented in STEM fields, historically Black colleges, or universities (HBCUs) are instrumental in educating Black students who go on to pursue doctoral degrees in STEM. Intersectionality, the main theoretical framework utilized in this study, emphasizes how aspects of a person's social and political identities, such as race, socioeconomic status, and sexuality, combine to create different modes of discrimination and privilege.<sup>1</sup> For example, studies have found that Black college women in STEM, specifically, experience gendered racial oppression and inequalities within STEM spaces due to their intersectional gendered racial identity. Yet, few studies have evaluated the influence of Black women's intersectional identity on their academic achievement and motivation among those pursuing a STEM degree at an HBCU. The present exploratory study examined perceptions of identity and academic achievement in STEM by conducting a focus group with three Black undergraduate women majoring in STEM at an HBCU. Results revealed that three themes emerged: 1) perceiving the STEM field as White male-dominated, 2) experiencing imposter syndrome in STEM, and 3) community and institutional support for Black women in STEM. Findings can be used to develop educational programs for faculty and administration on how Black college women's identity plays a crucial role in their motivation and persistence in STEM.*

## Introduction

Black women consistently have had unique experiences due to their position in society. Discriminatory social constructs such as the combination of racism and sexism (e.g., gendered racism)<sup>2</sup> can create difficulties for Black women navigating through the American education system. Yet still, in some disciplines, Black women encounter systemic challenges. Specifically, science, technology, engineering, and mathematics (STEM) disciplines are areas where Black women typically encounter structural barriers

(e.g., being viewed as less competent) that impact their persistence and success in STEM.<sup>3,4</sup> Indeed, the percentage of bachelor's degrees in STEM awarded to Black students (12%) from 2015 to 2016 was lower than the overall percentage (18%) of bachelor's degrees awarded in STEM fields.<sup>5</sup>

Yet, these percentages should be contextualized; where Black women choose to study STEM and earn their STEM degrees plays a significant role in their overall journey. For example, attending culturally significant institutions, namely historically Black

colleges or universities (HBCUs), is crucial in recruiting and retaining Black women in STEM in their pursuit of bachelor's degrees.<sup>6</sup> Despite HBCUs only accounting for 3% of postsecondary institutions in the United States, of the top eight institutions that matriculate Black STEM students that go on to earn graduate degrees, seven are HBCUs (NSF, 2020). While, in recent years, there has been an increased focus on encouraging Black women to pursue STEM studies and careers in various disciplines,<sup>7</sup> there is still a significant lack of research exploring

the unique circumstances of Black women in STEM. Few studies have evaluated the influence of identity and HBCUs on the academic achievement and motivation of Black women undergraduate students in STEM. Therefore, the current study aimed to explore the following research question: How does the intersectionality of one's race and gender identity influence self-perceptions of academic achievement, persistence, and motivation in STEM among Black female undergraduate students at HBCUs?

## Theoretical Framework

There are themes surrounding Black women scholars that should be explored to better understand their ability to thrive in STEM.<sup>8</sup> Thus, the main theoretical framework employed in the present study is intersectionality theory. Intersectionality is an analytical framework for understanding how aspects of a person's social and political identities, such as race, socioeconomic status, and sexuality, combine to create different modes of discrimination and privilege.<sup>9</sup> Intersectionality theory was appropriated in a study done by Smith and colleagues<sup>10</sup> to evaluate how the intersection of racial and gender identity influences academic identity and achievement in Black women in their STEM majors. The findings showed that Black women were unable to conceptualize their race and gender separately. Thus, intersectionality theory assists in exploring how the perception of Black women's intersectional social identities, such as their race, gender, class, may influence their ability to thrive in STEM. Additionally, this framework enhances one's understanding of how Black women navigate STEM educational experiences that shape their identities.

## Motivation and Persistence of Black Women in STEM in Higher Education

Higher education research has shown that academic discrimination and stereotyping are reoccurring themes related to Black women who are graduate students or faculty in higher education.<sup>11,12</sup> These stereotypes have been shown to directly affect Black women as they are more likely to receive lower employment opportunities than their White male counterparts.<sup>13</sup> Furthermore, the National Science Foundation (2015)

found that Black women make up only 2% of practicing scientists and engineers due to severe underrepresentation, which was found to contribute to the issues Black women face early in their STEM careers. McGee and Bentley<sup>14</sup> conducted a study to examine the impacts of structural racism, sexism, and discrimination related to their identity as Black women in STEM. The findings revealed that Black women often encountered many discriminatory and micro-aggressive experiences, including their credibility being questioned, causing individuals to feel like they must prove themselves to counteract these negative stereotypes.<sup>14</sup>

Similarly, Ireland et al.<sup>3</sup> conducted a theoretical study to evaluate how intersectional approaches have produced new knowledge about Black women and girls in STEM education. This study revealed the need for educational interventions to maintain Black women's persistence in STEM. More specifically, the findings emphasized how learning environments impact academic outcomes<sup>15</sup> in that Black women at undergraduate and graduate levels continue to experience micro-aggressive learning environments, negative stereotypes about their capabilities, alienation from study groups, and feelings of isolation.<sup>16,17</sup> In contrast, Cocker<sup>18</sup> noted that Black women identified extrinsic and intrinsic factors, such as familial and community support, as factors that foster their motivation to navigate higher education. Though studies have investigated factors that influence the persistence of Black women in STEM at predominantly White institutions (PWIs), more research is needed to explore the persistence of Black women at HBCUs.

## Identity Formation among Black Women in STEM

Previous literature has shown that to attain and maintain high academic success, Black women may feel pressured to de-emphasize their racial and gender identity.<sup>19,20</sup> Therefore, due to this stigma, some Black people, including Black women, in educational settings may downplay their racial identities and de-associate themselves from their same-race peers to reach high-achieving success as defined as displaying academic excellence.<sup>21,22</sup> While much of the present literature has focused on the educational experiences of Black men,<sup>22,23</sup> there

has been little research that has focused on Black women's educational experiences. For example, in a qualitative study examining challenges and issues regarding the identity of high-achieving Black women students, Marsh<sup>22</sup> found that Black women students were able to emphasize and stay connected to their racial and gender identity by maintaining close connections to community members and resources. More specifically, it was shown that the Black women students in the study did not attempt to minimize their racial identity due to the acknowledgment of challenges in associating with distinct racial/ethnic groups and embracing these challenges in academic settings.<sup>22</sup>

Regarding gender identity, it was found that these Black women demonstrated their "womanhood" by adjusting their social groups to include whoever cultivated or delayed their academic success.<sup>22,24,25</sup> While academic identity has been studied with more attention in the literature, domain-specific STEM identity has not been investigated as much.<sup>26</sup> Previous studies suggest that Black women may have more difficulty adopting a concrete science identity due to negative stereotypes about one's racial and gender identity (e.g., angry Black woman stereotype), lack of Black representation in science professions/fields, and lack of acceptance from White peers or counterparts.<sup>27,28</sup> Moreover, Carlone and Johnson<sup>28</sup> emphasized that when science identity is not incorporated in Black women's gender and racial identity, it may contribute to the challenges that Black women in STEM may face. In this qualitative study, the authors found that science identity consists of performance, recognition, and competence. Carlone and Johnson<sup>28</sup> defined performance as social performance, which measures how an individual achieves goals and creates value; recognition as the acknowledgment of oneself by themselves and others; and competence as knowledge of science. In conclusion, it is shown that Black women often are not able to fully express their identity due to negative stereotypes and perceptions.

Recently, Smith and colleagues<sup>10</sup> explored the relationship between racial and gender identity on the development of science identity and academic achievement among Black women undergraduate students at an HBCU. In this study, the authors utilized intersectionality theory,<sup>1</sup> the interconnected-

ness of social identities that cause prejudice and discrimination against a specific social group, and social identity theory,<sup>29</sup> the closer a variable to one's identity exhibits a direct positive correlation on how the variable is regarded. In a mixed-methods study, Smith and colleagues<sup>10</sup> found that Black women students in STEM with high-achieving abilities often felt like they had to de-emphasize or compartmentalize their identities to maintain success and avoid discrimination. Overall, the complexity of understanding identity development and formation among Black women in STEM merits further examination.

**Motivation and Persistence of Black women in STEM**

Specific to STEM, previous literature has shown that environments or institutions that provide continuous support, encouragement, and community are more likely to encourage student engagement and persistence in STEM.<sup>30</sup> As an example, Bryant<sup>31</sup> found that Black women view the support of STEM faculty and mentors as essential to their persistence in STEM disciplines. Moreover, Bryant's<sup>31</sup> findings also showed that exposure to underrepresented faculty in STEM encouraged and motivated Black women to stay within their STEM disciplines. Similarly, Morton<sup>32</sup> examined perceptions and experiences of Black women in STEM and how these experiences contribute to their engagement and persistence in science. This study showed that Black women who develop their identity using positive and inclusive strategies feel authentic and included within the research process and are willing to persist in STEM despite challenges concerning their identity.<sup>32</sup> Elsewhere, environmental, and contextual factors such as nuanced experiences have been found to play a significant role in Black women's engagement and persistence in STEM.<sup>33,34</sup>

Conversely, Black women have been found to be less likely to attain a STEM degree due to a lack of support in academic environments.<sup>35</sup> In particular, their persistence and engagement can be altered due to the lack of access to Black women faculty, mentors, and research projects that focus on Black women in STEM<sup>28</sup> and the lack of representation and stereotypes that negatively impacted their journey in the sciences.<sup>3</sup> The combined findings of the literature exemplify the need

for a more in-depth analysis surrounding the relationship between identity and academic achievement and persistence in STEM among Black women studying at HBCUs.

**Academic Achievement of Black women in STEM**

Limited studies have evaluated academic achievement among Black women in STEM careers. Previous literature has shown that Black women remain underrepresented in STEM fields due to their educational experiences being affected by the dual presence of their racial and gender identity.<sup>36,37</sup> Research has also shown that despite the dual existence of race and gender amongst Black women, another factor limiting the educational attainment of women and students of color in STEM includes insufficient resources, support, and preparation from prior schooling and current colleges/universities.<sup>6</sup> As this trend has been emphasized in research, it has been found that students attending colleges/universities that serve primarily Black populations and women show higher rates of educational attainment in STEM.<sup>38</sup> According to the Integrated Postsecondary Education Data System (2004), it has been found that HBCUs are a vital source of STEM degrees and professional attainment among Black women.

In summary, previous research has emphasized the importance of exploring how self-efficacy (an individual's belief in their capacity to reach a goal) among Black women's educational attainment in STEM fields, along with inefficient resources and preparation and stereotype threat may influence their motivation to persist in STEM.<sup>39,40,41</sup> However, research has also shown that HBCUs and women's colleges effectively address these structural barriers that limit Black women's STEM educational attainment.<sup>6,42,43</sup> Therefore, this current exploratory study sought to close the gap in literature, evaluating the perceived role Black women's colleges play in the academic achievement of Black women in STEM fields.

*Table 1 - Participants Demographics*

Pseudonym	Gender	Age	Race	Education Level	Major
K.J.	Woman	19	Black	Sophomore	Chemistry
Abby	Woman	20	Black	Sophomore	Biology
Paris	Woman	21	Black	Junior	Chemistry

**Current Study**

Few studies have evaluated the perceived influence of identity and the HBCU context on the academic achievement and motivation of Black women undergraduate students in STEM. Therefore, this qualitative exploratory study aimed to evaluate the self-perceptions of identity and academic achievement in science, technology, engineering, and mathematics among Black women undergraduate students at an HBCU. Given the intersectionality theoretical framework, we developed the following research question: How does the intersectionality of one's race and gender identity influence self-perceptions of academic achievement, persistence, and motivation in STEM among Black female undergraduate students at HBCUs?

**Methods**

*Participants*

The participants from this study were recruited from a women's HBCU in the Southeast region of the United States. A convenience sample was utilized to recruit the participants via emails and flyers. A total of three Black women between the ages of 18-22 were recruited to participate in this study. As shown in Table 1, all the participants consisted of undergraduate STEM majors. The specific majors of the participants were chemistry and biology.

*Measures*

A demographic survey in Qualtrics was utilized to assess background information such as race, age, education level, and years of experience studying math and science. Additionally, a set of questions was administered to participants that centered around their achievement, persistence, and science identity.

*Procedures*

Participants participated in one focus group, a semi-structured interview, and a group interview where only a set few of questions were asked and the others were not planned in a specific order, that lasted

about 45 minutes via Zoom. The participants were shown an informational sheet about the study via Qualtrics and consented to participate in the focus group and consented to have their responses audio recorded. Each participant was asked to use pseudonyms. In this focus group interview, participants were asked questions about their achievement, persistence, and science identity in STEM. Some of these sample questions included: “Do you feel that your professors provide support and are invested in your success in STEM?” and “Do you think that your grades in your STEM courses are a reflection of how well you can do in these courses? Why or why not?” After the interviews, participants were compensated \$10 for their participation. All data from the interviews were stored on a password-protected computer and analyzed for themes.

## *Positionality*

As Black undergraduate women in STEM, we have had the opportunity to analyze this study while being in a similar position to the participants. We are all Black women from different backgrounds but share the similarity of attending HBCUs as social science STEM majors. During our time as Psychology majors, we have all questioned our science identity at some point. We have experienced being told by our professors that we were not good enough and that we should choose another path. Being doubted by our professors had a negative impact on our confidence level as STEM majors. Even though this affected our persistence and how we viewed ourselves, we did not allow these doubts to affect our achievements. Therefore, we approach the analysis of this data from an insider’s perspective. We very much relate to the position of the participants.

## *Data Analysis*

This study utilized a qualitative design that consisted of a focus group interview. The focus group data were transcribed and then analyzed using phenomenological analysis, a methodological framework in qualitative research that examines how individuals make meaning of their lived experiences.<sup>44</sup> Furthermore, this analysis consists of identifying, analyzing, and interpreting patterns of meaning within qualitative re-

search.<sup>45</sup> This type of analysis was used to examine the themes and subthemes that may influence the self-perceptions of identity and academic achievement Black women STEM undergraduate students at HBCUs. To reach an intercoder agreement, we refined our main themes and subthemes and finalized each of our counts for each subtheme. Then, the intercoder agreement was calculated based on each of the coder’s final counts. The steps to conducting a phenomenological analysis<sup>46</sup> include Step 1: All raters read through the focus group session transcript and took notes on initial patterns. Step 2: Generated initial codes/subthemes and color code highlighted sections of the transcript to correspond with the code/subtheme. Step 3: Reviewed subthemes and developed main themes and defined main themes. Step 4: Refined final themes and subthemes and calculated the cut-off value. Step 5: Calculated percent agreement based on final themes and subthemes by evaluating intercoder agreement of all subthemes.

## **Findings**

There were seven preliminary themes that arose from this study. However, five major themes were chosen due to the selected cut-off value of a frequency of three. This cut-off value was chosen to determine the most prominent themes that arose in the study from the participants. The percent agreement for the final major subthemes was 100%. The final constructed major themes were a) science Identity, with subtheme past STEM interests/experiences, b) managing persistence in STEM, with subthemes preparation and self-motivation, c) community of support, with subtheme peer support, d) identity challenges in STEM, with subthemes gendered racism in STEM, imposter syndrome, credibility questioned, and underrepresentation in STEM, and e) learning barriers, with subthemes unfavorable learning and resources availability. These major themes point to how the intersectionality of Black women’s identities may influence perceived challenges in persistence and motivation in STEM. The findings are summarized in Table 2 which shows the theme, subthemes, definition of each subtheme, and an example of each subtheme.

## **Science Identity**

The first theme that emerged was science identity, which participants discussed how they developed their science identity through experiences and research. With a frequency of three, participants discussed how past STEM experiences and interests before college led to their interest in STEM. These findings are consistent with Wallace’s<sup>47</sup> findings that participants credited early influences prior to college for stimulating their STEM interest. Additionally, extracurricular STEM-related experiences during their college matriculation, such as summer internships and research, had a significant impact on participants’ formation of their STEM identity. One participant discussed her experiences in STEM during her K-12 education.

“I became interested in STEM in elementary school because I liked the structure of STEM, so especially science and math, and that it felt like a puzzle to me...” (Abby, Sophomore, Biology).

In reflecting on her STEM experiences in elementary school, Abby spoke about how using math and science to solve real-world challenges and problems was fascinating to her. Furthermore, Paris spoke about how their past research experiences helped form her science identity.

“I’ve had different research opportunities and experiences. And I feel like they’ve really impacted me... and finding my own authentic self within the scientific field.” (Paris, Junior, Chemistry).

In sum, the results demonstrate that the development of Black women’s science identity is largely influenced by past STEM encounters. Most participants discussed how the nature of their STEM courses and involvement in STEM activities outside of the classroom, helped them develop a science identity and interest in STEM.

## **Managing Persistence in STEM**

The second theme was managing persistence in STEM. In this theme, there was a focus on ways persistence is managed in STEM for Black women. Several participants shared the necessity of having preparation and self-motivation to be successful in their science studies, as this subtheme held a frequency of 10. Self-motivation was a sig-

Table 2: Focus Group Themes and Subthemes

Theme	Subthemes (f = total frequency)	Definitions	Examples
<b>Science Identity</b> - Discussion of how participants developed their science identity.	Past STEM Interests/ Experiences (f = 4)	previous K-12 experiences, or experiences before college, that led to the interest in STEM	"I became interested in STEM in elementary school because I liked the structure of STEM, so especially science and math, and that it felt like a puzzle to me..." (Abby, Sophomore, Biology)
<b>Managing Persistence in STEM</b> - Discussion of ways persistence is managed in STEM.	Self-Motivation (f = 10)	one's ability to strive and take initiative in order to execute one's tasks and goals through challenges and adverse experiences	"...And like, really the work ethic that I have, if I want to maintain that work ethic, then I have to really believe in myself and not look towards anyone else for validation." (Paris, Junior, Chemistry)
	Preparation (f = 3)	engaging in behaviors in the classroom to become "ready" for a specific event such as exams, homework assignments, essays, and/or other projects related to STEM.	"Of course, I went to office hours, study gap partners and stuff to help me." (KJ, Junior, Chemistry)
<b>Community of Support</b> - A description of support factors for Black women in STEM.	Peer Support (f = 3)	tools, skills, knowledge, or other forms of encouragement provided from peers	"My peers from home and from school definitely pushed me to keep going because the peers that I have that are STEM majors, it's helpful to have someone who just understands, and it makes you feel less like you're crazy for feeling the way you feel." (Abby, Sophomore, Biology)
<b>Identity Challenges in STEM</b> - Discussion of identity challenges within STEM participation.	Gendered Racism in STEM (f = 3)	experiences of prejudice or discrimination in STEM due to one's identity	"And that really affected how people spoke to me, I really experienced a different type of racism, where it's like, you're being treated as if you're incompetent." (Paris, Junior, Chemistry)
	Imposter Syndrome (f = 3)	the state of doubting one's abilities or future in STEM	"One is definitely myself. I learned what imposter syndrome was in college and definitely say that it sucks, and you feel it a lot." (Abby, Sophomore, Biology)
	Credibility Questioned (f = 4)	one's competency is questioned by other peers in STEM	"And a lot of the students when you're a minority student in a stem class, like they're not really reaching out to you like that" (Abby, Sophomore, Biology)
	Underrepresentation in STEM (f = 4)	the lack of Black women representation as faculty, staff, and students in STEM	" I would consider my grandma a stem role model. And she is identifies as female, and she's a black African American woman. And she went back to school when she was older and pursued a graduate degree. And she was like one of like four women in the whole group." (Abby, Sophomore, Biology)

<b>Learning Barriers</b> - A discussion of learning barriers that Black women face as they navigated through STEM.	Unfavorable Learning (f = 3)	unpreferable learning environment (remote/in-person) or learning style	"This is KJ and one of my top concern is not getting the full experience of everything. Being online, I just do not feel like I'm learning." (KJ, Junior, Chemistry)
	Resource Availability (f = 3)	support provided from high school and current college institution (i.e., tutoring centers, counseling centers, career centers) with the intention of increasing STEM matriculation	"And I also believe that this my university has a lot of different resources, such as the Success Center, where you can talk to a success coach, if you need help, like with really just be being successful in your courses, and in life as well. "

nificant subtheme defined as one's ability to strive and take initiative to execute one's tasks and goals through challenges and adverse experiences. Participants also noted that preparation and self-care are also important aspects of maintaining persistence in STEM. Paris, for example, discussed how she had to believe in herself and work hard to be successful in her STEM major.

"...And like, really the work ethic that I have, if I want to maintain that work ethic, then I have to really believe in myself and not look towards anyone else for validation" (Paris, Junior, Chemistry).

To reinstate the importance of self-care, Paris says,

"I'm really just focusing in on self-care and knowing that you need to take care of yourself and take time out for yourself to avoid burnout and stuff."

The necessity for self-motivation and self-care was shown to be a significant factor in the undergraduate experience and is supported by the literature. Blakely<sup>48</sup> emphasizes these sentiments in that Black women who are pursuing STEM paths are found to be more successful when they obtain motivation and inner drive.

## Community of Support

The third theme is community of support, and it acknowledges various factors of support in STEM, such as family, peers, and faculty. Peer Support was found to be the most significant subtheme and area of assistance, with a frequency of 3. Participants communicated the ways in which they received tools, skills, and other forms of positive engagement from HBCU faculty and peers, family, and friends. As such, KJ spoke about the dynamics of her re-

lationship with her mother and how her mother encouraged her to keep going.

"...My mom is very motivational. She always motivates me to keep on pushing to never give up." (KJ, Junior, Chemistry).

In addition, Abby discussed how it was motivating to have faculty at her HBCU who believed in her success as a Black woman in STEM.

"I think, at [my institution], there's definitely a good group of professors that are interested in seeing our success as women of color...My peers from home and from school definitely pushed me to keep going because the peers that I have that are STEM majors, it's helpful to have someone who just understands and it makes you feel less like you're crazy for feeling the way you feel." (Abby, Sophomore, Biology).

From the participants' acknowledgments, it is evident that support in various forms is integral to their ability to maintain their sense of capability and perseverance. It is also evident that HBCUs provide a culture where Black students, including Black women, feel a sense of belonging and support that helps them develop a positive identity and helps them succeed in their STEM education.

## Identity Challenges in STEM

The next constructed theme was identity challenges in STEM, and this theme highlighted identity challenges within STEM participation as Black women. The most prominent subthemes were credibility questioned (f = 4) and underrepresentation in STEM (f = 4). Students expressed the various issues they faced being Black women studying STEM, such as gendered racism and imposter syndrome.

"And a lot of the students when you're

a minority student in a stem class, like they're not really reaching out to you like that." (Abby, Sophomore, Biology).

Here, Abby emphasized that as a Black woman, she was not viewed as being capable and knowledgeable of the material, so her abilities and identity as a competent student in STEM were disregarded. Additionally, Paris stated how she encountered gendered racism during her STEM experiences.

"And that really affected how people spoke to me, I really experienced a different type of racism, where it's like, you're being treated as if you're incompetent." (Paris, Junior, Chemistry).

The participants' statements demonstrate their awareness of the negative narrative and stereotypes about Black women in STEM broadly. In addition, they spoke about their experiences of prejudice and discrimination, and feelings of doubt about their abilities in STEM educational experiences (e.g., conferences and internships). Also, participants discussed their knowledge about the lack of Black women representation as faculty, staff, and students in STEM and how that had an influence on their perceptions of their ability to persist in STEM.

## Learning Barriers

The final theme was learning barriers, and this theme focused on the many learning barriers among Black women during their education in STEM, such as the availability of resources. Along with resource availability, unfavorable learning was the most significant subtheme, with a frequency of three. Students explained that experiences with faculty's limited availability due to competing faculty demands, posed a challenge to their learning experience in addition to un-

preferable learning environments (remote/in-person) or learning styles that are not the most conducive to knowledge acquisition.

“One of my top concerns is not getting the full experience of everything. Being online, I just do not feel like I’m learning.” (KJ, Junior, Chemistry).

As this data was collected during the beginning of the COVID-19 pandemic, KJ spoke about the difficulty of learning amid a pandemic and racial unrest that was plaguing the Black community. In addition, Abby spoke about challenges with getting in contact with professors when the entire college was online.

“There has been a huge difference in the way professors choose to interact with students – they don’t respond to your emails, it’s easy to avoid your students online virtually.” (Abby, Sophomore, Biology)

The participants discussed these barriers, such as the overall low faculty interaction, which included faculty being unresponsive to online communication during the start of the COVID-19 pandemic. Participants emphasized the many obstacles they encountered which impacted their persistence and motivation in STEM during the pandemic.

## Discussion

Due to the lack of research addressing Black women’s challenges and support through their persistence in STEM at HBCUs, the current study aimed to explore perceptions of identity and academic achievement in STEM by conducting a focus group with three Black undergraduate women majoring in STEM at an HBCU. Overall, the findings illustrated how Black women in STEM experienced identity challenges in STEM and science identity. Participants in this study also emphasized how past STEM experiences in grades K-12 and STEM experiences throughout college matriculation contributed to developing a positive science identity. In general, the current study illustrates the perceived influence of being both Black and a woman, on how Black women navigated their experiences in STEM at a HBCU.

In the findings, participants became interested in STEM before attending college, and these interests persisted through internships, jobs, and/or summer research opportunities. Wallace<sup>47</sup> found that participants credited early influences before college for

stimulating their interest in STEM. Another common finding regarding their decision to become a STEM major was the amount of exposure students had to STEM coursework at a young age. This exposure came in many forms, including STEM camps, teacher recommendations for classwork, college visits, and meeting other professionals of color in the STEM field. Previous literature has shown that students’ early exposure to STEM allows them to be exposed to the environmental and technical style of STEM, which could attract their attention and prevent a lack of retention in this field.<sup>55</sup>

However, participants in the current study also encountered various barriers related to their identity in their persistence in STEM. Some of these barriers included experiences of gendered racism in STEM, low self-efficacy feelings (imposter syndrome), questioning regarding their credibility, and underrepresentation, which was found to be supported by previous literature.<sup>15,56</sup> These findings align with previous literature in that one’s belonging to a particular social group among a larger population with different identities will often experience imposter syndrome or feelings of inadequacy.<sup>55</sup> Participants stated that being one of the few minority students in STEM K-12 classes, they were often singled out or excluded in their science classes by their classmates. This also aligned with our findings in that participants experienced multiple forms of stereotyping, prejudice, and microaggressions related to their credibility. More specifically, participants in our current study expressed how individuals spoke to them, which was in a way that judged their credentials or capability in STEM.

Additional themes that arose during the focus group interview were strategies for participants to manage their persistence in STEM. Black women in the current study mentioned two strategies that positively manage their persistence in STEM, self-motivation, and preparation. As shown in the findings, self-motivation was one of the most prevalent subthemes in the current study ( $f = 10$ ). Self-motivation contributed to Black women’s persistence through college and pursuing graduate school and STEM careers, which was found to be a goal of all participants in the current study. Despite previous research which found that encountering negative barriers of gendered racism negatively

influence career aspirations<sup>52</sup>, according to Watson<sup>53</sup>, there was a connection highlighted between internal and external motivation influencing Black women to enter and succeed in STEM fields. As an example, Strayhorn<sup>56</sup> found that motivation and self-determination were key factors in overcoming barriers formed by Black women’s racial and gender identity. Therefore, similarly to our findings, the literature has shown that self-determination and motivation are essential to determining success in STEM for Black women. Preparation was another subtheme that frequently arose during focus group interviews. Participants in the current study attended an HBCU, which was found to positively influence their perceived academic achievement and strong persistence in STEM careers. Thus, one participant in the study emphasized how attending a women’s HBCU had a positive influence on STEM motivation among Black women due to strong faculty support. Perna et al.<sup>6</sup> emphasized benefits that women’s HBCUs hold, such as embracing various institutional approaches that seek to promote Black women students’ academic and psychological readiness to pursue STEM degrees and careers. In addition, such institutions encourage the importance of obtaining supportive and cooperative peer relationships, all of which promote academic achievement.<sup>6</sup>

Relatedly, community of support was found to be a significant protective factor in Black women’s attainment and academic achievement in STEM. In pursuing advanced degrees and careers in STEM, previous studies have found that family support, intrinsic motivation, perseverance, and teacher encouragement served as the main factors in STEM persistence for Black women.<sup>17</sup> Consistent with previous literature, in this study, faculty, family, and peer support were reported to be the largest support streams that influence Black women’s success in STEM. According to Sanchez and colleagues,<sup>55</sup> Black women in STEM face many challenges because they are underrepresented and do not have enough support such as access to mentors. These findings align with the findings of the current study because participants expressed the importance of faculty support and mentorship in their confidence in STEM (science identity), and their willingness to persist in STEM. In further support, strong

peer mentoring has also been found to be a positive mechanism that strengthens Black women's retention in STEM.<sup>6,56,57</sup> In conclusion, support was found to be a significant protective factor in maintaining Black women's persistence and motivation in STEM.

Finally, STEM learning barriers, such as unfavorable learning, which is a learning style that negatively impacted the participants, was also a major theme that arose during the focus group interviews. Participants in the current study emphasized their dissatisfaction with their learning style and accessibility to their instructors, mainly throughout the COVID-19 pandemic. A study conducted by Wester et al.<sup>58</sup> found that during COVID-19 remote learning, there was found to be a significant decline in attitudes toward science, meaning that students felt like their skills weakened throughout the pandemic, and there was an overall negative shift in engagement. Furthermore, these variables, also considered social stressors, were found to contribute to the decline in an individual's mental and physical health<sup>59</sup>. However, despite these challenges, it was found that Black women persisted in their discipline through community support, which was found to be the primary protective factor in the academic achievement of Black women in STEM<sup>60</sup>. In conclusion, the COVID-19 pandemic served as an additional barrier to Black women's STEM experiences.

## Limitations

Despite the strength of the research design, this study has a few limitations. First, the preliminary study consists of Black women in only two STEM majors at one HBCU. Due to the study being exploratory, there were only three participants, and the findings may not reflect a representative view of other Black undergraduate women majoring in STEM at a women's HBCUs. Secondly, the data collection method being a focus group interview could have impacted how the participants answered the questions presented. Social desirability could be a potential limitation, which is the idea that individuals answer based on socially acceptable answers as opposed to their true feelings. For example, in the focus group interview being in a group with other participants may take away participant speaking time, causing them not to share their honest opinion freely.

Furthermore, this could cause bias as sharing in groups can influence their answers. Nonetheless, through the strategic research design, this study provides insights into the relationship between identity and academic achievement in STEM among Black female undergraduate students at HBCUs.

## Future Research and Implications

There are a few implications for this study. First, future research should build on and consider the insights of the participants in this study. At the institutional level, researchers and stakeholders should explore how institutions can make sure Black women are confident, embraced, and feel seen while being STEM majors. This can be done by implementing intervention and educational programs such as STEM clubs led by Black or Black women STEM faculty. Such programs would allow Black women STEM majors to feel a sense of comfortability in the STEM field at their school.

Additionally, developing such strategies in assisting Black women with reducing the barriers they face (such as finding their science identity) could positively contribute to Black women's STEM experiences. As an example, the implementation of STEM events on campus that cater to Black women, such as panel discussions. This would allow Black undergraduate women in STEM to network and possibly find a mentor or role model. Atkins et al.<sup>61</sup> emphasized, after conducting a qualitative study, that mentorship in STEM plays a huge part in one forming their science identity as well as viewing themselves as scientists. It is important that institutions have appropriate faculty members who want nothing but the best interest of Black STEM students. This could be accomplished by faculty of color or other allies such as diversity program coordinators that can help Black undergraduate women navigate STEM. Atkins et al.<sup>61</sup> also found that students strongly resonated with mentors with whom they shared demographics or values with. A particular recommendation is that each student be assigned to an engaged STEM advisor that they can connect with early in the degree progress. Regarding Black women's K-12 educational experience, future research should also explore ways to ensure the preparedness of Black women interested in pursuing STEM majors. As such,

pre-college prep could be implemented by requiring Black women interested in STEM majors to participate in a summer STEM prep program at their institution in order to promote readiness before starting undergraduate studies. This will allow future STEM pursuers to get a sense of college-level STEM courses and possibly receive credit that will put them ahead in their degree progress.

Lastly, regarding support, it is critical that Black women have the support of others, especially family and friends, as they progress in STEM. Families and friends can better support their STEM scholar by serving as a source of encouragement by making themselves aware of negative stereotypes about Black people and women in STEM. This could help foster a sense of belonging for Black women knowing there is someone rooting for them.

## Conclusion

The current study found that Black women matriculating through STEM at an HBCU experience identity challenges such as imposter syndrome and additional learning barriers related to their gendered racial identity, which was found to influence other factors such as their science identity. However, despite these barriers, resilience factors such as a community of support and the HBCU context were found to strengthen this persistence in STEM among Black women. As with previous literature, the current study emphasized the importance of strong peer relationships, family relationships, and faculty-student relationships in the success of Black women in STEM. Based on the results of the current literature, more institutions should adopt policies and characteristics that promote academic and psychological readiness among Black women students to influence persistence and academic achievement in STEM courses and careers.

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