Invisibilized Hypervisibility: Black STEM Doctoral Students, HBCUs, and Mentoring

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Abstract

Background: Even though Historically Black College and Universities (HBCUs) make up only 3% of higher education's institutions, they play a pivotal role in producing Black scientists by virtue of the fact that many received either their undergraduate or doctorate degree from a HBCU. HBCUs are credited with providing a more supportive and nurturing environment that thrives on communal mindsets and practices, emphasizing the importance of relationships, offering opportunities for Black students to "see themselves" as part of the academic and social milieu whereas Historically White Institutions (HWIS) are characterized as being hostile and discriminatory.

Mentoring is said to be pivotal in the attainment of the PhD. Mentorships have an inherent gatekeeping mechanism, better positioning those who receive effective mentorships while disadvantaging those who do not. It has potential to harm and marginalize when not engaged with deliberate care and a culturally liberative mindset. Mentoring, when not under the thumb of colonizing mindsets, can contribute to more equitable experiences and outcomes for students who hail from AGEP population groups. Literature has indicated that Black students are less likely to have a mentor or be engaged in effective mentorships.

The HBCU narrative of supportive environment is consistently told but has scant empirical validation for Black students pursuing STEM doctoral degrees. In fact, the lure of having faculty and peers who look like you is something of an enigma given that even at HBCUs there are limited numbers of Black faculty in STEM. How are same race, same gender mentorships attained when, not unlike their HWIS counterparts, HBCU STEM faculties have a large number of White and Asian men? If the environment is indeed different at HBCUs, is it different for Black STEM doctoral students? Is STEM doctoral mentoring at HBCUs emblematic of anti-Blackness or is it yet another tool used to oppress marginalized students?

Theoretical Framework: Anti-black racism and critical capital theory serve as critical theoretical frameworks and were selected because they highlight the ways violence is enacted through taken for granted colonized practices such as mentoring. Fanon understood that thoughts and mindsets are the progenitors of violence and dehumanization is the process through which violence is enacted. Anti-black racism and critical capital theory can be useful in unearthing the structural inequalities that uphold the current system in place for STEM doctoral learning.

Research Design: An embedded multiple qualitative case study research project sought to understand the nature and quality of STEM doctoral mentorships at an HBCU. The analysis on the HBCU subcase asked, how are STEM doctoral mentorships understood by Black STEM doctoral students at HBCUs? Black STEM HBCU students were interviewed and completed a mentoring competency assessment survey. In addition STEM doctoral students from three universities also completed the survey. The qualitative data was analyzed using narrative analysis and the survey data was analyzed using descriptive and inferential statistics. This project is part of a larger NSF AGEP sponsored research study.

Research findings: The findings from this study expose that Black STEM doctoral students at HBCUs have not reached the proverbial Promise Land. In spite of being in a space that is more diverse, they manage to simultaneously be invisible and hypervisible. An unmerited sense of assumed cultural belonging was highlighted with students reporting a lack of selfethnic reflectors in their programs. In many ways the systemic and institutional structures on HBCUs with respect to STEM doctoral programming mirrored the colonial structures more often associated with HWIS. Their culture and cultural-based experiences as domestic students as well as their academic strengths were often not recognized by mentors while that of international students were. Three themes were supported by the data: Conspicuous Absence, Race Still Matters, and Invisibilized Hypervisibility.

Implications: Better understanding how STEM doctoral mentoring is facilitated at HBCUs holds the promise of informing a mentoring practice that supports cultural liberation instead of cultural degradation and suppression. It becomes one avenue as the "The Call" suggests to "confront our own complicity in the colonial enterprise" by holding STEM doctoral mentors and the institutions they represent accountable for socially just mentoring practices. Greater intentionality as well as mandated training informed by the study's results are recommended. HBCU faculty doctoral mentors are challenged to be scholar activists who engage mentoring from an advocacy and accomplice framework. The development of STEM scholar activists is the aspiration of more culturally liberative STEM doctoral mentorships. Black students need mentors who are willing and equipped to be advocates and accomplices in their success.

Introduction

Historically Black Colleges and Universities (HBCUs) have a long history of providing educational opportunities to Black students [1]. There are just over 100 HBCUs operating today, a number representing half as many as previously existed. Cheyney University, which was initially named the African Institute then the Institute for Colored Youth, was established in 1837 in Pennsylvania and is credited with being the first HBCU. However, Lincoln University, founded in 1854 under the name The Ashmun Institute, was the first designated to award college degrees [1]. Just two years later, Wilberforce University was founded with the distinction of being the first Black owned and operated university [1]. The mission of these forerunners has been the blueprint for the many HBCUs that followed in their wake: make education accessible to students of African descent. Before desegregation, HBCUs were the only viable options for earning a college degree available to most Black students and were responsible for educating the majority of the Black leaders of the day.

There are both public and private HBCUs, with public HBCUS enrolling the most students. While domestic Black students comprise the largest population enrolled, close to 25% of enrollment is accounted for by International and other non-Black students [2]. The majority of all HBCUs are baccalaureate degree granting institutions that do not offer a research doctorate. In spite of this, HBCUs play a pivotal role in producing Black scientists [3], [4], [5]. HBCUs are credited with graduating 18% of all Black science, technology, engineering, and mathematics (STEM) baccalaureate students [7], in spite of making up only 3% of higher education's institutions [6], having smaller operational budgets than most Historically White Institutions

(HWIS) [5], and having markedly smaller enrollments [5]. Further HBCUs account for 21 of the top 50 institutions who have Black students graduating with baccalaureate STEM degrees who subsequently earn a doctorate in STEM [5]. Thirty percent of all Black STEM students who receive a PhD from any university are alumni of a HBCU STEM undergraduate program [7] and 10% of all STEM PhDs graduate from HBCUs [6]. This is significant given the underrepresentation of Black people in STEM fields. Toldson [5] noted that Black students "are significantly less likely than White Americans, Asian Americans and Hispanic Americans to earn doctorates in life sciences, physical sciences, mathematics and computer science, and engineering."

Researchers [3], [5], [8] have explored the why and how of the success of HBCUs in ensuring representation of Black people in the STEM field. Characteristics often cited as critical include better relationships with faculty [3], [5], [8], a higher sense of belonging [3], [5], [8], command of social capital [3], and less academic pressure [5], [8] as compared to HWIS. HBCUs are celebrated for providing a more supportive and nurturing environment that thrives on communal mindsets and practices while emphasizing the importance of relationships, and offering opportunities for Black students to "see themselves" as part of the academic and social milieu [9] whereas HWIS are characterized as being hostile and discriminatory.

Overall HBCUs were found to be structurally different [3], [5] because of the higher concentration of Black students who attend that reduced feelings of isolation through peer relationships [3], teaching requirements that created increased opportunities to connect faculty with students [5], presence of more Black faculty and administrators which provided selfethnic reflectors [10] and cultural validation through pedagogical choices that support cultural liberative aims, community building, and hands-on experiences [3]. Effective mentoring relationships [3], [5] and developmental versus punitive policies that bolstered student support [3], [5], especially for those entering with "less academic preparation and resources" [5], were also beneficial characteristics. Taken together, the characteristics set the stage for a welcoming and nurturing environment wherein

> relationships between faculty and students at HBCUs show that faculty have a genuine concern for the students' well-being via true support and understanding. Students from HBCUs report that faculty are sensitive to their needs, notice their talents, closely mentor them, encourage them to attend graduate school, and care for each of them as a unique individual, not just another student. [3]

Black student success at HBCUs is predicated on how HBCUs curate experiences for the Black student population. Much of the research on HBCU characteristics that support the success of Black students centers on undergraduate experience, less is known about STEM doctoral experiences of Black students at HBCUs, especially in terms of mentoring. In this paper we explore the mentoring experiences of Black STEM doctoral students at a HBCU.

HBCUs and STEM Doctoral Programs

The extant literature, as others have suggested [11], [12], revealed little about the experiences of Black doctoral STEM students enrolled in STEM programs housed at HBCUs. It was even

challenging to find statistics that highlight Black STEM student enrollment in HBCU programs or Black STEM faculty appointments in doctoral programming. Using a wide range of search terms, in isolation or combination, often led to articles and books highlighting undergraduate experiences. A notable exception was McGee et al. [13] whose study included Black PhD students in STEM attending HBCUs and offered a disaggregated look at their experiences. Black students are often viewed from a deficit frame and less often experience *belongingness* in their department due to having few peers or faculty who look like them. Black STEM doctoral students and Black STEM faculty make up a small number of all STEM doctoral students and STEM faculty but generally have greater representation at HBCUs. McGee et al. [13] indicate that the phenomenon of being one of few and being viewed as inferior are racialized stressors that "take an emotional, psychological, and physical toll", a by-product of John Henryism, a negative coping strategy of trying to prove your worth by overworking and over compensating. Like John Henry, Black STEM doctoral students may graduate, but leave their institutions feeling jaded and dissatisfied as a result of diverting energy from other areas of their lives, including wellbeing, in order to survive the oppressive learning environments in which they found themselves. Many aspects of Black students' doctoral experiences may suffer including mentoring relationships that have been found to be critical to successful doctoral degree matriculation and academic progress [14], [15], [16].

McGee et al.'s [13] review mirrors others [11], [12], [17] who have explored the experiences of Black STEM doctoral students at HWIS. but what surprised the researchers was that Black STEM doctoral students from HBCUs had similar experiences. What was most telling was the similarity between experiences of Black STEM students at HBCUs and HWIS. HWIS are often castigated for their racially inhospitable environments and anti-Black racism attitudes which are visible in their practices, policies, and dispositions, both institutionally and personally. In spite of the overall student body and faculty "looking like them" their departments did not. The environmental culture of their departments was enshrined in anti-Black racism and prejudice. More specifically McGee et al. [13] found HBCU STEM "departments' microcultures had similar characteristics: high numbers of international Asian and White students and faculty; a competitive, even cutthroat environment; overburdening of the few Black STEM faculty with serving and mentoring students of color; and the segregation by race of study and laboratory groups."

Black doctoral STEM mentoring experiences at HBCUs were also challenging to find in the extant literature. Boykins [11] research, while not specific to STEM doctoral study at HBCUs, drew from Fountaine's [18] conceptualization of internal, external, and advisor engagement, each of which speak to positive and strong connections to the faculty. Those findings were echoed by Griffin et al. [19]. Alston et al. [17] explored the experiences of Black men, US and foreign born, with mentoring at HBCUs in STEM. Alston et al. [17] found that Black men overall were satisfied with their mentoring experiences, in terms of career preparation, even those with mentors whose cultural backgrounds were different than theirs which was what the majority experienced. Their participants, on the other hand, also expressed that their mentoring relationships did not always live up to their expectations, suggesting that the lack of Black men STEM mentors constricted developing more potentially satisfying mentorships. "Even on the HBCU campus, STEM environments do not appear welcoming by way of being spaces in which African American males find role models with their demographic" [17]. The HBCU narrative of

a supportive environment is consistently told but has scant empirical validation for Black students pursuing STEM doctoral degrees [20]. In fact, the lure of having faculty and peers who look like you is something of an enigma given that even at HBCUs there are limited numbers of Black faculty in STEM. How are same race, same gender mentorships attained when, not unlike their HWIS counterparts, HBCU STEM faculties have a large number of White and Asian men? If the environment is indeed different at HBCUs, is it different for Black STEM doctoral students? Is STEM doctoral mentoring at HBCUs emblematic of anti-Black racism, is it yet another tool used to oppress marginalized students?

Theoretical Framework

These are questions raised when anti-Black racism [21] and Critical Capital Theory [22] serve as critical theoretical frameworks. These frameworks were selected because they highlight the ways violence is enacted through taken for granted colonized practices such as mentoring. Fanon [23] understood that thoughts and mindsets are the progenitors of violence and dehumanization is the process through which violence is enacted. Anti-Black racism and Critical Capital Theory can be useful in unearthing the structural inequalities that uphold the current system in place for STEM doctoral learning.

Bancroft's [22] concept of Critical Capital Theory combines "critical race theory, forms of capital, and fictive kinship" to understand and articulate how capital is weaponized and used as a shield for anti-Black racism and white supremacist ideology. Bancroft's [22] theorization suggests that the experiences of Black STEM doctoral students are the natural, and to be expected, by-product of colonizing practices in higher education like mentoring. Processes of racialization are enacted through everyday practices in colleges and universities because those engaging the practices hold deficit views propped up by anti-Blackness sentimentality.

Anti-Blackness, as explained by Gordon [21], creates social imaginaries of Black people in which they are deemed inferior and nonhuman. This impacts how Black people are seen and understood, a seeing that is often viewed through lenses shaped by media, narrowed personal experiences, and unconscious fear of losing privilege and power. Anti-Blackness is a theorization of Black humanity as predicated by white supremacy and seeks to push back against narratives of Black inferiority. Anti-Blackness Theory demonstrates how anti-Blackness is a vehicle for erasure, marginalization, and dehumanization. Taken together Critical Capital Theory and anti-Blackness help to deconstruct the lived experiences of Black people in ways that are authentic and validating.

Research Design

A multiple embedded qualitative case study research study [24], [25] was employed using a semi-structured interview and a survey as methods to understand STEM doctoral mentoring across three institution types. To better understand how Blackness was experienced in STEM doctoral mentoring by Black STEM doctoral students at a HBCU, a subset of the data was examined. For this subset case, we asked in what ways are Black STEM doctoral students mentoring experiences at a HBCU racialized? All participants were STEM doctoral students enrolled in departments participating in a National Science Foundation (NSF) Alliance for Graduate Education and the Professoriate (AGEP) funded program. Students from any of the

three universities' participating departments were invited to complete the Mentoring Competency Assessment developed by the University of Wisconsin at Madison Institute for Clinical and Translational Research [28], a quantitative survey, to help understand their mentoring experiences. At the conclusion of the survey, students were invited to participate in a qualitative interview. AGEP population doctoral students - African American/Black, Latine/Latina/Latino, Native Pacific Islander, Native Hawaiian, and Native Alaskan recognized as systemically underrepresented in STEM by the National Science Foundation - were also invited directly by email to participate in an interview. The interviews of the HBCU Black STEM doctoral students were extracted from the larger data set for separate analysis. The survey data includes student data from all of the universities to provide a broader context for the interview data, but there were comparisons between a variety of subgroups (i.e., HWIS v. HBCU and HBCU AGEP v. HBCU International).

Qualitative Interviews

Nine HBCU Black STEM doctoral students (six women and three men) representing a range of STEM doctoral programs were interviewed and completed the survey. Semi-structured interviews were conducted using Zoom, a video conferencing platform, were recorded, and later transcribed. Participants were assigned pseudonyms by the researcher to maintain anonymity. Two broad topics were covered: characteristics of effective mentors and mentorships, and role of culture in mentorships. Prior to engaging the interview protocol, demographic data was gathered such as race, gender identity, and program name. The 15-question interview protocol included items such as how do you define mentoring, do you have a faculty mentor, what have your experiences with STEM doctoral mentoring been like, and what is the role of culture in a mentorship. Average duration of the interviews was 60 minutes. Students who participated in the interviews received a $25 gift card.

The qualitative interview data was analyzed using narrative analysis [26] which involves attention to social circumstances (context) and as well behaviors and perceptions (content). Merriweather et al. [27] described the narrative analysis process as

> listening to the digital recordings and reading the transcripts to become more intimately acquainted with the data. A process of memoing and notetaking accompanied later readings to help summarize and outline the stories within the transcripts and to highlight recurring patterns as well as our thoughts. Salient patterns were named as categories and similar categories were merged to create themes. A spreadsheet was used to help organize the data.

Mentoring Competency Assessment Survey

STEM doctoral students from two HWIS (HWI-Flagship and HWI -Regional) and one HBCU were asked to complete the Mentoring Competency Assessment (student version) in Spring 2021 to provide a holistic understanding of their mentoring experiences. A total of 137 responses were collected, including from the 9 Black HBCU students. Respondents from the HWI-Regional (n = 44), HWI-Flagship (n = 60), and HBCU (n = 33) were compared using only a dichotomous grouping: HBCU (n = 33) and HWIS (n = 104). For the HBCU, 10 of the respondents are AGEP,

21 are international students, and 2 are other (which includes White and Asian individuals who are American). Demographic information for the two groups (HBCU and HWIS) is presented in Table 1. For the HBCU, there is a higher percentage of male and First-Generation participants than their HWI counterparts. Specifically, regarding the 33 respondents from the HBCU, 20 are First Generation students and 21 are males. There is also a different representation in age groups, 73.1% of the respondents from PWIS were 21–30-year-old participants in contrast to 33.3% from the HBCU.

Table 1

Demographic Representation at HBCU (n = 33) and HWIS (n = 104)

Demographic	HBCU (%)	HWIS (%)
Gender		
Female	36.4	49.0
Male	63.6	47.1
Prefer not to report/Missing	0	3.9
AGEP Status		
AGEP	30.3	17.3
International	63.6	40.4
Other	6.1	42.3
First-Gen		
Yes, First Gen	60.6	25.0
No, Not First Gen	39.4	75.0
Age		
21-30 years old	33.3	73.1
31-40 years old	48.5	23.1
41-50 years old	15.2	3.8
Prefer not to report/Missing	3.0	0

Note. Data is collected from the Spring 2021 distribution. HWIS = HWI-Flagship and HWI-Regional.

The student survey consisted of demographic questions and the Mentoring Competency Assessment for mentees. The MCA consists of six constructs to measure mentoring competency skills: maintaining effective communication, aligning expectations, assessing understanding, addressing diversity, fostering independence, and promoting professional development. Students completed the survey to evaluate the different skills of their mentors based on the 26 individual statements using a seven-point Likert-type scale—where 1 = "not at all skilled", 4 = "moderately skilled", and 7 = "extremely skilled", with a non-applicable option available. For the analysis, a total mean score was found for each of the six constructs for each participant. The mean and

standard deviations for each of the six constructs for the HBCU and HWIS are displayed in Table 2. Using the total mean scores, a Mann-Whitney U Test was completed to compare student responses based on their university (HBCU or HWI) to look for any differences in their perceived mentoring experience.

The *maintaining effective communication* construct had six statements, which included: "How skilled is your formal doctoral advisor in active listening". The *aligning expectations* construct included five statements, such as inquiring about personal and professional differences in expectations. The *assessing understanding* construct included three statements, such as seeing if there was an enhanced understanding in research. The *addressing diversity* construct included two statements, and they included asking personal backgrounds and potential biases. The *fostering independence* construct included five statements, such as seeing if there was acknowledgement for their contribution. Lastly, the sixth construct, *promoting professional development*, included five statements, such as inquiring if they received help towards their career goals. [28]

The quantitative analysis using the MCA is limited due to the small sample size for the HBCU. The small sample size did not allow for statistical analysis based on subpopulation (AGEP, International, and Other) disaggregation. The disaggregation would have been key to better understanding the experience of the AGEP STEM doctoral students. However, the means of the HBCU institutional subgroups are presented to provide a basic descriptive comparison. It is recommended to repeat this analysis with additional universities for a larger sample size and a better representation of HBCUs and AGEP STEM doctoral students, particularly HBCU Black STEM doctoral students.

Research findings

The findings from this study expose that Black STEM doctoral students at HBCUs have not reached the proverbial *Promise Land*. In spite of being in a space that is more diverse, they manage to simultaneously be invisible and hypervisible. The sense of cultural belonging highlighted in literature was unmerited with students reporting a lack of selfethnic reflectors [10] in their programs. In many ways the systemic and institutional structures at HBCUs with respect to STEM doctoral programming mirrored the colonial structures more often associated with HWIS. Their culture and cultural-based experiences as domestic students as well as their academic strengths were often not recognized and were frequently dismissed by mentors while that of international students were acknowledged and praised. Before presenting a summary of the themes emanating from the qualitative interviews, the survey analysis data will be presented to provide a base understanding of mentoring as experienced across the three institution types.

Although there are some key demographic differences between gender, first generation status, and age representation (Table 1), there were no statistically significant differences found from the Mann-Whitney U Test for comparing the HBCU and the HWIS responses for each of the six constructs in the MCA: (*maintaining effective communication*, $z = -0.196$, $p = .845$; *aligning expectations*, $z = -0.309$, $p = .757$; *assessing understanding*, $z = -0.697$, $p = .486$; *fostering independence*, $z = -0.761$, $p = .447$; *addressing diversity*, $z = -0.029$, $p = .977$; and *promoting professional development*, $z = -0.555$, $p = .579$). This indicates that there is not sufficient

evidence to indicate different mentoring experiences for students attending a HBCU or HWIS based on student responses. When comparing the values shared in Table 2 below, the means and standard deviations for each construct are similar when comparing between the HBCU and HWIS. This supports the findings from the Mann-Whitney U Test that the differences between both groups are not significant. Overall, mentees at both types of institutions are reporting positive doctoral mentoring experiences.

Table 2

Mentoring Experiences at HBCU and HWIS

Constructs by Subgroups	n	M	SD	Mdn
Communication				
HBCU	33	5.64	1.42	6.00
AGEP	10	4.52	1.20	4.17
International	21	6.06	1.28	6.83
HWIS	104	5.66	1.40	6.00
Expectations				
HBCU	33	5.57	1.60	6.20
AGEP	10	4.51	1.46	4.40
International	21	5.95	1.50	6.75
HWIS	104	5.56	1.51	6.00
Understanding				
HBCU	33	5.61	1.66	6.00
AGEP	10	4.47	1.62	4.67
International	21	6.03	1.49	7.00
HWIS	104	5.61	1.35	6.00
Independence				
HBCU	33	5.40	2.02	6.60
AGEP	10	3.73	1.79	3.67
International	21	6.07	1.75	7.00
HWIS	104	5.52	1.59	6.00
Diversity				
HBCU	30	5.58	1.79	6.25
AGEP	10	4.75	2.23	4.50
International	18	5.89	1.45	6.25
HWIS	104	5.68	1.71	6.25
Professional Development				
HBCU	33	5.33	1.97	6.00
AGEP	10	3.65	1.97	4.20

| | International | 21 | 6.03 | 1.55 | 6.80 |
| | HWIS | 104 | 5.41 | 1.56 | 6.00 |

Note. Data is collected from the Spring 2021 distribution. HWIS = HWI-Flagship and HWI-Regional. For the HBCU, AGEP (n = 10) and International (n = 21) subgroups are provided. "Other" was not included due to small sample size.

Within Table 2, looking at two subgroups of students (AGEP and International) at the HBCU allows us to see the bigger picture. Based on the responses from the HBCU, AGEP students (n = 10) overall had lower mean scores for each construct than the International students (n = 21). This survey finding, which merit the need for continued exploration given the limited sample sizes for each subgroup, suggests that AGEP student experiences differ from their White, Asian, and International counterparts in HBCU STEM doctoral programs. Consistent with the survey findings, the interview analysis, which included only Black STEM doctoral students at a HBCU, suggests that mentoring experiences in STEM doctoral programs are less than ideal and are infiltrated by anti-Blackness and racialization. Three organizing themes emerged: *conspicuous absence, race [still] matters*, and *invisibilized hypervisibility*.

Conspicuous absence

Conspicuous absence speaks to the scarcity of domestic Black students studying in STEM doctoral programs and domestic Black faculty teaching in them. Each of the nine interview participants noted the absence of Black people in their programs. The campus was majority Black but not one of the STEM departments was. Black STEM doctoral students were disheartened by the dearth of Black faculty and peers in their departments. The phrase "someone who looks like me" was invoked multiple times across the interviews when mentioning the challenge of finding a mentor in their department who shared their racialized identity. Scarcity of Black STEM faculty was evident to the students, hanging thick in the air, but seemed like the elephant in the room that went unnoticed by non-Black students and faculty. Diversity has been touted as part of the richness of HBCUs, a richness that results in a broadening of horizons, so it seemed ironic to the students that their Blackness was not really part of the STEM doctoral landscape. This is supported by the survey demographics, only nine of the 33 respondents were Black, an absence that was as noticeable on our spreadsheet as it was for students navigating the Ivory Towers.

LaQuieta, Joshua, and Jabez all noted the importance of their intersectional identities and gravitated toward same gender identity-same race mentoring relationships. Alexis said

> It's really hard to come across other females, even more so Black females in technology. So, when I come across those people, it's something that I grab onto because a lot of the things that I'm going through, they have been through and could offer good guidance, right? It's something pretty much, most of my mentors over time have been women, Black females.

LaQuieta was a unicorn in this study as she expressed satisfaction with her mentoring relationships and she was able to cultivate that with two Black women faculty on her campus,

one who served as her research advisor and the other who served as her mentor, but she realized that most of her Black peers were not as fortunate. She indicated that they did not have mentors. Joshua also indicated that he had a mentor but his research advisor and mentor was a Middle Eastern man.

Joshua exclaimed "I would have loved to work with another Black man, but not one" was available. His preference was to have a Black man research mentor and research advisor but there were none on faculty in his department. In fact, Joshua exclaimed "there were only two brothers in the whole college!". His experiences within his department led him to seek mentorship outside of his department.

> Because I know I didn't want to go with anybody in my actual department. I can work with anybody else at the university. I don't have to work with somebody that's in my department…The whole reason I came to A&T is to work with people that look like me or problems that affect people like me.

Alexiss' faculty mentor is a Black man from a different department but described how surprising it was to many she knew that Black faculty, particularly in STEM, were in short supply.

> So, it's a totally different department. He was the only Black faculty member in that department, and I was in his lab. So, it was interesting because no one believed me when I'm like, "Yeah. At an HBCU, faculty members aren't all Black." So, I just wanted to finally be under someone who looked like me where I'm so used to seeing people who don't and don't understand where I'm coming from, things that I've been through as just a Black person in general and that was sensitive to the topics that were going on in the world.

Based on comments from Alexiss, Joshua, and others, the lack of Black STEM faculty at a HBCU is one of the *world's best kept secrets*. Students nor their communities were aware of how few Black STEM faculty would be available to them at their HBCU.

Alexiss nor Iyanna, who does not have a mentor at her HBCU, cannot make sense of the narrative of why it is so hard to recruit Black STEM faculty into a HBCU. Only slightly amused, Alexiss remembered that a previous department she had been enrolled in hired

> Two White men, one of which came out of retirement for this, and I'm just like, there were plenty of professors that were here that you could have chosen from, but you chose someone who was already retired. It's just crazy to me. But again, what do I know? I'm just a student.

These students' stories of conspicuous absence were revealing of the racialized underside of STEM doctoral mentoring at HBCUs. They desired same gender identity, same race mentorships or at the very least same race. It is clear based on these testimonies that race *still* matters.

Race *still* matters

In various ways the Black STEM students in this study acknowledged how race occupies space and place in ways viewed as instrumental to their success. Whether it is attending to societal dysfunction or being able to connect in meaningful ways to how they have been racialized and minoritized, Black STEM doctoral students yearned for their mentors to be "woke", to be aware that race still matters. It was the awareness and acknowledgment that earned the respect of students. This seemed to happen naturally for those students who had Black mentors either inside or outside of their universities.

Mykyra did not have a mentor from within her university, bluntly stating "I can't say that I have a mentor at my university". Like most, she had a university-based research advisor who was a man and International faculty. She relied on a mentorship she developed with a Black woman faculty who worked at another institution. While her university-based research advisor provided her with useful academic tips, her Black woman mentor provided insights for navigating STEM as a Black woman that included but went beyond academic navigation.

> It could be relationships that they have with someone that may be doing the job that you're doing, or maybe connecting you with people, or giving insight into things that they have knowledge about, that you as an apprentice coming up in that field may need to be privy to, and not just limited to things that apply to the job, but social aspects of the job, how to move and maneuver around working in a male dominated field, being the only African American person working in a room with multiple other ethnicities, or even just one and just really understanding the responsibility that comes with that a lot of times and certain things like that.

Zoey currently does not have a mentor and has fraught relationships with her research advisor who does not share her racial identity. She described a discriminatory experience she had while in the field, and the even more troubling response received from the female research advisor who was dismissive of the experience. For Zoey obtaining a STEM doctoral degree was traumatic on many fronts. Zoey would have liked to have had a mentor she could trust to help her navigate the challenges that accompanied being a Black woman in STEM. Instead her research advisor in her opinion

> needs to know how to work with Black students and with these types of issues, maybe to help her understand and come out of her box or shield or whatever, and recognize her refusal to acknowledge what she's doing.

Keigan called this type of behavior insensitive and feels insensitivity to the Black culture and experience is pervasive across her HBCU campus STEM departments. Alexiss also regularly experienced insensitivity from her research mentor who is not Black, recalling a time that he assumed she came from a single-family home and a time when a White woman was surprised to learn how invested she was in STEM outreach to her community. She doubts that the woman's privileged upbringing with access to STEM activities and people engaged in STEM allowed her to fully grasp why it was so important. Faculty mentors at HBCUs, in particular, should have awareness and sensitivity to issues confronting the Black community. Joshua indicated that should be part of an advisor's duty.

Just given what's happening in the world, I'm going to want to say some things as a Black man in this world and HBCU that I feel like I should be able to say to whoever's on faculty, no matter what their color is. That's going to help me get through this dissertation. I'm going to look at it as part of your advisor duty. Is that something that you can handle? …Because as a Black man, this world just won't give me no peace.

Jabez was more forthright. Though he was able to connect with a Black man to serve as his faculty mentor, he also had to go outside of his department to locate him. He feels fortunate because he feels that his Black faculty mentor "understands" what it means to be embodied in a Black skin and male form in a STEM doctoral program. He feels overall that most faculty, especially the international faculty are not prepared to mentor Black men. He discussed how he has been perceived as super aggressive for simply being confident.

Well, for African-American male I do know I run into situations where I'm perceived as super aggressive or dominant at times. I also know some of my African-American female colleagues are perceived the same way. And it's not necessarily that we're going out of our way to do it, if we are just being confident that culturally that's the thing you have to think of. Culturally you don't know if these people [non-Black faculty], their perception or description of what African-American is is based off of TV or based off of limited interaction. So when they do see you against the mode or not in their stereotypical box, I use the term again, [it is like] ringing the bell because it kind of triggers. So yeah, they deem it all very super aggressive, conflict. What they tag us as a lot in our department is problem student.

Jabez followed up by describing how one Asian faculty interacted with Black men. In reaction to a disagreement about a paper, this faculty began

insulting me, talking about my family, talking about the person I was dating at the time. And when I got up to say this is not getting anywhere, he ran over and got in my face. So there.

Joshua also concurred that this same faculty member was particularly problematic, deeming him a trash professor.

Moreover, every Black male has an experience with him that he has said some really off the wall stuff that under another circumstance would get him popped outside of the university and this classroom. That's what I mean by trash.

These narratives speak to the legibility of their Blackness. It was startling to learn that many faculty in STEM still function from the color-blind bind as if not acknowledging race makes their behaviors, perceptions, and dispositions neutral. Mykyra feels this approach is a disservice to Black students like herself.

I just feel especially being on a historically Black college campus, that there are some things that you [faculty] should just go ahead and try to brush up on because you're going

to be interacting with a lot of people who identify with the Black culture. And so it's just some things that have to be learned.

This sentiment was also voiced by Zoey who said faculty pick their college, insinuating they knew that a Historically Black College or University would require engaging Black culture in a meaningful way. But given that a sizeable portion of faculty and students in STEM at HBCUs are from other international locales like Asia and the Middle East in particular, it may be that at best those faculty do not see a need to better connect culturally with Blackness. Or worse case scenario, they may feel validated in being dismissive and in denigrating Blackness because they can function within their own cultural cocoons, seeing and working with people who look like them daily.

The themes of conspicuous absence and race *still* matters provide foundational understanding for the theme of invisibilized hypervisbility.

Invisibilized hypervisbility

Invisibilized hypervisbility is feeling invisible despite their hypervisibility of being one of few Black students in their programs. A recurring frame was not being seen or respected. For a myriad of reasons, the Black STEM doctoral students in this study felt invisible and believed that effective mentorship would have helped to mitigate those feelings. Those students who had Black mentors attested to the power of that relationship. I'rel currently has a Black female mentor but previously his mentor was a South Asian man. He liked his first mentor but felt that under the mentorship of the Black woman that he was empowered to "bring myself to the academy" because she was more inviting, comforting, and understanding of his perspective. LaQuieta indicated "It is a little easier for me, at least I think, to have a mentor that I really could relate to". Jabez described it as not having "to hold that part [culture and race] out" of his interactions in his STEM doctoral mentorship.

Alexiss and others voiced what it was like to not have that level of support, she said

> So, it's like I notice that I have to, I guess, tread lightly with some people instead of just being myself unfortunately because of my Blackness, and it sucks because it's like at an HBCU. You should be used to this…. But some of them [faculty] are very uptight about it. It's been constant back and forth and it just brings me back to high school where I had racist teachers to fail me purposely because I was smarter than White students or purposely not call me by my name because they feel like my name was too White for my color, little things like that. It's just like, here we go again, and this time, it's HBCU edition.

These types of experiences when confronted without buffering from engaged mentors produce trauma, loss of self-confidence, and anxiety, causing some to feel invisible. Zoey just flat out said "I just feel very invisible as a Black woman in STEM at my HBCU". Similar to Zoey, Mykyra experienced and went further in naming it as trauma that requires her to protect herself and Alexis referred to the invisibility as imposter syndrome. "I would maybe at first just constantly be worried about the interaction [if my mentor was a white man]". Intentionality

toward preparing Black STEM doctoral students for the racially fueled oppression and isolation they would inevitably face in STEM was determined to be a key but was not something students dependably received from their cross-racial mentorships. Students with regularity had to leave their departments, colleges, and/or HBCUs to receive this.

Access and availability to Black STEM doctoral mentors or non-Black STEM doctoral mentors who *get it* offset those feelings but too many Black STEM HBCU doctoral students relate that they do not have that access or availability in their department or sometimes not even within their university. Iyanna found great comfort in having faculty that looked like her that she perceived as having her back and best interest at heart. These are things that several students believed international students had: faculty that looked like them, a sense of belonging, and strong advocates who looked out for them. These perceptions have some support from the cross-institutional survey analysis that found no statistical difference between student experiences of mentoring at HBCUs and PWIS, but a comparison of the means between International students and AGEP students (the majority of which were Black students) at the HBCU revealed that the AGEP students consistently provided lower ratings. This suggests that international students at HBCUs may not feel as negatively about their experiences thus scoring their mentorships higher on the survey, lending support to the perceptions of the Black students interviewed in this study who strongly felt that international students were provided a qualitatively different learning experience.

Implications

Many of the findings from this study support themes noted in the existing literature on Black doctoral STEM HBCU students [13], [17], [19]. Similar to those studies, this research found that race *still* matters because being seen matters even in spaces where students are minority majorities. The power of being able to "show up as my whole self" as Joshua shared says to students, *I see you and you matter, all of your being matters*. At the undergraduate level, Rankins [9] determined this to be key for experiences reported as affirming and effective for success. The lack of such experiences for doctoral students suggests, as did McGee et al. [13], that the microculture of STEM doctoral programs is indeed different and was more like that reported at HWIS. Consistent across participants in this study was the desire for more Black faculty in their programs and greater awareness of the ways in which anti-Black racism infiltrates mentoring practice. Hiring practices should be reviewed to determine the system-level factors that inhibit the hiring and retention of Black STEM faculty. Perhaps the presence of more Black faculty, like that experienced at the undergraduate level, could be part of the process of changing the microculture of STEM doctoral programs.

The microaggressive passive assaults on Black bodies must be named and confronted by policy, practice, and culture change. For example, Jabez shared that he and his Black peers were "perceived as super aggressive or dominant at times", which is a result of incorrect stereotypes and misconstrued labels, suggesting greater intentionality by administrators but especially by faculty is needed to eliminate "racialized stressors" [13]. These racialized stressors impacted the quality of Black STEM doctoral students' learning experiences and mentoring relationships. Most clearly communicated were perceptions of anti-Black racism, resulting in a devaluing of Black STEM students' cultural capital. This was evident in the extant research as well [11], [12],

[13], [17]. When the general consensus calls out the need for more representation and culturally liberative training, then change is needed. Culturally liberative mentor training should be ongoing and mandated and should focus on developing competencies for cross-racial/cultural mentorships and dispositions that better honor the cultural personhood of Black students. The STEM doctoral environment should be a place where Black students can embrace their Blackness and have it valued by faculty, administrators, and university policy.

Lastly, scholarship focusing on Black STEM doctoral students and their STEM faculty mentorships at HBCUs should be promoted and supported. It is disheartening the number of Black students who felt forced to look for mentoring outside of their departments and sometimes even outside of the university. Like Alston et al.'s [17] participants, the participants in this study desired more satisfying mentoring experiences but many did not find them in the most likely place, their STEM doctoral program. Effective mentoring incorporates cultural awareness and respect for diversity, leading to asset framing instead of deficit framing, and feelings of belongingness, instead of exclusion. As evidenced in the Mentoring Competency Assessment, professional development opportunities and acknowledgement of mentees' contributions are important components within a mentoring relationship [28]. Black students need faculty doctoral mentors who are willing and equipped to be advocates and accomplices in their success. We recommend a reframing of the STEM doctoral mentorship, one in which culturally liberative practices are commonplace and one in which mentors function as scholar activists. The development of STEM scholar activists is a cultural ethos aligned with the history and tradition of America's Historically Black Colleges and Universities. This cultural ethos demands that faculty honor, support, and encourage the critical capital their Black STEM doctoral students possess as well as recognize the ways in which they may be consciously or unconsciously promoting anti-Blackness in their labs, classrooms, and mentorships. The specific STEM doctoral program culture, not just the overarching culture at a HBCU, needs to be culturally pluralistic, supportive, and receptive. The findings from this study provide a clear picture that work still needs to be done to strengthen the skills, knowledge and dispositions of faculty doctoral mentors who mentor Black STEM doctoral students.

Literature based on undergraduate experiences paint a portrait of HBCUs as utopias that create environments for learning that do not come at the expense of one's culture, environments that are welcoming and supportive. Those experiences do seem to be structurally and culturally different [3], [5], [8] in terms of student composition, Black faculty presence, and feelings of belonging, but these characteristics are not replicated with fidelity or consistency in STEM doctoral programs. Each study [13], [17], [19], including this present one, on STEM doctoral mentoring at HBCUs indicates that structural and cultural change is needed within departmental micro-cultures. Better understanding how Black STEM doctoral students perceive mentoring at HBCUs holds the promise of informing a mentoring practice that supports cultural liberative experiences instead of cultural degradation and suppression undergirded by anti-Black racism. It becomes one avenue, as the call for the Equity and Social Justice division suggests, to "confront our own complicity in the colonial enterprise" by holding STEM doctoral mentors and the institutions they represent accountable for socially just mentoring practices that value Black bodies, Black minds, Black culture, Black history, and Black people. HBCUs cannot afford to pay lip service to this for their Black STEM doctoral students.

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