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BLACK MALES IN STEM: EXPLORING FUTURE ENGINEERING GRADUATE SCHOOL ASPIRATIONS OF UNDERGRADUATE BLACK MEN

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Black males are underrepresented in undergraduate and graduate engineering programs. While a significant amount of research studies have highlighted Black men's challenges in engineering graduate programs, fewer studies have sought to uncover and understand the factors that influence Black males to pursue engineering graduate degrees. As part of a more extensive study, in this investigation we used thematic analysis to understand the factors that might influence 20 Black male engineering undergraduate students to pursue engineering graduate degrees. Although we took an inductive approach to data analysis, we used community cultural wealth to hone our sensitivity to the assets Black males engage in as they pursue advanced degrees in engineering. We developed four themes, which describe what might drive participants' motivations to pursue advanced degrees in engineering in the future: passion for knowledge, financial security and career advancement, early exposure to graduate school, and influence of social networks. The findings of this study may impact intervention design and efforts to recruit and retain Black males in engineering graduate programs.

KEY WORDS: *Black men, community cultural wealth, broadening participation in engineering*

1. INTRODUCTION

In 2012, the Council of Advisors on Science and Technology predicted a deficiency of one million science, technology, engineering, and mathematics (STEM) graduates between 2012 and 2022 (President's Council of Advisors on Science and Technology, 2012). These fields in the United States have struggled to recruit and retain students to fill the growing workforce demand (U.S. News Media, 2016). Furthermore, although increasing the number of students who complete engineering degrees is also a national concern, there needs to be more diversity in all segments of engineering pathways, including graduate programs (Poock, 2007). For instance, Black men only represented 4.0% of bachelor's degrees awarded in engineering in 2019 (American Society for Engineering Education, 2020). The outlook is bleaker among Black males who obtain gradu-

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ate degrees. They account for only 4.8% and 3.5% of engineering master's and doctoral degrees, respectively (American Society for Engineering Education, 2020).

Although there is a growing body of work that has sought to understand the graduate experiences of Black male graduate students and their motivations for pursuing advanced degrees (Burt and Johnson, 2018; Henderson et al., 2022; McGee et al., 2016), learning from Black men earlier in their degree programs (e.g., while in undergraduate programs) will be critical in understanding how to recruit and retain more Black males into graduate engineering programs. Therefore, in this study, we were guided by the following research question: How do undergraduate Black male engineering majors describe their motivations for the future pursuit of engineering graduate degrees?

2. LITERATURE REVIEW

Much has been said about why Black men do not pursue degrees in engineering or the challenges that they have in completing advanced degrees in engineering (Burt et al., 2019; Hrabowski and Pearson, 1993; Maton and Hrabowski, 2004; Moore et al., 2003; Samuelson and Litzler, 2016). For example, previous research studies have indicated that Black men and other students of color—especially those who aspire to earn doctoral degrees—often experience inequalities such as racism and discrimination within their graduate programs (Yi and Ramos, 2022). Other challenges include situational, environmental, and interpersonal hurdles that make degree attainment more complex compared to what their peers experience (Cook-Sather, 2018). Environmental challenges such as stereotypes and the threat of being stereotyped (Steele and Aronson, 1995) make degree attainment difficult (Johnson-Ahorlu, 2012). For instance, in an attempt to understand Black male PhD students' experiences, Burt et al. (2019) learned that racial microaggressions enacted by graduate advisors are obstacles to retention and highlighted the importance of support networks for Black males' success in PhD programs. Other challenges, such as professors' lower-than-average expectations or deficit perspectives of Black students, can negatively impact their learning process, classroom participation, and educational aspirations (Harper, 2010; Martin et al., 2020; Samuelson and Litzler, 2016).

Despite these challenges, researchers have also worked to understand what might motivate Black men to pursue advanced degrees in engineering (Burt et al., 2017, 2019; Burt and Johnson, 2018; Henderson et al., 2023; McGee et al., 2016). Studies have revealed such assets as a love for their disciplines, financial implications, early exposure, and the role of social networks as key factors.

Studies have shown that love of their disciplines motivates Black males to pursue advanced degrees in engineering (Henderson et al., 2022; McGee et al., 2016). For example, researchers investigated the intrinsic and extrinsic motivations of 44 Black PhD students in engineering (28 men and 16 women). They found that Black engineering PhD students were motivated by their love of the discipline and their desire to give back to their own communities through service informed by their expertise (McGee et al., 2016). Similarly, Henderson et al. (2022) aimed at understanding the factors that influ-

enced 15 Black males to pursue engineering graduate degrees, in which it was found that the love of a discipline was a key motivator for pursuing an advanced degree.

In addition, previous studies have also highlighted financial implications as an essential factor in advanced degree pursuit (Fernandez, 2019; Henderson et al., 2022; McGee et al., 2016; Nevill and Chen, 2007). For instance, researchers have demonstrated that an important extrinsic motivation for engineering PhD students was the personal and financial benefits of pursuing and obtaining an advanced degree (McGee et al., 2016).

The role of social networks (e.g., friends, family, professors, and mentors) in motivating post-baccalaureate degree aspirations has also been highlighted as an essential factor (Antonio et al., 2004; Burt et al., 2019; Henderson et al., 2022, 2023; Maton and Hrabowski, 2004; McCarron and Inkelas, 2006; McGee et al., 2016; Varhegyi and Jepsen, 2009). For example, researchers have found that networks such as undergraduate mentors, family, and spirituality or faith-based communities are essential to Black males' perseverance in their graduate engineering programs (Burt et al., 2019). A qualitative study of 30 Black men enrolled in three elite graduate engineering programs showed that Black males received encouragement throughout their degree pursuits from mentors who also motivated them to pursue graduate degrees (Burt et al., 2019). Moreover, although the participants' parents and guardians had differing levels of educational achievement, their parents were still instrumental in providing positive support toward degree attainment (Burt et al., 2019). Students also described their parents' praying for them, using places of worship for counseling, and their belief in God as essential to not dropping out of their programs (Burt et al., 2019).

The literature studies presented in this section centralize work reporting the lived experiences of Black graduate students, in which much of the research has centered the decision-making processes of current graduate students. As valuable as this perspective is for educators and policymakers, fewer research studies have focused on Black students currently earning their undergraduate engineering degrees. Therefore, a key contribution of this work is to understand the vantage point of students who have not yet started advanced degree pursuits rather than on students' retrospective accounts as seen in several important studies (Burt et al., 2019; Henderson et al., 2022; McGee et al., 2016). We also seek to extend the knowledge base by explicitly focusing on undergraduate Black males in engineering instead of STEM more broadly and recruiting Black men from various types of institutions [e.g., historically Black colleges and universities (HBCUs), Hispanic-serving institutions (HSIs), and primarily White-serving institutions].

3. GUIDING FRAMEWORK

3.1 Community Cultural Wealth

Yosso (2005) defined community cultural wealth (CCW) as "an array of knowledges, skills, abilities, and contacts used by Communities of Color to survive and resist macro and micro-forms of oppression" (p. 77). This framework has been broadly applied in education to identify and share ways that students and educators of color tap into these forms of cultural wealth to achieve academic and career success. Community cultural

wealth as a theoretical framework extends the Bourdieu (1986) notion of social reproduction via various forms of capital to move beyond the focus on dominant group values (Yosso, 2005). The CCW framework draws from critical race theory to demonstrate the need to understand and articulate cultural attributes as assets that students build upon (Villalpando and Solórzano, 2005; Yosso, 2005). CCW posits that people of color bring cultural wealth to educational environments. Yosso (2005) put forward six forms of capital that communities of color engage to navigate and succeed in educational settings: aspirational, linguistic, familial, navigational, social, and resistant (Allen and Solórzano, 2001; Alva, 1991; Auerbach, 2007; Bernal, 1997; Freire and Ramos, 1970; Giroux, 1983; Huber, 2009; Samuelson and Litzler, 2016; Solorzano et al., 2000; Solorzano and Bernal, 2001). Table 1 provides a summary of the forms of capital given in Yosso (2005).

3.2 Role of Community Cultural Wealth in this Study

In this study, we used CCW, as defined in Yosso (2005), because of the way she frames cultural assets. Her ideas about capital, which consider race, offer an appropriate lens for understanding the assets of Black men in engineering (McCoy and Winkle-Wagner, 2022). Our work explicitly highlights social and navigational capital.

In addition, since we took an inductive approach to this study, we used CCW for three reasons. First, it provided a vocabulary for articulating our emergent findings among researchers. In this way, the framework served as a layer of communicative validation (Walther et al., 2013) between our team members who conducted data analysis. Since we used an inductive thematic analysis approach (Braun and Clarke, 2006; Nowell et al., 2017), the framework was also used to hone our sensitivity

TABLE 1: Descriptions of the forms of capital as presented in Yosso (2005)

Capital	Definition
Aspirational	Ability of students to persist even in the face of actual or perceived barriers
Linguistic	Communication skills that students possess in multiple languages and styles
Familial	Intersectionality of familial and cultural knowledge with an emphasis on the creation of community and the well-being of that community
Navigational	The sets of skills that students learn to use to help them maneuver through educational institutions with dominant cultural norms and the conditions that put them at risk of doing poorly or dropping out of school
Social	Networks of people and community resources that enable students to achieve their goals
Resistance	The skills and networks students use to challenge inequality

(Huff et al., 2021). For example, CCW raised our awareness to become sensitive to participant responses. The CCW framework also provided a way to expand our understanding beyond the experience near (e.g., term used in everyday language) that participants used to the conceptual and theoretical levels of understanding data (Geertz, 1974). Thus, CCW informed how we approached the study, particularly with respect to data analysis and dissemination.

4. METHODOLOGY

We approached this study from a constructivist epistemological perspective (Charmaz, 2014; Creswell and Creswell, 2003). This qualitative inquiry was selected since it gave the researchers the most flexibility without being bound to the theoretical underpinnings of any specific qualitative method (Caelli et al., 2003). Instead, this approach allowed us to "simply seek to discover and understand a phenomenon, and the perspectives and worldviews of Black male participants" (Merriam, 1998, p. 11). A detailed account of the data collection and analysis processes is provided in the following sections.

4.1 Protocol Development

Protocol development involved an entire research team approach through a series of collaborative and repeated processes, the first of which required the fourth and fifth authors (study designers) to create a protocol to deliberate with the team. The other authors provided feedback to strengthen the clarity of items asked, list of questions, and conceptual changes. The final version of the protocol consisted of 24 open-ended questions. The interview questions were categorized as follows: (a) K-12 relevant experiences and reasons for pursuing engineering, (b) relevant undergraduate experiences, (c) hurdles/barriers related to the engineering major, (d) career aspirations, (e) support structures necessary for advanced degree attainment, and (f) advice for support structures to support Black men in engineering. The data for this study were primarily situated within participant responses to questions from categories (d) and (e).

4.2 Data Collection Procedure

An Institutional Review Board approved recruitment email was distributed to National Society of Black Engineers (NSBE) secretaries and presidents across the United States. These officials were asked to distribute the email to their respective chapters. In addition, the NSBE headquarters communications team distributed the recruitment email on our behalf to all members. Before participating in an interview, participants completed an online demographic form that gathered information on their personal and academic backgrounds. Each participant was allowed to select a pseudonym. The recruiting efforts yielded 20 participants.

4.3 Participants

Table 2 presents a selective participant demographic profile that includes participant-selected pseudonyms, their engineering majors, and institution type [i.e., predominantly White institution (PWI), HSI, or HBCU]. To maintain consistency and trustworthiness across interview sessions, two specific team members individually or collaboratively conducted all semi-structured interviews.

4.4 Data Analysis

An external transcription service transcribed the interviews. Then, as the first stage of reliability, the first author reviewed and updated the transcripts to remove any transcription (Creswell and Clark, 2007). Our analysis was iteratively guided by the following six phases of thematic analysis: (a) data familiarization, (b) generating codes, (c) constructing themes, (d) reviewing themes, (e) defining themes, and (f) writing-up the results (Braun and Clarke, 2006). Specifically, after each read of the transcript, we

TABLE 2: Participant table with selected demographics

Pseudonym	Classification	Engineering major(s)	Institution type
Billy	Junior	Mechanical	PWI
Carl	Junior	Electrical	PWI
Christopher	Sophomore	Mechanical	HSI
Corbin	Senior	Electrical and Computer	HSI
Dave	Junior	Industrial	HSI
Ed	Junior	Chemical	PWI
Jack	Sophomore	Mechanical	HBCU
Jalen	Senior	Mechanical	PWI
Jay	Junior	Computer	PWI
Jefferson	Junior	Computer	PWI
Joe	Senior	Mechanical	PWI
John Edward	Senior	Civil	PWI
Jonail	Senior	Mechanical	PWI
Josh	Junior	Mechanical	PWI
Matthew	Senior	Civil	PWI
Oman	Senior	Chemical	PWI
Omarion	Junior	Civil	PWI
Peter	Senior	Chemical	PWI
Plato	Freshman	Chemical	HSI
Quinton	Senior	Mechanical	PWI

(the first, second, and fifth authors) discussed our reflections and instances of (dis)/agreement until all of our codes aligned. We created a matrix in Excel to illustrate our inductive themes with excerpts from the participants' transcripts. We moved forward with data analysis using a team approach. This team approach, which has worked for our team in the past, also allowed for mentorship between more experienced authors and graduate and undergraduate researchers. We convened with the third author during what we called times of calibration to discuss the emergent findings (Henderson et al., 2022; Hines et al., 2015). These times of calibration provided an opportunity to gain consensus on the definitions of the themes (Moore et al., 2003). Once all of the transcripts were examined, potential themes were noted and placed into Excel spreadsheets (by the first, second, and fifth authors). An auditor (the fourth author, who was not involved in data analysis) conducted an independent review of the data to ensure the trustworthiness of the data analysis and develop a summary of themes (Smith and Osborn, 2008). Next, the team agreed upon the final themes. All of the authors contributed significantly to manuscript preparation and times of calibration.

5. POSITIONALITY

All of the authors identify as Black and are students or professors who desire to see more Black men earn graduate degrees in engineering. We believe that our shared identities with the participants, insider status (Smith and Osborn, 2008), and similar lived experiences were assets to the participants. It is likely that the participants were able to develop a rapport with the researchers, which could have resulted in them being more willing to and comfortable with sharing their experiences and a more nuanced data analysis process (Prosek and Gibson, 2021). The first author is a Black male, a fourth-year doctoral candidate with interests focused on the impact of racial microaggressions on Black and other underrepresented students. The second author is a Black male undergraduate student studying to become a mechanical engineer. The third author is a Black female of Afro-Caribbean heritage and a Postdoctoral Fellow. The fourth author is a Black male associate professor whose research agenda focuses on college and career readiness for African American males. The fifth author is an engineering professor whose research focuses on engineering identity development among men of color. The team was conscious of the possible influences of their own lived experience on the data analysis and incorporated systems for the reliability and validity of the data, such as engaging in team discussions to interrogate each other's interpretations of data and data analysis.

6. PROTECTION OF VULNERABLE POPULATIONS

In addition to Institutional Review Board requirements, the team implemented processes to protect Black male engineering undergraduate participants. For example, the team created a separate Excel sheet with participants' demographic information that was only accessed by the research team. Participants selected their own pseud-

onyms before or after the interview to help preserve confidentiality. Because Black males are severely underrepresented at many institutions, the study participants were recruited from multiple universities (i.e., PWIs, HSIs, and HBCUs) stretching across most areas of the United States, without providing localization to a specific school(s).

7. LIMITATIONS

As with any study, this study design had limitations that must be addressed. For example, since the goal of the study was not generalizability because of the sample size, the researchers needed to be mindful when considering the transferability of their findings to their context. We also understood that institutional context matters; however, we did not analyze data based on institution type, instead we aggregated all data. Finally, we used the term Black to describe all of the participants within the diaspora. Although all of the students were attending U.S. institutions for their undergraduate studies, some had attended high schools outside of the United States. We did not analyze for potential nuanced differences related to their respective high schools.

8. FINDINGS

From our inductive data analysis, we developed four themes (summarized in Table 3) that describe what might drive participants' motivations to pursue advanced degrees in engineering in the future: passion for knowledge, financial security and career advancement, early exposure to graduate school, and influence of social networks. In addition, although not discussed here, an unexpected finding highlighted an entrepreneurial mind-

TABLE 3: Themes and descriptions

Theme	Description
Passion for knowledge	Enjoyment of learning new material, gaining an in-depth understanding of their engineering disciplines, applying, and sharing what they learn
Financial considerations	Negotiation of the career and financial implications of pursuing an advanced degree
Early exposure to graduate school	Exposure to graduate degrees and their benefits through several avenues during or before undergraduate studies, which may have inspired them to pursue an advanced degree
Influence of social networks	The influence of peers or mentors may lead students toward pursuing advanced degrees

set among some participants in that they expressed a desire to pursue Master of Business Administration degrees rather than advanced engineering degrees. This finding was discussed in a previous publication (Henderson et al., 2022).

8.1 Passion for Knowledge

Based on our findings, we describe passion for knowledge as Black males' desire to learn new or gain a more in-depth understanding of their engineering disciplines and share that knowledge. When asked about reasons for pursuing an advanced degree, one participant, Dave, said, "to acquire more in-depth knowledge in the specific field." John Edward said, "I think I just want to learn more." Another participant further highlighted this idea of a passion for knowledge. Joe said, "I like the idea of being able to specialize in something specific that you want to do within the major." These statements represent counternarratives to those who suggest that Black men do not pursue engineering degrees because they are uninterested.

In addition to learning new material, our participants shared additional passion-based motivations. Plato said:

> *I'd probably pursue a master's or maybe a PhD, which also I feel like, with more experience, it would help. I feel like coming straight out of college is definitely doable, but, for me, I'm hands-on, and I feel like for me personally, graduate school is more application based …*

Plato knows that he wants to pursue an advanced degree, but because of his hands-on orientation he wants to go into industry and then use the knowledge he gains to supplement his graduate education. Plato's passion for knowledge was also anchored in his ability to generate knowledge that could be shared. He said:

> *After [I have] worked at my job, after I've done my thing, I do want to teach. I want to become a professor or something, and I want to pass on my knowledge and my experience to the next generation of engineers, chemical engineers, and I know that it definitely does help to have a graduate degree, so somewhere between my graduation and then.*

His ability to pursue his dreams while hoping to impart knowledge to others someday highlights the bidirectional nature of his aspirational capital (Tolbert Smith, 2022) and his altruistic view of reaching back to help others.

8.2 Financial Considerations

Exhibiting their navigational capital, this theme describes the financial considerations Black males make in deciding whether to pursue an advanced degree in engineering. For example, participants shared that they would pursue an advanced degree if they could

make more money. Peter said, "It's really just going to be for higher pay, to be honest." Carl expounds on this. He stated:

> *At this point, since I'm going to graduate, that has to do with how much the school's going to give me. Do I possibly have a fellowship I could find or something? Whereas for a job, it depends on how close to home it is and how much they're paying me in terms of other jobs I've applied to.*

As we have seen in a previous work (Henderson et al., 2022), Carl is undergoing a cost-to-benefit analysis to assess the inherent financial value of pursuing an engineering graduate degree. While he acknowledges that graduate fellowships might be available, the decision to pursue an advanced degree or not comes down to its financial implications for his current life situation. He said, "So, right now, it has to be more financial than my passion after I graduate more so than anything." Jack also demonstrates how he navigates the decision. He stated:

> *Honestly, if I can get a good job without graduate school and without having to pay the extra money and student loans, I'd rather just get the bachelor's and go into my field. I have other friends that have gone into engineering, and they didn't need to go to graduate school. They're working good jobs that they're happy with, so I just don't feel the need to at this moment.*

Jack is also undergoing this cost-to-benefit analysis to assess the inherent value of pursuing an engineering graduate degree. When he said, "I have other friends that have gone into engineering, and they didn't need to go to graduate school," he brought into the conversation a consideration that stakeholders should be discussing when thinking about how to recruit Black males to pursue advanced engineering degrees around this idea of needing a graduate degree. Jack demonstrated that within student meaning-making processes, students are deciding whether a graduate degree is needed in their field and whether they will be in student loan debt after obtaining an advanced degree.

As Black males demonstrate their navigational capital in deciding to pursue graduate school or not, it also calls into question the messages that are still out about funding a graduate education in engineering and how we can make graduate degree salaries more competitive (Freeman, 2005; Hurtado et al., 2008; Syed et al., 2019; Wall et al., 2020). Previous research studies have indicated that financial support can be a deciding factor in whether students pursue graduate degrees in STEM and engineering. However, some studies have shown other factors such as self-efficacy and identity (Syed et al., 2019) as more salient to students pursuing graduate degrees in STEM (Wall et al., 2020).

8.3 Early Exposure

This theme, early exposure, highlights one way that stakeholders can help students as they undergo their cost-to-benefit analyses. Among our study participants, early expo-

sure to graduate school could have come from teachers, professors, or those in the field that painted a picture of what graduate engineering could look like for them. One participant, Billy, pointed out that working with faculty benefited him. He said:

> *My main influence would be the research that I've done with my faculty mentor. He just showed me all the possibilities that Chemical Engineers can do when you go that far ahead to be a full-on PhD when you're doing research.*

Billy's experience highlights the potential benefit of early exposure. It further supports the literature studies that have pointed to research experiences for undergraduate students as an essential tool for motivating them to pursue graduate studies (Griep and Watkins, 2018; McDevitt et al., 2017). Billy's experience was so impactful that he stated, "Then I decided that was something I wanted to do for the rest of my life."

Jalen also described how early exposure was instrumental in his decision to pursue an advanced engineering degree. Upon reflection, he said:

> *the person who guided me in those specific places, her name is Wanda [pseudonym], … I actually got to see her … [defend] her dissertation, and present her final work, and after the M.E. [mechanical engineering] advisory board deliberated, and they returned back saying 'Congratulations! You are now Dr. Wanda.' So, seeing something like that really made me see the amount of work and dedication I've seen, and seeing her actually get the results that she wanted, really showed me you can do this too, and hard work determines your results.*

For Billy, watching the successful PhD defense of someone—in this case, his research mentor—was transformative. This glimpse into the future inspired him. He concluded by saying, "So, as long as you keep that same consistency, discipline, and drive, you should be able to thrive inside of graduate school."

These participants demonstrated the power of exposure (e.g., participating in research opportunities and seeing the process). These are examples of how stakeholders can demystify the graduate degree process and experience (Henderson et al., 2022) for future Black male engineering students.

8.4 Influences of Social Networks

Our participants revealed that they depend on their networks to help motivate them to pursue graduate degrees. The participants described networks as people who were also Black and had gotten through graduate engineering programs. Jefferson recounted his experience in a workshop. He said, "The people that were speaking, they were all people of color … you kind of got that feeling like, Wow, they did that. This is something I could do." This single instance appears to have convinced Jefferson that he could achieve an advanced degree since others who look like him had done so.

Jalen also illustrated the importance of the influence of his faculty mentor, who was a part of his social network. Jordan said:

> *and working with our faculty member named Dr. Nielsen (pseudonym), or the engineering department, just the whole vibe or just the whole entire experience really told me I would love to do it. I would love to continue this. I would love to go ahead and pursue this in a graduate degree to continue this further.*

Jalen's interactions with his professor and the vibe at his institution helped him leave with a desire to pursue an advanced degree. In our previous work, we highlighted the importance of students experiencing a vibe (Henderson et al., 2023) as they pursued advanced degrees in engineering.

Carl further illustrated the importance of peers in motivating his future decision:

> *My influences have been upperclassmen I've been talking to that we're in Victory House [pseudonym] mainly. They've been advising me how they got theirs paid for. They've been advising me where to apply [and] where not to apply. They've been advising me on what it's like, their experiences so far, and what they're doing after because I've learned a lot of things through them about graduate school more than anything else.*

Carl's experience with his peers is well rounded. The advice of peers taught Carl about the mechanics of the process. Carl also pointed out experiences with the particular program, Victory House. This institution's program provided resources aimed at exposing him to graduate school. Carl described this experience as follows:

> *Victory House helped me through visiting some of these schools. They helped me understand what you can do with a Master's Degree … and a PhD I use those to decide what I'm going to do. Also, my sister graduated with a Master's. So, I'm thinking I want to do it, but it still comes down to finances …*

Although Carl was concerned about the financial implications of pursuing an advanced degree, his social network (i.e., social capital) was instrumental in helping him understand how to navigate a graduate education. This and other examples demonstrate how influential social networks might be to Black males pursuing advanced degrees in engineering.

The findings presented here describe how Black male engineering students early in the engineering career pathways (i.e., undergraduate engineers) make meaning of the possibility of pursuing advanced degrees. They rely on their love of their disciplines, financial career implications, early exposure, and their social networks (namely professors, peers, and intervention programs). When viewing their perspectives through the lens of CCW, we also gain insights into the power of social and navigational capital as support for their future goals.

9. DISCUSSION

The existing body of literature studies, our own work included, have primarily focused on the experiences of Black men that have already commenced or completed graduate programs in engineering (Burt and Johnson, 2018; Burt, 2019; Henderson et al., 2022; McGee et al., 2016). In this study, we sought to add to the scholarly discourse by examining the perspective of undergraduate Black males about their future pursuit of advanced degrees. Our findings illustrate how students rely on social and navigational capital to support their future endeavors. This is manifested in their love of knowledge, early exposure to the graduate school experience, support of social networks, and financial implications of earning an advanced degree.

Similar to previous research findings, we also found the importance of early exposure to research and graduate school to the desires of Black males to pursue advanced degrees in engineering. This speaks to the usefulness of experiences such as research experiences for undergraduates (REUs) (Fernandez, 2019). As similarly found by previous researchers (Burt and Johnson, 2018), we also saw the role of social networks—namely, peers and faculty—in the advanced degree pursuit of participants. Although the family has often been mentioned as a source of support for advanced degree pursuit, we did not see it in this study; the role of faculty and peers was more salient. The social networks of our participants not only encouraged them through conversations but also empowered them by giving them opportunities.

More unique to this study, participants specifically demonstrated the navigational capital they used to understand the financial implications of pursuing an advanced engineering degree. This area must be addressed if we want to move the needle on the enrollment of Black men in engineering graduate programs (Fernandez, 2019; Henderson et al., 2022).

10. IMPLICATIONS FOR FUTURE RESEARCH AND PRACTICE

As educational and societal stakeholders amplify calls for broadening participation in engineering, this work stands to impact education, policy, and practice directly. What we learn from these uniquely situated participants (i.e., undergraduate engineering students reflecting on their K-12 engineering experiences, current engineering realities, and future aspirations) might be used to develop and inform additional studies or implement interventions. Higher education institutions wanting to plug the gap of engineers in the United States can use these themes to support undergraduate Black male engineering students and foster relationships with secondary education institutions to strengthen the engineering pipeline.

10.1 Future Research

Our findings were consistent with those obtained in previous works. While envisioning what is next, one might imagine designing studies to investigate the impact of institu-

tion type, region of the country, or first-generation status, to name a few, on the factors motivating Black male undergraduate engineering students to pursue (or not to pursue) advanced degrees. To expand the scope of this work, researchers might develop and validate quantitative survey instruments that can reach additional Black males. Along these lines, we also recommend creating a theory grounded in the data describing Black males' pursuit of advanced degrees.

10.2 Practice

The findings lay the groundwork for interventions that institutions could implement to increase the number of Black males pursuing advanced engineering degrees. For example, several participants were concerned about the financial implications of pursuing an advanced degree. Most engineering graduate programs are fully funded; therefore, providing information sessions to expose students to this information would enhance their navigational capital and possibly result in more Black males deciding to pursue advanced degrees. Furthermore, interventions should ensure that Black males are offered the most competitive graduate study stipends possible. In our previous work, we determined that this contributed to Black men feeling like a recruitment priority and was a part of the vibe they looked for when selecting graduate engineering programs (Henderson et al., 2022b). In addition, our work further supports the power of REUs in motivating Black men to pursue advanced degrees. When possible, institutions and principal investigators should develop REU grants (sites or supplements) with targeted recruiting plans to recruit more Black men for early exposure. Finally, our participants described how a program/intervention (e.g., Victory House, which we came to understand was a living and learning community designed for Black men) expanded their knowledge about advanced degrees and impacted their decisions to pursue advanced degrees (Cintron et al., 2020). Other institutions might consider this model and build on it to support additional Black men in engineering across the country.

11. CONCLUSIONS

In this study, we explored the reasons that motivate Black male undergraduate students to pursue advanced degrees in engineering. The findings presented here contribute to the ongoing discussion of broadening participation in engineering. We hope that this research gives practical ideas for institutions aimed at unclogging the proverbial engineering pipeline and outlines a blueprint that professors, administrators, and students (peers) can use to support Black men entering and progressing through that engineering pipeline.

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