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ASPIRING TO THE ROAD LESS TRAVELED: FACTORS INFLUENCING BLACK MALES' PURSUIT OF ENGINEERING GRADUATE DEGREES

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A growing body of research explores the experiences of students in graduate education and more—particularly, students of color pursuing advanced degrees. However, little research provides information about Black students' aspirations to pursue graduate education in science, technology, engineering, and mathematics (STEM). Even less is known about Black males' aspirations to pursue graduate education in STEM. Knowing why Black males aspire to pursue graduate education would assist stakeholders (e.g., administrators, faculty, advisors, family members, and peers) in better supporting and motivating students while they are in graduate school, or earlier in their educational trajectories. This retrospective study of 50 Black males' aspirations for graduate school aimed to better understand the factors that influenced their aspirations to pursue graduate degrees in engineering. Four themes were most influential: (a) Black male students received messages implying that a bachelor's degree was insufficient, (b) earning a graduate degree in engineering was regarded as a sign of community influence and respect, (c) students' professorial career goals necessitated an advanced degree, and (d) mothers functioned as support systems and role models for earning an advanced degree. Finally, we offer implications for future research and practice. These new findings about aspirations regarding graduate education will assist stakeholders in identifying critical moments and experiences necessary to encourage talented individuals to pursue advanced degrees in STEM fields.

KEY WORDS: *aspirations, motivation, Black males, graduate education, engineering, broadening participation*

1. INTRODUCTION

In the poem *The Road Not Taken* ["I shall be telling this with a sigh, somewhere ages and ages hence: two roads diverged in a wood, and I—I took the one *less traveled* by, and that has made all the difference" (Frost, 1915)], Robert Frost uses the idea of taking the road less traveled to suggest two options: (a) do I voyage on a typical or even prescribed path; or (b) do I embark on a journey not often taken, one potentially wrought with twists, turns, and uncertainty? For many individuals, pursuing graduate education is the road less traveled. In 2020, of the approximately 258 million eligible college goers, only 1.7 million (less than 1%) were enrolled in

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graduate education in the United States, with science, technology, engineering, and mathematics (STEM) degrees in top demand (Council of Graduate Schools, 2020; United States Census Bureau, 2020). Of the 1.7 million enrolled, 688,267 were male-identifying individuals, and Black males only comprised 12,578 (or 0.7%) of graduate students enrolled. Furthermore, only 120 Black males earned graduate degrees in engineering (American Society for Engineering Education, 2020). Indeed, 0.06% of all engineering graduate degrees were earned by Black males. Aspiring to a career in engineering is daunting for Black males, where they are expected to pave a less traveled road themselves.

A growing body of research explores the experiences of students in graduate education (Baker et al., 2013; Wofford et al., 2022), and more particularly students of color pursuing advanced degrees (Burt, 2020; Burt et al., 2020; Cuellar and Gonzalez, 2021; Johnson and Strayhorn, 2022; McCallum, 2017; Miles et al., 2020; Rodriguez et al., 2022). However, only a handful of research studies provide information about Black students' aspirations to pursue graduate education in STEM (McGee et al., 2016). Even less is known about the factors influencing Black males' aspirations to pursue graduate education in STEM. Knowing why Black males aspire to pursue graduate education would assist stakeholders (e.g., administrators, faculty, advisors, family members, peers, etc.) in better supporting and motivating students while they are in graduate school or earlier in their educational trajectories. This retrospective and asset-based study centers on the experiences and voices of 50 Black males and their aspirations to journey down the road less traveled, with the aim of better understanding the factors that influenced their aspirations to pursue graduate degrees in engineering. The following research question guided our inquiry: What factors influence Black males' aspirations to pursue an advanced degree in engineering? The new information obtained in this study will assist stakeholders in identifying critical moments and experiences necessary to encourage talented individuals to pursue advanced degrees in STEM fields.

2. REVIEW OF THE LITERATURE

Extant scholarship indicates a diverse array of factors that propel college students' aspirations to pursue postsecondary education. It is crucial to understand students' reasons for attending college, since they may directly influence academic engagement and outcomes. Among the top reasons are to increase upward mobility and gain educational attainment (Milovanska-Farrington, 2020; Sellar and Gale, 2011). In addition, as students consider STEM graduate degree aspirations (Baber, 2014; Litzer and Lorah, 2018; Maton et al., 2009) some cite encouragement from family and helping family as prominent reasons to pursue graduate education (Henderson et al., 2022; McGee et al., 2016; Moore, 2006). The myriad identities students hold (e.g., race, gender, ethnicity, etc.) and the environments they experience shape their reasoning behind pursuing a postsecondary education degree, choosing fields of study, and embracing a career path.

While it may be assumed that many of these factors remain consistent for high school students aiming to acquire bachelor's degrees and students with bachelor's degrees aiming to acquire graduate degrees, few research studies have investigated the nuanced aspirations of STEM graduate students by field of study. Since Black males remain underrepresented across all STEM fields, with engineering being one of the most notable, it is crucial to investigate the educational aspirations of Black male graduate students in engineering.

2.1 Black Males in Engineering Graduate Programs

Only approximately 1% of individuals enrolled in graduate engineering programs in the United States are Black males (American Society for Engineering Education, 2020; Burt et al., 2018). Alarmingly, the small number of Black males earning doctoral degrees in engineering has steadily dwindled over time (American Society for Engineering Education, 2019). In research on practices that impact Black males' participation and retention in engineering, little attention is paid to their educational aspirations; however, much is known about the multitude of problems and barriers they experience in their graduate programs. Being forced to endure stereotypical and racialized experiences in the admission process and throughout their programs from non-Black peers and advisors (Burt et al., 2019a), while having to work twice as hard to be recognized and sacrificing school/life balance as a result (McGee et al., 2019), Black males are prevented from entering or are pushed out of engineering. Moreover, even for those with an early penchant for engineering (Burt and Johnson, 2018; McGee et al., 2016) the accumulation of these barriers impacts their ability to construct an engineering identity (Benjamin et al., 2022) and hampers the socialization process needed to assume their desired professional role (Johnson and Strayhorn, 2022). Tasked with simultaneously navigating a hostile institutional environment and proving their competence, some Black males may find the cost of pursuing postsecondary education too high.

2.2 Communal Change for Black Students

The existing literature shows that individuals from historically excluded communities feel an inherent duty to give back to the community from which they came (Charleston, 2012; McCallum, 2017; McGee et al., 2016; Means et al., 2022). Black college students' expression of the need to uplift and add value to their community is prevalent. Driven by a collectivist worldview (Phinney et al., 2006), many Black students find an obligation to support and give back to other Black individuals to be a motivational force behind their educational aspirations (Carson, 2009; McGee et al., 2016). Furthermore, Black doctoral students' persistence can be sustained by a desire to give back to their community and transform the image of the professoriate (Burt, 2020; McCallum, 2017). Thus, for many Black students, choosing to obtain a graduate degree is not an act of elite selfishness, but rather an act of cultural synergy that is seen as a way to pay it forward and uplift the community.

2.3 Students of Color Educational Pursuits Are Supported by Their Families

Decades of research indicate that investment from both immediate and extended family members is a strong predictor of access to and persistence in postsecondary education for students of color (Burt and Johnson, 2018; Burt et al., 2019b; Espino, 2014; Gándara, 1982; McCallum, 2016; McGee et al., 2016; Means et al., 2022; Nora and Cabrera, 1996; Strayhorn, 2009). In a study of 41 Black students' decisions to enroll and stay in doctoral education, McCallum (2015) highlighted that family members' insights, resources, and emotional and social support were important for retention. Likewise, in the McGee et al. (2016) study of STEM doctoral students, nearly one-half of the participants expressed that their support system was rooted in a communal network of family and friends. When considering Black males' enrollment in graduate school, Strayhorn (2009) found that parental educational attainment was strongly correlated with postsecondary access. Taken together, this corpus of work emphasizes the notion that for students of color, especially Black students, aspirations to attend and persist in graduate school often arise from familial roots.

Existing literature studies center the educational aspirations of college students of color, highlighting community and family as sources of support through racialized adversity and STEM as a primary choice of field of study. However, the issues and persistent inequities within the field warrant detailed scholarship to examine the aspirations of graduate students of color, especially Black males in engineering. Such new scholarship targeted at better understanding the reasons Black males choose to pursue engineering graduate programs will contribute to the literature aimed at mitigating institutional barriers that may hinder their success.

3. THEORETICAL FRAMEWORKS

To better understand the aspirational factors that drive Black males to pursue graduate degrees, two asset-based frameworks were utilized in this study: (a) community cultural wealth (CCW) (Yosso, 2005) and (b) social cognitive career theory (SCCT) (Lent et al., 1994). The CCW framework developed by Yosso (2005) recognizes the existence of various types of cultural capital in communities of color. CCW has been used to make sense of a wide variety of diverse student populations' knowledge sources in postsecondary education research (Burt and Johnson, 2018; Cooper et al., 2017; Espino, 2014). Yosso (2005) used six forms of capital (i.e., aspirational, linguistic, familial, social, navigational, and resistant) to help us consider how Black males use the richness of their communal knowledge when determining their future academic pursuits (i.e., graduate education in STEM). Our definitions of the six forms of capital have been modified to fit this study's student sample (i.e., Black males in graduate engineering programs) (see Table 1). We used these six types of capital to better comprehend student participants' forms of capital as interrelated knowledge sources, rather than in isolation from one another (Yosso, 2005).

TABLE 1: Modified CCW framework for Black male graduate students in STEM

Number	Capital
1	Aspirational Capital: Black males maintain an optimistic attitude regarding their hopes and dreams and persist toward graduate education and STEM careers, despite complexities.
2	Linguistic Capital: Black males in STEM graduate programs, with different career trajectories, are fluent and proficient in a variety of styles and techniques of communication.
3	Familial Capital: Black males place a premium on their family's cumulative knowledge and experiences to assist them in acquiring their graduate degrees and embarking on rewarding career paths.
4	Social Capital: Black males summon consciousness from their village and/or support systems during graduate STEM degree completion and STEM careers.
5	Navigational Capital: Black males pilot through oppressive graduate education and career labyrinths.
6	Resistant Capital: Black males combat injustice and bigoted practices and ideologies in their graduate programs and career pathways.

Although the CCW framework emphasizes the significance of students of color drawing on their various types of capital, it is limited in its specificity regarding how students' existing wealth may inform their academic and/or career interests. Therefore, in this study we also drew on the Lent et al. (1994) SCCT framework. The SCCT framework has been utilized by a growing number of scholars to examine the experiences of different underserved populations (Borrego et al., 2018; Cadenas et al., 2022; Scheuermann et al., 2014; Wang, 2013). Regarding populations of color, SCCT advances understandings of how race and gender differently influence individuals' interest in academic and career pursuits. The Lent et al. (1994) SCCT extends the Bandura (1986) general social cognitive theory and focuses on a range of cognitive variables (e.g., student interest, student values, student environment, etc.) that aid in making sense of a student's academic and professional aspirations. The SCCT framework asserts that individuals' self-efficacy, personal goals, and outcome expectations (directly, indirectly, and occasionally both simultaneously) influence their academic and career decisions. Within the framework, self-efficacy—a psychological self-interpretation of one's ability to complete a task—guides individuals as they engage in tasks related to their academic and career pursuits (e.g., students confidently conducting experiments in a laboratory to advance their research). Personal goals create the drive to achieve a specific result that often aids in overall agency development. Individuals' goals provide an aim by which to aspire, and can help facilitate the creation of actions and behaviors to achieve one's goals. Finally, outcome expectations capture the hopes that people develop as a result of performing certain actions. As an example of an outcome expectation, a Black male might be interested in earning a doctorate in STEM to help motivate future generations of Black scientists. In addition, other factors (e.g., environmental, socioeconomic status,

parental background, community resources, etc.) also influence an individual's educational and career trajectories.

Taken together, CCW and SCCT provide frameworks to more holistically understand Black males' interests in and aspirations for their futures (e.g., graduate education). Both qualitative and quantitative scholarship have used CCW and SCCT together (Davis et al., 2021; Lunn et al., 2021; Medina et al., 2021) to better understand participants' journey through STEM. Likewise, in pairing these two frameworks, this study offers an asset-based approach to exploring Black males' educational pathways. The following research question guided our inquiry. What factors influence Black males' aspirations to pursue an advanced degree in engineering?

4. METHODS

In designing this study, we acknowledged that individuals can experience lived realities that differ from one another. This does not make one's experiences more valid than another's; they are equally valid (i.e., social constructivism) (Creswell, 2012). Therefore, we used exploratory basic qualitative methodological techniques (Merriam and Tisdell, 2016) to better understand 50 Black males' aspirations for pursuing the road less traveled of graduate studies in engineering. Participants varied on a host of dimensions. For instance, all of the participants attended one of six historically and predominantly White institutions for their graduate studies; however, the types of schools they attended before graduate school varied. These Black male students were also enrolled in a variety of engineering graduate programs (e.g., agricultural, aerospace, biomedical, chemical, civil, computer, computer science, design, electrical, industrial, material science, and mechanical engineering). The majority were at least second-generation college students (having parents and/or grandparents who attended some form of postsecondary education). Finally, the majority held postgraduation plans to pursue industry careers, followed by smaller numbers who intended to work in academe, policy, and government, or were unsure at the time of data collection. We provide these demographic details (see Table 2) because they help, in part, to inform students' aspirations for pursuing graduate studies in engineering.

4.1 Data Collection

Data collection took place between 2008 and 2021. Students were purposefully recruited with the assistance of institutional liaisons, and further recruited through snowball sampling via other students (Merriam and Tisdell, 2016). Upon reviewing and signing the informed consent form [required by the authors' institutional review board (IRB)], participants completed an eight-item demographic form comprised of the background information presented in Table 2. The majority of participants (42) participated in at least one in-person, semi-structured interview that lasted approximately 60–150 minutes; an additional nine students participated virtually (i.e., via Zoom). Of the total 50 participants, 29 participated in a follow-up second interview. In addition, to ensure trust in our

TABLE 2: Demographic data for study participants

Pseudonym*	Mother education	Father education	Undergraduate major	Graduate specialization	Class level	Postgraduate career intention
Aaron	X	X	X	X	X	X
Ali	Bachelor's	Bachelor's	Aerospace	Aerospace	Second	Industry
Alphonso*	Bachelor's	Some college	Electrical	Electrical	Fifth	Industry
Ben	Bachelor's	High school	Electronics	Mechanical	Second	Industry
Bilal	High school	Vocational	Computer	Computer	First	Faculty
Braxton	Associate's	N/A	Electrical	Electrical	Second	Industry
Calvin	Master's	Doctorate	Chemical	Material science	Second	Industry
Chris*	Bachelor's	Master's	Chemical	Chemical	Fifth	Industry
Christian	Some college	Some college	Sustainability	Civil	Third	Faculty
Courtney	Some college	Some college	Mathematics	Civil	Second M	Unsure
Daniel	Vocational	Master's	Mathematics	Industrial	First	Unsure
Daryl	Bachelor's	High school	Aerospace	Aerospace	Seventh	Industry
David	High school	Community college	Industrial	Design	First	Unsure
Dean	High school	High school	Computer	Electrical	First	Faculty
Isaac*	Master's	High school	Agricultural	Agricultural	Fourth	Unsure
Jackson*	Some college	Bachelor's	Biomedical	Mechanical	Third	Unsure
Jacob	Doctorate	Bachelor's	Chemistry	Chemical	Third	Policy
Jaden*	Doctorate	Doctorate	Electrical	Electrical	Second	Industry
Jai	Bachelor's	Some college	Mechanical	Mechanical	Fifth	Faculty
Jalen	Vocational	Vocational	Mechanical	Mechanical	First	Faculty
James*	Master's	Master's	Biosystems	Biomedical	Fourth	Faculty
Jesse*	Bachelor's	Bachelor's	Electrical	Electrical	Fifth	Faculty
Joseph*	Doctorate	Doctorate	Material	Material	Fourth	Unsure

TABLE 2: (*continued*)

Pseudonym*	Mother education	Father education	Undergraduate major	Graduate specialization	Class level	Postgraduate career intention
Kemani	Doctorate	Master's	Electrical	Electrical	Second	Industry
Kendall	Bachelor's	Bachelor's	Mechanical	Mechanical	Second M	Industry
Logan*	Master's	Master's	Electrical	Electrical	Fifth	Industry
Lucas	Master's	Some college	Electrical	Electrical	Second	Faculty
Malik	Master's	Bachelor's	Mechanical	Mechanical	Fourth	Unsure
Marco	High school	Vocational	Mechanical	Aerospace	First	Industry
Marcus*	Doctorate	Master's	Mechanical	Mechanical	Third	Unsure
Martin	Master's	Master's	Design	Industrial	Second	Industry
Micah	Bachelor's	Bachelor's	Physics	Industrial	Third	Faculty
Muhammad	High school	Doctorate	Computer science	Computer science	Third	Industry
Norman	High school	Bachelor's	Mechanical	Mechanical	First	Industry
Paul*	Elementary	Elementary	Electrical	Electrical	Fourth	Unsure
Quentin*	Some college	Bachelor's	Electrical	Electrical	Fifth	Unsure
Rafeeq	X	X	X	X	X	X
Ricky	Middle school	Some college	Electrical	Electrical	Fourth	Faculty
Robert	Master's	Bachelor's	Mathematics	Industrial	Second M	Government
Samuel	Middle school	Middle school	Civil	Civil	Fifth	Faculty
Shawn	High school	High school	Chemistry	Material	Fourth	Industry
Sive	Associate's	Master's	N/A	Industrial	N/A	Industry
Terrence*	Bachelor's	Doctorate	Mechanical	Material	Second	Unsure
Thomas	High school	N/A	Nuclear	Mechanical	Third	Industry
Tinashi	Master's	Master's	N/A	Aerospace	N/A	Industry
Titus	Master's	Master's	Civil	Civil	Second	Unsure

TABLE 2: (*continued*)

Trai*	Bachelor	Master's	Mechanical	Mechanical	Fourth	Industry
Tristan	Master's	Bachelor's	Mechanical	Aerospace	First	Unsure
Victor*	Master's	Bachelor's	Chemical	Chemical	Fifth	Industry
Xavier	Some college	Some high school	Computer science	Computer science	Fourth	Industry

*The student has graduated since data collection.

Note: Class level, number of years a student has been in graduate school; M, master's student; N/A, information not available; X, student chose not to share information.

data (Merriam and Tisdell, 2016), we conducted three follow-up focus group interviews (which included a total of 11 participants) to challenge preliminary findings and early hypotheses related to students' aspirations. Reflective and analytic memos (Merriam and Tisdell, 2016) were completed after each interview to capture immediate reactions, possible connections to existing research, and potential hypotheses related to students' aspirations for attending graduate studies in engineering.

Although a standardized interview protocol afforded uniformity in questions across student participants and the 13-year project, we remained open to asking follow-up questions when more clarity was needed. Across (multiple) interviews, students were asked broad questions about their personal backgrounds, educational experiences, and long-term interests in STEM. These questions were in alignment with the constructivist view (i.e., knowledge is created and can have multiple trurths) and the theroretical frameworks (i.e., CCW and SCCT) that guided the study. Most germane to this study were students' reactions to questions related to their background experiences, sense making of graduate school, and aspirations to pursue graduate education in engineering. Sample questions included the following. "What influenced your decision to go to graduate school in engineering?" "How have your actual experiences differed from or aligned with the experiences you were expecting to have here?" Interviews were either audio or video recorded and transcribed verbatim to capture students' authentic sense making of their aspirations toward graduate education.

4.2 Data Analysis

Thematic analysis techniques were used to identify the lived experiences (e.g., interactions, motivations, and sense making) of students to better understand their decision to pursue graduate education. Thematic analysis techniques aid in the discovery of patterns within text data (Braun and Clarke, 2006). Although we were aware of existing broad conceptualizations of aspirations for Black graduate students, and particularly those in STEM (McCallum, 2020; McGee et al., 2016), no pre-existing codes based on *a priori* findings were used to generate our codes in this study. We engaged in two phases of analysis. To start, one member of the research team read all transcripts and labeled small segments of transcript text (i.e., open coded) where students elaborated on their aspirations for pursuing graduate studies in engineering. Definitions with criteria were created for each code to establish coding properties, and then compiled within a codebook. The team member then developed a codebook with categories and sub-categories, along with definitions and criteria for the inclusion of each code.

Next, the remaining research team members read transcripts, open coded, and wrote memos about their reflections. Then, the initial codebook was shared with the full team for peer debriefing, a technique to enhance study trustworthiness (Merriam and Tisdell, 2016). At this stage, the team discussed all codes (and their definitions), adding new codes to the codebook and clarifying existing ones. Codes were continuously scrutinized through this iterative process to make sure their properties were distinct (i.e., constant comparison) (Corbin and Strauss, 2008). At times, we returned to the recorded

interviews to verify and/or challenge our interpretations of codes. All of the codes and their definitions were discussed until consensus was reached. Confidence that saturation had been reached occurred when no new codes were identified. These strategies further enhanced our confidence in the soundness and trustworthiness (Creswell, 2012; Merriam and Tisdell, 2016) of our findings.

After the open-coding process, similar codes were combined into categories. For example, the codes *messages from the engineering field*, *network of engineering profession*, and *mothers' encouragement* coalesced into a category related to external factors influencing students' aspirational intentions. In another example, the codes *engineering faculty conversations* and *mother's educational background* coalesced into categories of capital, social, and familial. After developing categories, we discussed how the categories fit together to offer a cohesive explanation of students' aspirations to pursue graduate school in engineering. Our intentional inductive approach to data analysis allowed the unique experiences of the Black males in this study to emerge and the unique story of their lived experiences to be developed.

4.3 Researcher Positionality

Because the research team held a variety of identities (e.g., gender, student/faculty, and educational background), we continuously engaged in researcher reflexivity throughout all stages of data analysis (Bhattacharya, 2017). During these conversations, we individually and collectively discussed how our identities, worldviews, and assumptions informed our understandings of the students' differences and lived experiences (e.g., race, gender identity, place of origin, family background, undergraduate experiences, work force/career paths, etc.). By openly naming and discussing our intersecting identities and assumptions, we were able to implement strategies to shift from assumptive knowledge of ourselves to recognizing students' narratives in their own voices. For example, one research team member is a Black female, while the other three are Black males. We first acknowledged the unique perspectives that come with Black males and Black females studying Black males. This opening discussion led us to a broader conversation about gendered racism in academia (Smith, 2010; Smith et al., 2007) and science and engineering fields in particular (McGee, 2020), and how students may differently experience their graduate programs based on being Black males. However, we remained open to each other's opinions and possibilities, acknowledging that Black males are not a monolith. As another example, the research team consisted of four differently identifying researchers (i.e., associate professor and three doctoral students) with educational experiences from different disciplines (i.e., chemistry, communication, education, higher education administration, neuroscience, and physiology). Because of our varied educational backgrounds, we held conversations to discuss our own aspirations for pursuing graduate education. Through these ongoing conversations, we processed our own motivations for pursuing and persisting in graduate school, which helped us to better understand our individual and collective experiences related to aspirations for graduate school, and not to conflate our experiences with those of the Black males in our study.

4.4 Protection of Black Male Participants (i.e., Vulnerable Populations)

We took a number of precautions to safeguard the safety of the Black male students in this study. All of the participants were informed that this research posed no additional risks beyond their lived experiences as Black males in STEM, as per IRB standards. In addition, students were reminded that their participation was voluntary and they could stop the interviews and/or have their data removed from the study at any time. Pseudonyms were assigned to the students and any identifiable sensitive information was decoded (e.g., institution, town/city location, references to advisors, faculty, staff members, family members, peers, etc.). Furthermore, audio recordings and transcripts were stored on a multiple authentication secure university server that was password protected by the first author. No one outside of the research team was given access to the raw data used for this study.

4.5 Limitations

Because the 50 particpants in this study are not representative of all Black males, it is likely that additional factors (from other students) beyond those identified here influence students' pursuit of advanced degrees in engineering. In addition, our sample included those in master's (terminal and non-terminal) and doctoral programs. It is possible that there are unique aspirational factors for those interested in earning a terminal master's degree compared to those interested in earning a doctoral degree. Finally, the temporal nature of this study's research design (i.e., interviewing students once they were already graduate students) might have influenced the kinds of information shared. It is possible that students' sense making of their aspirations may have differed had they been interviewed at earlier points in their undergraduate experiences, including, but not limited to, when they were going through the admission process.

5. FINDINGS

Four themes describe factors influencing students' aspirations to pursue graduate degrees in engineering (see Table 3): (a) Black male students received messages implying that a bachelor's degree was insufficient; (b) earning a graduate engineering degree was regarded as a sign of community influence and respect; (c) students' professorial career goals necessitated an advanced degree; and (d) mothers functioned as support systems and role models for earning an advanced degree.

5.1 Students Received Messages Implying That a Bachelor's Degree Was Insufficient

Students received consistent messages as undergraduates (mainly from engineers and prospective employers) that their bachelor's degree alone would not be sufficient to have full membership and job security in the engineering profession. Thus, for those who

TABLE 3: Factors influencing students' aspirations to pursue graduate degrees in engineering

Factors influencing students' aspirations to pursue graduate degrees in engineering	Theoretical linkages	Select quotations
Students received messages implying that a bachelor's degree was insufficient	CCW: aspirational capital, social capital; SCCT: expected outcomes, self-efficacy	James: From what I've heard from people before, according to my major which is biomedical engineering, I don't want to say a [bachelor's] is useless, but you're more marketable [with a graduate degree].
Earning a graduate engineering degree was regarded as a sign of community influence and respect	CCW: aspirational capital, navigational capital, and resistant capital; SCCT: environmental factors, personal factors (e.g., race/ethnicity), self-efficacy	Lucas: The reason why I want a PhD is … there aren't that many Black people that I know who have a PhD, and so simply the fact that it increases that number for people to have that interaction, to know that it exists. To be that source of validity for other people, I think, is from a social aspect, a worthy pursuit. What is the impact that I could have on other people on top of just what does my work do? What can my work do for other people, and then what can I personally do for other people?
Students' professorial career goals necessitated an advanced degree	CCW: aspirational capital, navigational capital; SCCT: outcome expectations, personal goals (e.g., career specific interests)	Christian: I think my primary motivation was that I'm deeply passionate about teaching and I knew that the only way for me to continue mentorship and continue teaching was to pursue a graduate degree … ultimately … a PhD.
Mothers functioned as support systems and role models for pursuing an advanced degree	CCW: familial capital, linguistic capital, social capital; SCCT: contextual and environmental factors, interests	Joseph: In some ways [I chose my doctoral institution] because my mom went here to get her PhD. She took her sabbatical here back when I was in middle school, when I was 14, and so I had exposure to [my institution's city] and the surrounding area.

wanted to feel like a legitimate member of the engineering profession (i.e., engineering identity), attending graduate school was needed. Joseph, a fourth-year graduate student in material engineering, mentioned:

> *When I talked to a lot of people who had jobs in engineering that came right out of a bachelor's degree they kind of felt that there was a ceiling on what they*

were able to do because they only had a bachelor's degree. At least in science and engineering a lot of people that are very high achieving in the field kind of talk about the PhD as almost like your barrier for entry to doing anything really creative, to controlling your own destiny.

Joseph's quotation illustrates the engineering workforce's influence on his graduate aspirations. He took note that individuals in the field believed a PhD was necessary for employment in STEM. Similarly, additional students stated that an unwritten norm that a bachelor's degree in engineering is no longer sufficient played a role in their desire to seek graduate degrees. For example, James, a fourth-year graduate student in biomedical engineering, heard a distinct message from others in the field: "From what I've heard from people before, according to my major which is biomedical engineering, I don't want to say a [bachelor's] is useless, but you're more marketable [with a graduate degree]." In their quotations, both Joseph and James assert that their graduate degrees were highly regarded as almost a rite of passage into the STEM world. However, much of this information was obtained after participants had completed their undergraduate degree, spoken with potential employers, and/or had several failed job searches.

Students who did not have a graduate degree struggled to obtain work in their fields of study, while others were criticized about a general lack of employment possibilities. Marco, a first-year doctoral student in aerospace engineering, shared his thoughts "when it came to applying for jobs":

There were some jobs that I found really interesting, but even though I had sat through undergraduate classes, and gone through the curriculum for five years of my life, they were still telling me that I either needed a graduate degree or I needed more experience. You come out expecting a couple more doors to open than actually do, and you're stuck with what seems to be like grunt work when you're applying for full-time positions. So really seeing that some of the positions that I wanted to obtain after I had graduated undergrad really required either more experience or more education was like—it was kind of like the nail on the head.

In Marco's quotation, he discusses the difficulties of looking for employment with only a bachelor's degree in engineering. Although he was interested in several employment options, he discovered that they required additional work experience or an advanced degree and realized that he needed to go back to school. Jesse, a fifth-year student in electrical engineering faced a similar situation: "I was rather naive in terms of level of education and certain jobs and things like that. That's when I found out that just having the undergrad degree doesn't just get you everything." Jesse felt he was unaware that an advanced degree was necessary for particular jobs. He discovered that having an undergraduate degree did not provide him the education he needed to obtain specific jobs within the STEM field. When met with the challenge of career advancement in engineering, some students made the decision to attend graduate school. Their

commitment to work in the engineering field, despite the setback of needing additional advanced education, demonstrates their aspirational capital to succeed.

Participants also contended that even with a master's degree, it could be difficult to find jobs that aligned with their interests. Micah, a third-year student in industrial engineering, stated the following:

> *I was looking for work, just right after I got my Master's … I just thought after I graduated, 'I had my master's, so that's a big deal, right? So, I should just be able to easily find work.'... So, that led into my decision to go into the PhD because during that year, the position I was looking for ... my degree didn't really reflect the position that I was looking for.*

Micah shared that even with a master's degree he could not find a job that fit his employment goals at the time. One way to make sense of Micah going back to school was that he wanted to increase his chances of gaining positions aligned with his career focus. The previous examples demonstrate two types of capital: social and aspirational. Many students were able to benefit from their interactions with current engineers and faculty by speaking with them about the current landscape for careers in engineering. That is, students were informed by individuals in the engineering field and employee recruiters that they should pursue advanced degrees. This finding highlights how environmental factors can play a role in a student's career choice decision-making process when viewed through the lens of SCCT.

5.2 Earning a Graduate Engineering Degree Was Regarded As a Sign of Community Influence and Respect

An advanced degree in engineering was considered to be a marker of influence and respect. This finding is slightly different from having a competitive edge for the purposes of securing a job. For these students, having an advanced degree was a requirement to feel like (i.e., engineering identity) and be seen as a respected Black leader within the engineering field. Chris, a fifth-year chemical engineering doctoral student who aspired to work in industry, shared the following:

> *One of the main factors was a desire to achieve a terminal degree because wherever I wanted to go, I wanted the opportunity to be a leader in a position and wanted to be sure that … once I got into [the] workforce that I would likely have a position of leadership, like head of a research group.*

Chris's quotation reveals his urge to become a leader in his career. For Chris, having a PhD would grant him such an opportunity. He was inspired to pursue a PhD because he aspired to be a leader in engineering. Not only did students want to be leaders in the engineering world, but they also wanted to be respected. When using the SCCT framework to analyze students' self-efficacy in leadership, their thinking about and confidence

in their abilities to become a leader corresponds with their motivations for pursuing an advanced degree in engineering.

Not only did some students want a graduate degree to enhance their leadership opportunities, but they also wanted respect from their peers and future colleagues in the engineering community. For instance, Thomas, a third-year student in mechanical engineering, shared that having a desire for more *clout* when interacting with colleagues motivated his pursuit of an advanced degree in engineering:

> *Every time I try to say something or bring a point no one listens to me but yet after that it's like, 'I told you.' It's like what do I need for you to be able to listen to me? I need some level of clout. 'Maybe, if I have a PhD people will take me more seriously or hear my opinions.'*

For students like Thomas, there was an assumption that a PhD would help make their voices heard in various work-related settings. Alphonso, a fifth-year doctoral student in electrical engineering, shared a similar perspective:

> *Having that [PhD] next to your name changes the perception ... so you know they feel like, 'oh, if he got his doctor's then he must know what he's talking about.' You can see that play out in society, how they place people who have the doctor in their name, but they're not necessarily doctors in what they're talking about. But, people have a certain feeling about them or more respect for what they say just because it says doctor.*

Like Thomas, Alphonso also believed that obtaining a PhD offers a person social respect and acceptance. Like them, several other students in this study also believed that obtaining a graduate degree would get them more respect and confirm their professional talents to others inside and outside of the engineering field.

Throughout interviews, students articulated the underrepresentation of people that looked like them in the field of engineering. They wanted to become members of the elite band of Black engineers with graduate degrees and be the source of representation for others. Jaden, a second-year student in electrical engineering**,** asserted, "There aren't that many Black professionals with PhDs. Well, particularly in the STEM field." Identically, Isaac, a fourth-year student in agricultural engineering, proclaimed, "There's not a lot of African Americans that can say they have a PhD in [my engineering subfield]; you would be one of a handful. It's a very small community." Lucas, a second-year student in electrical engineering who intended to become a faculty member, offered a similar explanation as to why he chose to work toward an advanced degree:

> *The reason why I want a PhD is ... there aren't that many Black people that I know who have a PhD, and so simply the fact that it increases that number for people to have that interaction, to know that it exists. To be that source of valid-*

ity for other people, I think, is from a social aspect, a worthy pursuit. What is the impact that I could have on other people on top of just what does my work do? What can my work do for other people, and then what can I personally do for other people?

Lucas's statement emphasizes that obtaining a PhD is not just about advancing his work, but also about promoting Black people and breaking down barriers for future generations. Like Lucas, Jaden, Isaac, and other Black male students aspired to their graduate programs in part to help broaden participation in (i.e., racially diversify) STEM. For these students, there appeared to be a desire to make an impact and increase the number of Black engineers that are available to the Black community.

The findings within this theme, representative of several other students, call attention to some students' hopes and dreams of being seen as prominent and distinguished individuals within society, as well as role models to others in the Black community. Their aspirational capital, rooted in a commitment to uplift their communities and the generation coming after, informed their aspirations to earn a graduate degree in engineering. Using CCW reveals that students drew from various forms of capital (e.g., aspirational, navigational, and resistant) in the context of wanting to serve their community and enact change. From an asset-based perspective, considering SCCT, when juxtaposed with CCW, race/ethnicity (as an individual's personal factor) might be predictors of academic discipline and professional job choice, at least for some of the Black male graduate students in this study.

5.3 Students' Professorial Career Goals Necessitated an Advanced Degree

Several students asserted that earning a graduate degree was a requirement on their path to becoming a professor. For these students, attending graduate school was the pragmatic and logical next step to fulfilling their career goals of joining the professoriate (e.g., researching, teaching, and mentorship). For instance, Titus, a second-year student in civil engineering, shared, "My end goal still is to become a professor … You need a PhD to become a full-time professor. That was the main goal and I like doing research." Titus's quotation implies that his graduate degree aspirations were influenced by his long-term career goals. Similarly, Christian, a third-year student in civil engineering, explained his rationale for pursuing an advanced degree: "I think my primary motivation was that I'm deeply passionate about teaching and I knew that the only way for me to continue mentorship and continue teaching was to pursue a graduate degree … ultimately … a PhD." Christian's desire as an undergraduate student to enter the academy fueled his pursuit of a graduate degree. Furthermore, Christian aspired to use his PhD as a communal tool to inspire and enlighten future engineering scholars. Therefore, this was a necessary step in doing the work related to his overall career pursuits. Collectively, students' quotations assert that their career-specific interest (e.g., personal goals; SCCT) informed their graduate degree aspirations.

Becoming a professor and teaching was also the goal for Jesse. He affirmed that "I always wanted to teach and faculty established that connection between teaching at the collegiate level and the PhD." Jesse reports that he always had a desire to teach. He learned through his discussions with faculty that an intersection existed at the crossroads of the PhD and teaching at the collegiate level. These students' quotations correspond to two forms of capital supported by Yosso's (2005) work: aspirational and navigational capital. Employing SCCT, this finding aligns with the Black males' personal goals and interests in fulfilling their career aspirations of gaining membership in academia.

5.4 Mothers Functioned as Support Systems and Role Models for Pursuing an Advanced Degree

While many participants cited family (e.g., parents, siblings, and extended family) as an influential factor in their pursuit of graduate degrees in STEM, most identified their mothers as the transformational force behind their aspirations. Victor, who was a fifth-year student in chemical engineering, discussed how his mother impacted his desire to pursue graduate education:

> *Talking with my parents was the biggest influence, especially my mom kind of kneaded it into me and my brother. You know, 'Go as far as you can go. Don't just stop. Just keep going. Never stop learning.' My mom did a master's, so she kind of infused it inside of my head. My mom … made sure that I didn't lose sight of the fact that I wanted to go to grad school.*

Victor's statement emphasizes that while his mother regularly supported his efforts to obtain an advanced degree, she also led by example since she had earned a master's degree. Her having an advanced degree may have made it possible for Victor to see a doctoral degree as obtainable for a Black male and as a way to honor his mother's commitment to education.

Similarly, others explained how their mothers played a role in their graduate degree aspirations. For example, Trai, whose mother and father had attended college, shared the following:

> *I think, especially my mother … has been really big on education; my dad has too—but my mother … has really just emphasized a Black male … trying to make it in this society, [do] whatever to distinguish yourself in a positive way … [This graduate degree] is probably going to be something that's only going to help me.*

Trai's comment highlights that his parents thought highly of education, but his mother continuously reminded him that being a Black man with a graduate degree would place him within a positive sector of society. What is more important is that his mother knew having an advanced degree would help her son and not hurt him in any way.

Marcus, a third-year student in chemical engineering, had a mother who shared parallel ideas regarding schooling. He affirmed that his mother always pushed the importance of education: "My mom always stressed education and getting all the education that you can get. So you know, with that mindset it was kind of like a no brainer." He refers to pursuing grad school as a *no brainer* because his mother set the foundation of continued education as a necessity. As a result, he saw an advanced degree as an opportunity to acquire more knowledge and follow the guidance of his mother.

Kendall, a second-year master's student, had a mother who also pushed him and made sure her son stuck to his promise to her about attending graduate school:

> *I ... made a promise with my mom, saying if I don't see anything [in the job market of interest] then I'll definitely go to graduate school. Basically, after looking around for six months and not finding anything, my mom gave me the push, she gave me the reminder. She said, 'You promised me that you would go to grad school.'*

Kendall recognizes that his mother wanted him to be a man of his word, that is, going back to claim an advanced degree in STEM. His mother was intentional in reminding her son that getting an advanced degree was still an option for him. From all of these examples and more, the Black male graduate students were able to draw on the knowledge and support obtained from having mothers who were passionate about their sons' scholastic aspirations. This not only aligns with the Yosso (2005) premise of familial capital, but it also leverages the contextual and environmental factors described by Lent et al. (1994) utilizing the SCCT lens.

Not only did mothers' encouragement motivate their sons to pursue graduate degrees, but their own educational achievements and occupations also aided in their sons' aspirational journeys through STEM. Specifically, a few of the students considered their mothers' degrees and positions in the professoriate to be essential factors in their doctoral aspirations. For instance, Titus shared, "My mom is a professor, so she had a little bit of influence on me." The same was true for Joseph:

> *In some ways [I chose my doctoral institution] because my mom went here to get her PhD. She took her sabbatical here back when I was in middle school, when I was 14, and so I had exposure to [my institution's city] and the surrounding area.*

Joseph was enlightened about the professorate at an early age because of his exposure to the academy through his mom. Like Joseph, Jacob, a third-year doctoral student in chemical engineering, was also inspired to continue his education because of his mother's occupation in the academy: "[M]y mom's always been an academician, and there was a choice that I made in going into college that I wanted to go to college primarily for academics … I think coming to graduate school was … a continuation of that interest." These students' exposure to the academy served as a model for them to pursue

doctoral degrees. For Jacob, his mother's role as an academic not only influenced his prioritization of academics in college, but further fueled his aspiration to attend graduate school.

Likewise, Kemani stated his aspirations for graduate school:

> *My mom was a medical doctor. I've known other professions. I know you get a doctorate—you have to get a PhD ... My mom, she was highly influential in most of my academic pursuits because she was the one who took me to 30 different colleges to visit. I visited most of those before I was a junior [in high school]. For the longest time I knew what a doctorate was. At least I knew it was the highest level of degree you could get. I didn't really know what it entailed, but for the longest time I knew that was the ... highest level that you could go.*

Kemani's quotation highlights how his early exposure to postsecondary education, at the hands of his mom, acted as a guiding principle for his own academic endeavors. For students in this study, their mothers' own education enticed them to get a graduate degree. Furthermore, their mothers' additional roles in having them on campus, familiarizing them with their profession's terminology, and role modeling what it means to be a [Black] person with an advanced degree provided aspirational foreshadowing of their future doctoral selves. Not only were these Black males able to rely on their familial capital, but they were also able to draw on linguistic capital as a result of exposure to the academy vis-à-vis their mothers' professional and academic careers.

6. DISCUSSION

Black male matriculators and earners of advanced degrees are a fraction of the total population who could be earning advanced degrees. For this reason, we describe aspirations for—and attendance in—graduate school as the road less traveled. The challenges to attending graduate school are exacerbated for minoritized populations (e.g., Black males), for whom many systemic and systematic barriers may threaten their aspirations to pursue the road less traveled. Thus, this study, centering the voices of 50 Black males, aimed to better understand the factors that influenced their aspirations to pursue graduate degrees in engineering.

We drew from the CCW framework (Yosso, 2005) to better understand the existing forms of capital that Black males possessed and activated in pursuing an advanced degree. In general, the Black male students did not speak about a single form of capital. Rather, as illustrated in the findings and discussed in Yosso (2005), there is frequently overlap between the various capitals of cultural wealth. Students' various forms of cultural wealth/capital aided in their aspirations for and actions to pursue graduate education. We also used SCCT (Lent et al., 1994) because of its properties, which explain individuals' self-efficacy, personal goals, and expectation outcomes relative to their academic and professional aspirations. In so doing, the SCCT framework helped illuminate how students' personal and environmental experiences informed their engineer-

ing graduate school academic and workforce (e.g., faculty and industry) aspirations. Taken together, CCW and SCCT provided useful understandings of the precollege and pregraduate school cultural knowledge and expectations regarding academic outcomes that some Black males come equipped with before arriving on postsecondary campuses. Our analysis of the aspirational experiences of Black males in engineering graduate programs, who are pervasively racialized and gendered in the academy (Burt et al., 2018; McGee, 2020; Smith, 2010; Smith et al., 2007), offers an important extension to previous research illustrating how different forms of capital may be unique to Black males. This new knowledge about the aspirations of Black males considering advanced degrees adds to the growing corpus of literature.

We acknowledge that not all students need to attend graduate school, nor do all individuals want to attend college. By framing graduate school as the road less traveled, we do not intend to suggest that there are not other important—and equally tumultuous—journeys that individuals take. However, the Black males in this study did want to pursue advanced degrees, and their pursuit of graduate education was a commitment to a journey not taken by all. Other scholars have offered insights into why some Black students pursue advanced degrees and have offered clues as to some of the individuals who assist in students' graduate aspirations (McCallum, 2016; McGee et al., 2016). In making sense of their aspirations, the Black males in this study described multiple reasons, aligned with their personal and career goals, that aided in their pursuit and completion of advanced degrees.

It is evident from the students' voices that their mothers believed in the value of education and their sons' abilities to academically succeed. Across students, mothers were described as keeping students on track, leading by example (in their own educational pursuits), and reminding participants of the positive impacts they could have on society as Black males with advanced degrees. Existing research studies (McCallum, 2016; McGee et al., 2016; Means et al., 2022; Sellers et al., 2022) have highlighted that familial capital (e.g., mothers stressing the importance of education and motivating and encouraging their children) helps to foster students' educational aspirations. Support from their mothers contributed to the early aspirations of some of the Black males in this study to pursue graduate school. Although the significant roles that mothers played in students' aspirations to pursue graduate school emerged as a finding, we want to be clear that students' fathers were not necessarily absent or unhelpful in Black males' aspirations regarding graduate school. Previous research studies have highlighted important ways that Black males' fathers assist with their persistence when in graduate school (Burt et al., 2019b), not to mention assist with the formative origins of their STEM interest (Burt and Johnson, 2018). The distinction in this study is the nuanced and specific roles mothers played in their sons' aspirations to pursue graduate degrees in engineering. Cultural knowledge is innately cultivated within families, as stated in Yosso (2005). For many students in this study, familial capital (e.g., support and knowledge) propelled them into their educational pathways; parents' (broadly, and mothers specifically) commitment to, and persistent emphasis of, a Black male earning an advanced degree appeared to guide their efforts.

Our findings indicate that students (at the undergraduate level, if not before) give thought to their future careers and professions. These thoughts about their future professional selves inform the steps and strategies they take to achieve their career goals. In particular, one group stood out because of their detailed aspirational plans to pursue the professoriate (11 students). While many more students indicated via the demographic form that they intended to pursue industry careers (22 students), those who explained having early aspirations toward a faculty career shared how this career goal was a dominant motivator in their choice to pursue graduate school. In presenting this finding, we are not suggesting that certain postgraduate careers are more significant than others. However, as a pattern within the data, the level of clarity and commitment regarding graduate school seemed to be differently explained (i.e., more clearly and definitively) by those who wanted to pursue faculty careers. It is possible that holding early aspirations to join the professoriate may result from students being able to see professors and know what they do, such that they can visibly see a more direct pathway toward a career.

We find it interesting that students knew they needed a PhD to pursue a faculty career yet did not know that a PhD could facilitate access to better industry positions. We were left with more questions than answers. Specifically, who is not privy to this unwritten rule (about the importance an advanced degree can have in the engineering industry)? In addition, who is it unwritten for (people of color, first-generation college students, other minoritized individuals, etc.) (Bejerano and Bartosh, 2015; Villanueva et al., 2018)? If some of the males in this study did not have access to current engineers in industry to gain information about the need for advanced degrees, how would they know that a bachelor's degree alone might limit them to a professional ceiling? In this regard, access to social capital assisted in their career planning, which included aspiring to attend graduate school. However, it is not lost on us that some students outside of our study may not receive this same information if they are not connected with or exposed to those within the engineering industry who can help to explain the opportunities afforded by an advanced degree.

Finally, we offer reflections on a theme that at times pointed in conflicting directions: influence and respect. On one hand, some participants shared a strong desire to become engineers in order to do the work of engineers and serve their community. This finding appeared to most closely align with those of McGee et al. (2016), who similarly found that Black engineering doctoral students had a combination of passion and purpose—the purpose, in part, being altruistic and community centered (in addition, see Charleston, 2012; Johnson and Strayhorn, 2022; McCallum, 2017; Means et al., 2022). On the other hand, some of this study's student participants also candidly shared that pursuing an advanced degree in engineering would provide them both status and respect in their communities; they may have been referencing multiple communities with which they identify. In other words, it appeared that for some students it was not just about aspiring to become a professor (as one example) out of a desire to do the work and make the contributions of a professor, but rather aspiring to become a professor because of the status that the title of professor might confer on themselves.

6.1 Implications for Future Research and Practice

The current study lends itself to several implications for research and practice. This study identifies some of the external and internal factors that informed students' aspirations for pursuing a graduate degree. However, it remains unclear exactly when students' aspirations began. More intentionally exploring the emergence of students' aspirations may provide clues as to how different stakeholders (e.g., parents, K-12 teachers, undergraduate advisors, support services, faculty, mentors, peers, etc.) can leverage students' inquisitiveness about graduate school and encourage their interests. In turn, stakeholders could begin talking to students about graduate school earlier, with the hope of decreasing the unknowns and mysteries surrounding graduate education. Additionally, knowing when students become—even remotely—inquisitive might also assist stakeholders in helping students navigate through potential barriers known to threaten their continued participation in science and engineering (e.g., weed out courses, gendered and racialized microaggressions, racism, etc.) (Burt and Johnson, 2018; Burt et al., 2018, 2019a,b; McGee, 2020; Seymour and Hewitt, 1997).

Just like the brilliant students in this study, there are countless numbers of equally bright and talented Black male engineers who choose not to pursue advanced degrees. It is possible that these males are having fruitful engineering careers and do not feel as if they have hit their professional ceilings. Thus, future research might explore the education to engineering workforce pathways of Black males who remained in the engineering field after earning their bachelor's degree. Such an exploration of their persistence in STEM despite potential coursework and workforce barriers might offer valuable insights into the navigational and resistance forms of capital (Yosso, 2005) necessary for broadening sustained participation in STEM for Black male engineers. In contrast, further research could also explore why a student would decide to become a faculty member over pursuing an industry professional. As the results of this study imply, one possible explanation is that some students view an advanced degree more as a communal token of significance (i.e., benefits their community/future generations) than as an opportunity for personal advancement (i.e., financial gain).

Relatedly, we did not intentionally seek to understand why some Black males aspired to gain respect and influence within their communities. For some, earning an engineering degree might be considered a marker of *making it* in a predominantly White, patriarchal, heteronormative United States context; a marker of *arrival* (the validation of belonging to an elite group of people who have made it down through the road less traveled). However, it can simultaneously be possible that aspiring to earn an advanced degree in engineering could be perceived as—and function as—a necessary credential needed to help one's community. These potential effects can operate simultaneously. The existing literature offers some explanation for how respect and influence are connected to Black males' conceptions of masculinity and manhood (Dancy, 2012), but how this relates specifically to Black males pursuing advanced degrees in engineering remains unclear. More information is needed on how perceptions of earning an advanced

degree—yielding respect and influence and other outcomes—might be related to Black male's understandings of their gendered and racialized masculinity within anti-Black societal contexts. Such a study could offer additional clarity regarding students' experiences of feeling like they belong and are respected (or disrespected) within their engineering educational pathways.

In our study, some students received information about the various possibilities of engineering careers through their interactions with those in the engineering workforce. However, access to this career information appeared to be circumstantial. Instead, departments could develop mentoring programs to ensure that Black males (as well as all undergraduate students) understand the benefits of gaining advanced degrees for both academic and industry careers, and the requirements necessary for obtaining them. In addition, the engineering profession, primarily industry, should promote clarity regarding educational expectations for various roles. For instance, corporations could partner with engineering departments to develop promotional items (e.g., charts, infographics, and flyers) that explain the approximate education levels required for certain positions. This could be beneficial for students, particularly Black males, who are pursuing engineering degrees and may be unaware of the educational expectations for prospective engineering roles in industry.

7. CONCLUSIONS

Many barriers stand in the way of Black males earning a graduate degree. However, first they must develop their aspirations to apply and matriculate into a graduate degree program. There are clearly a host of factors, both internal and external, that inform Black males' aspirations for earning advanced degrees. Needed now are commitments, not exclusively from Black males themselves, but from stakeholders truly committed to increasing the participation of Black males in engineering pathways, engineering graduate education, and the engineering workforce. True commitments to increasing their participation would include engaging and supporting them at the point where their aspirational interest begins. Then, committed stakeholders should leverage and nurture Black males' aspirational interests until passage down the road less traveled becomes the journey fulfilled.

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REFERENCES

American Society for Engineering Education. (2019). *Engineering and engineering technology: By the numbers*. Retrieved from https://ira.asee.org/wp-content/uploads/2021/06/Engineering-by-the-Numbers-2019-JUNE-2021.pdf.

American Society for Engineering Education. (2020). *Engineering and engineering technology: By the numbers*. Retrieved from https://ira.asee.org/wp-content/uploads/2021/11/Total-by-the-Number-2020.pdf.

Baber, L. D. (2014). When aspiration meets opportunity: Examining transitional experiences of African American males in college readiness programs. *Community College Journal of Research and Practice*, 38(12), 1097–1111. DOI: 10.1080/10668926.2012.745384

Baker, V. L., Pifer, M. J., & Flemion, B. (2013). Process challenges and learning-based interactions in stage 2 of doctoral education: Implications from two applied social science fields. *The Journal of Higher Education*, 84(4), 449–476. DOI: 10.1353/jhe.2013.0024

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Hoboken, NJ: Prentice Hall.

Bejerano, A. R., & Bartosh, T. M. (2015). Learning masculinity: Unmasking the hidden curriculum in science, technology, engineering, and mathematics courses. *Journal of Women and Minorities in Science and Engineering*, 21(2), 107–124. DOI: 10.1615/JWomenMinorScienEng.2015011359

Benjamin, L. S., Henderson, J. A., & Hines, E. M. (2022). *Is the "E" in engineering for entrepreneurship? An emerging concept of entrepreneurial engineering Identity* [Conference presentation]. 2022 ASEE Gulf Southwest Annual Conference, Prairie View, TX, United States. Retrieved from https://sftp.asee.org/39190.

Bhattacharya, K. (2017). *Fundamentals of qualitative research: A practical guide*. Routledge.

Borrego, M., Knight, D. B., Gibbs, K., Jr., & Crede, E. (2018). Pursuing graduate study: Factors underlying undergraduate engineering students' decisions. *Journal of Engineering Education*, 107(1), 140–163. DOI: 10.1002/jee.20185

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. DOI: 10.1191/1478088706qp063oa

Burt, B. A. (2020). Broadening participation in the engineering professoriate: Influences on Allen's journey in developing professorial intentions. *Journal of Engineering Education*, 109(4), 821–842. DOI: 10.1002/jee.20353

Burt, B. A., & Johnson, J. T. (2018). Origins of STEM interest for Black male graduate students in engineering: A community cultural wealth perspective. *School Science and Mathematics*, 118(6), 257–270. DOI: 10.1111/ssm.12294

Burt, B. A., McKen, A., Burkhart, J., Hormell, J., & Knight, A. (2019a). Black men in engineering graduate education: Experiencing racial microaggressions within the advisor–advisee relationship. *Journal of Negro Education*, 88(4), 493–508. DOI: 10.7709/jnegroeducation.88.4.0493

Burt, B. A., Roberson, J., Johnson, J., & Bonanno, A. (2020). Black men in engineering graduate programs: A theoretical model of the motivation to persist. *Teachers College Record*, 122(11), 1–58. DOI: 10.1177/016146812012201109

Burt, B. A., Williams, K. L., & Palmer, G. J. M. (2019b). It takes a village: The role of emic and etic adaptive strengths on the persistence of Black men in engineering graduate programs. *American Educational Research Journal*, 56(1), 39–74. DOI: 10.3102/0002831218789595

Burt, B. A., Williams, K. L., & Smith, W. A. (2018). Into the storm: Ecological and sociological impediments to Black males' persistence in engineering graduate programs. *American Educational Research Journal*, 55(5), 965–1006. DOI: 10.3102/0002831218763587

Cadenas, G. A., Liu, L., Li, K. M., & Beachy, S. (2022). Promoting critical consciousness, academic performance, and persistence among graduate students experiencing class-based oppression. *Journal of Diversity in Higher Education*, 15(1), 26–36. DOI: 10.1037/dhe0000250

Carson, L. R. (2009). "I am because we are:" Collectivism as a foundational characteristic of African American college student identity and academic achievement. *Social Psychology of Education*, 12, 327–344. DOI: 10.1007/s11218-009-9090-6

Charleston, L. J. (2012). A qualitative investigation of African Americans' decision to pursue computing science degrees: Implications for cultivating career choice and aspiration. *Journal of Diversity in Higher Education*, 5(4), 222–243. DOI: 10.1037/a0028918

Cooper, J. N., Porter, C. J., & Davis, T. J. (2017). Success through community cultural wealth: Reflections from Black female college athletes at a historically Black college/university (HBCU) and a historically White institution (HWI). *Journal of Intercollegiate Sport*, 10(2), 129–156. DOI: 10.1123/jis.2017-0006

Corbin, J., & Strauss, A. (2008), *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage.

Council of Graduate Schools. (2020). *Graduate enrollment and degrees: 2010 to 2020, Appendix B: Data tables for graduate applications, first-time enrollment, total enrollment, Fall 2020, and degrees conferred, 2019–20*. Retrieved from https://cgsnet.org/wp-content/uploads/2022/02/CGS_GED20_Report_Apx-B.pdf.

Creswell, J. W. (2012). *Qualitative inquiry and research design: Choosing among five traditions* (3rd ed.). Sage.

Cuellar, M. G., & Gonzalez, A. M. (2021). Beyond the baccalaureate: Factors shaping Latina/o graduate degree aspirations. *Journal of Hispanic Higher Education*, 20(1), 59–74. DOI: 10.1177/1538192719830082

Dancy, T. E. (2012). *The brother code: Manhood and masculinity among African American males in college*. Charlotte, NC: Information Age Publishing.

Davis, R. D., Winfield, L., Spivak, D., & Wilson-Kennedy, Z. S. (2021). Role of international research experiences in the development of women of color in chemistry. *Journal of Chemical Education*, 99(1), 104–112. DOI: 10.1021/acs.jchemed.1c00518

Espino, M. M. (2014). Exploring the role of community cultural wealth in graduate school access and persistence for Mexican American PhDs. *American Journal of Education*, 120(4), 545–574. DOI: 10.1086/676911

Frost, R. (1915). *The road not taken.* Atlantic Monthly, August 1915 Issue.

Gándara, P. (1982). Passing through the eye of the needle: High-achieving Chicanas. *Hispanic Journal of Behavioral Sciences*, 4(2), 167–179. DOI: 10.1177/07399863820042003

Henderson, J. A., Hines, E. M., Boyce, A., Golden, M., Singleton, P., II, Davis, J. L., Slack, T., & Junqueria, W. (2022). Factors impacting engineering advanced degree pursuit and attainment among Black males. *Journal of Women and Minorities in Science and Engineering*, 28(4), 1–24. DOI: 10.1615/JWomenMinorScienEng.2021036005

Johnson, R. M., & Strayhorn, T. L. (2022). Examining race and racism in Black men doctoral student socialization: A critical race mixed methods analysis. *Journal of Diversity in Higher Education*, Advance online publication. DOI: 10.1037/dhe0000420

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior*, 45(1), 79–122. DOI: 10.1006/jvbe.1994.1027

Litzer, E., & Lorah, J. (2018). Degree aspirations of undergraduate engineering students and the intersection of race/ethnicity and gender. *Journal of Women and Minorities in Science and Engineering*, 24(2), 165–193. DOI: 10.1615/JWomenMinorScienEng.2018017998

Lunn, S. J., Ross, M. S., Hazari, Z., Weiss, M. A., Georgiopoulos, M., Christensen, K., & Solis, T. (2021). Uneven playing field: Examining preparation for technical interviews in computing and the role of cultural experiences [Conference presentation]. *2021 ASEE Virtual Annual Conference Content Access, Virtual Conference.* Retrieved from https://peer.asee.org/37973.

Maton, K. I., Sto Domingo, M. R., Stolle-McAllister, K. E., Zimmerman, J. L., & Hrabowski, F. A., III. (2009). Enhancing the number of African-Americans who pursue STEM PhDs: Meyerhoff Scholarship Program outcomes, processes, and individual predictors. *Journal of Women and Minorities in Science and Engineering*, 15(1), 15–37. DOI: 10.1615/JWomenMinorScienEng.v15.i1.20

McCallum, C. M. (2016). "Mom made me do it": The role of family in African Americans' decisions to enroll in doctoral education. *Journal of Diversity in Higher Education*, 9(1), 50–63. DOI: 10.1037/a0039158

McCallum, C. (2017). Giving back to the community: How African Americans envision utilizing their PhD. *The Journal of Negro Education*, 86(2), 138–153. DOI: 10.7709/jnegroeducation.86.2.0138

McCallum, C. M. (2020). Othermothering: Exploring African American graduate students' decision to pursue the doctorate. *The Journal of Higher Education*, 91(6), 953–976. DOI: 10.1080/00221546.2020.1731262

McGee, E. O. (2020). *Black, brown, bruised: How racialized STEM education stifles innovation.* Harvard Education Press.

McGee, E. O., Griffith, D. M., & Houston, S. L., II. (2019). "I know I have to work twice as hard and hope that makes me good enough": Exploring the stress and strain of Black doctoral students in engineering and computing. *Teachers College Record*, 121(4), 1–38. DOI: 10.1177/016146811912100407

McGee, E. O., White, D. T., Jenkins, A. T., Houston, S., Bentley, L. C., Smith, W. J., & Robinson, W. H. (2016). Black engineering students' motivation for PhD attainment: Passion plus purpose. *Journal for Multicultural Education*, 10(2), 167–193. DOI: 10.1108/JME-01-2016-0007

Means, D. R., Stanton, J. D., Mekonnen, B., Oni, O., Breeden, R. L., Babatola, O., Osondu, C., Beckman, M. A., and Marshall, B. (2022). A deeper calling: The aspirations and persistence of Black undergraduate students in science at a predominantly White institution. *The Review of Higher Education*, 46(2), 151–180. DOI: 10.1353/rhe.0.0183

Medina, A., Chen, C., Doyle, J., Sonnert, G., & Sadler, P. (2021). The association of career outcome expectations and STEM career choice among Hispanic first-generation students: A unique pattern. *Journal of First-Generation Student Success*, 1(3), 203–223. DOI: 10.1080/26906015.2021.2004081

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). Jossey-Bass.

Miles, M. L., Brockman, A. J., & Naphan-Kingery, D. E. (2020). Invalidated identities: The disconfirming effects of racial microaggressions on Black doctoral students in STEM. *Journal of Research in Science Teaching*, 57(10), 1608–1631. DOI: 10.1002/tea.21646

Milovanska-Farrington, S. (2020). Reasons to attend college, academic success, and post-college plans. *Education Economics*, 28(5), 526–547. DOI: 10.1080/09645292.2020.1801597

Moore, J. L., III. (2006). A qualitative investigation of African American males' career trajectory in Engineering: Implications for teachers, school counselors, and parents. *Teachers College Record*, 108(2), 246–266. DOI: 10.1111/j.1467-9620.2006.00653.x

Nora, A., & Cabrera, A. (1996). The role of perceptions of prejudice and discrimination on the adjustment of minority students to college. *The Journal of Higher Education*, 67(2), 119–148. DOI: 10.1080/00221546.1996.11780253

Phinney, J. S., Dennis, J., & Osorio, S. (2006). Reasons to attend college among ethnically diverse college students. *Cultural Diversity and Ethnic Minority Psychology*, 12(2), 347–366. DOI: 10.1037/1099-9809.12.2.347

Rodriguez, S. L., Perez, R. J., & Schulz, J. M. (2022). How STEM lab settings influence graduate school socialization and climate for students of color. *Journal of Diversity in Higher Education*, 15(1), 58–72. DOI: 10.1037/dhe0000361

Scheuermann, T. S., Tokar, D. M., & Hall, R. J. (2014). An investigation of African-American women's prestige domain interests and choice goals using social cognitive career theory. *Journal of Vocational Behavior*, 84(3), 273–282. DOI: 10.1016/j.jvb.2014.01.010

Sellar, S., & Gale, T. (2011). Mobility, aspiration, voice: A new structure of feeling for student equity in higher education. *Critical Studies in Education*, 52(2), 115–134. DOI: 10.1080/17508487.2011.572826

Sellers, V. B., Martin J. P., & Seraphin, M. (2022). A narrative inquiry approach to community cultural wealth of Black men in engineering. *Journal of Women and Minorities in Science and Engineering*, 28(4), 69–95. DOI: 10.1615/JWomenMinorScienEng.2021038012

Seymour, E., & Hewitt, N. M. (1997) *Talking about leaving: Why undergraduates leave the sciences.* Boulder, CO: Westview Press.

Smith, W. A. (2010). Toward an understanding of misandric microaggressions and racial battle fatigue among African Americans in historically White institutions. In E. M. Zamani-Gallaher & V. C. Polite (Eds.), *The state of the African American male* (pp. 265–277). Michigan State University Press.

Smith, W. A., Allen, W. R., & Danley, L. L. (2007). "Assume the position … you fit the description": Psychosocial experiences and racial battle fatigue among African American male college students. *American Behavioral Scientist*, 51(4), 551–578. DOI: 10.1177/0002764207307742

Strayhorn, T. L. (2009). Different folks, different hopes: The educational aspirations of Black males in urban, suburban, and rural high schools. *Urban Education*, 44(6), 710–731. DOI: 10.1177/0042085908322705

United States Census Bureau. (2020). *The U.S. adult and under-age-18 populations*. Retrieved from https://www.census.gov/library/visualizations/interactive/adult-and-under-the-age-of-18-populations-2020-census.html.

Villanueva, I., Gelles, L. A., Stefano, M. D., Smith, B., Tull, R. G., Lord, S. M., Benson, L., Hunt, A. T., Riley, D. M., & Ryan, G. M. (2018). What does hidden curriculum in engineering look like and how can it be explored? [Conference presentation]. *2018 ASEE Annual Conference and Exposition*, Salt Lake City, UT, United States. Retrieved from https://peer.asee.org/31234

Wang, X. (2013). Modeling entrance into STEM fields of study among students beginning at community colleges and four-year institutions. *Research in Higher Education*, 54(6), 664–692. DOI: 10.1007/s11162-013-9291-x

Wofford, A. M., Sax, L. J., George, K. L., Ramirez, D., & Nhien, C. (2022). Advancing equity in graduate pathways: Examining the factors that sustain and develop computing graduate aspirations. *The Journal of Higher Education*, 93(1), 110–136. DOI: 10.1080/00221546.2021.1930840

Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race, Ethnicity, and Education*, 8(1), 69–91. DOI: 10.1080/1361332052000341006