Black Men in Engineering Graduate Programs: A Theoretical Model of the Motivation to Persist

BRIAN A. BURT

University of Wisconsin, Madison

JUSTIN J. ROBERSON

Iowa State University

JARREL T. JOHNSON

Iowa State University

ANNE BONANNO

Miami University

Background: *A growing body of research highlights the experiences of Black men students who successfully navigate science, technology, engineering, and mathematics (STEM) educational pathways. Many Black men graduate students in engineering describe moments when their advisors, peers, and, at times, community members make them feel different because of their race and gender. Needed is a better understanding of what motivates Black men to persist in graduate school despite such challenges.*

Purpose: *This study advances a new theoretical model, "Black Men's Graduate Engineering Motivation" (BMGEM), to describe the overlaying factors and sources of motivation—and their interrelations—that influence Black men in engineering graduate programs to persist.*

Research Design: *To explore the motivational factors that influence Black men in graduate engineering programs at predominantly White institutions (PWIs) to persist, this study of 42 students used an eight-item demographic form, one-on-one semi-structured interviews, and follow-up focus groups. Data analysis was conducted using adapted grounded theory techniques. After the completion of data collection and multiple iterations of analyses (both inductive and deductive), existing conceptualizations of motivation were used to help make sense of data. The connection to existing literature, code development, their placement into categories, and placing categories into themes led to the creation of a substantive, practice-informing theory: Black Men's Graduate Engineering Motivation.*

Teachers College Record Volume 122, 110309, November 2020, 58 pages

0161-4681

Findings: *Data analysis resulted in the theory of Black Men's Graduate Engineering Motivation (BMGEM). The BMGEM explains the overlaying factors that influence individuals' experiences and motivations to persist (i.e., sociocultural factors, personal factors, social identities, pre-graduate school experiences), and external and internal motivational sources that also influence students' motivations to persist (i.e., desire to earn a graduate degree, desire to become an engineer, challenges during graduate school, peers, family members, [under]representation, self-coaching practices, career and professional goals).*

Conclusions and Recommendations: *The findings from this study inform future research, and practice-based strategies around broadening participation, that aid in Black men's progress through science and engineering pathways. With this new information, we charge engineering colleges to make true commitments to broadening participation, which means centering students—in this case, Black men—as contributors to STEM. In doing so, engineering colleges need to commit to helping Black men succeed. Assisting in their motivation to persist is a key to meeting this charge.*

Courtney, Christian, Martin, and Dean (all pseudonyms) are Black male graduate students in well-respected engineering programs. All had early interests in science and engineering, supportive family members who encouraged their science, technology, engineering, and mathematics (STEM) interests, and K–12 teachers who helped nurture those interests further (Burt & Johnson, 2018; Burt et al., 2019). Partly due to these three sources of support, they held sustained competitive academic records from elementary through undergraduate studies (their self-reported average high school and undergraduate grade point averages were 3.26 and 3.44, respectively), earning them admission into prestigious engineering graduate programs. Unfortunately, once there, they all described moments when their advisors, peers, and, at times, community members in the cities where their institutions are located, made them feel different—in negative ways—because of their race and gender (Burt et al., 2017, 2018, 2019). These moments of feeling out of place threatened their dreams of completing graduate school.

The stories told by Courtney, Christian, Martin, and Dean are not rare; their narratives illustrate the ugly lasting vestiges of systemic racism in higher education (Brooms, 2019; Chavous et al., 2017; Harper, 2015; Harper & Palmer, 2016; Ingram, 2007; Muñoz & Maldonado, 2011; Smith et al., 2007). Yet, despite the shared challenges threatening their persistence, they and other Black men remain motivated to make progress toward their graduate degrees or have already earned them. In this study, consonant with existing higher education literature, when we use the word "persistence" and its derivatives (e.g., "persist," "persisting," "persisted"), we are describing the *process* by which an individual makes progress toward a specified goal; this is in contrast to "persistence" being exclusively referred to as the *outcome* that is college graduation

(Fries-Britt et al., 2012; Hagedorn, 2005; Pascarella & Terenzini, 1991, 2005; Reason, 2009). For instance, in the current study, some students described incremental goals of making progress from semester to semester, not dropping out of graduate school, and remaining in STEM. We consider these to be examples of persistence.

In this study, we focus exclusively on Black men, recognizing the historic gendered and racialized stereotyping that shapes how people pathologize Black men (Burt, et al., 2018; Curry, 2017; Smith, 2010). Further, we agree with other scholars that individuals' motivation to achieve is related in part to their values, goals, and choices, which is based on societal socialization and informed by their gender, race, and ethnicity (DeCuir-Gunby & Schutz, 2014; Eccles, 2011; Smith et al., 2007). Drawing on previous research about Black men in science and engineering, this article explores the experiences of 42 Black men to better understand their motivation to persist. We conclude by advancing a new theoretical model of motivation, and offer implications for future research, theory, and practice pertaining to Black men in engineering graduate programs.

THEORY AND LITERATURE ON MOTIVATION, STEM, AND BLACK STUDENTS

Before describing the experiences specific to Black men in engineering, it is necessary to acknowledge a broader STEM context. Even though STEM fields have and continue to receive a considerable amount of public attention and resources to broaden participation in those fields of study (Baber & Jackson, 2018; Chubin et al., 2005; Hrabowski III, 1991; Hrabowski & Pearson, 1993; Lane, 2016; Russell & Atwater, 2005), research and data show that interest in and completion of STEM pathways remain stagnant (National Science Foundation, 2017; Yoder, 2017). The statistics are even more alarming when considering the growing proportion of people of color in the United States. Persistent trends in data suggest that challenges to broadening participation in STEM remain. For instance, existing research suggests that before even making it into STEM graduate education, one must acculturate to difficult and unwelcoming STEM environments in undergraduate studies (Fries-Britt et al., 2012; Fries-Britt & White-Lewis, 2020). Often, this acculturation process at the undergraduate level takes the form of weed-out courses that use outdated Eurocentric and male-centric pedagogical practices, with a curriculum that is not representative of the diverse tapestry of today's students (Gasiewski et al., 2012; Green & Glasson, 2009; Seymour & Hewitt, 1997). At the graduate level, these challenges may be exacerbated when compounded with the demands of similar classroom experiences, as well as grueling numbers of hours

and racial and gendered microaggressions within the research laboratory, complicated interactions with one's advisor and peers, and their cumulative effects (Burt et al., 2018; Campbell et al., 2018; McGee et al., 2019; Perez et al., 2019). Taken together, classroom, laboratory, advising, and peer interactions tend to serve as implicit gatekeepers to persistence and broadening participation in STEM.

Such gatekeeping poses challenges for all engineering students, but these challenges are likely exacerbated for Black men, due to their underrepresentation. Black men make up only about 1% of those who are enrolled in graduate engineering programs and awarded graduate engineering degrees in the United States (Yoder, 2017) (see Table 1).

Table 1. Black Men Enrolled in and Awarded Engineering Graduate Degrees in 2017 in the United States

	Master's	%	Doctoral	%	Total	%
Black Male Enrollment (all student total)	940 (86,872)	1.1%	732 (70,026)	1%	1,672 (156,898)	1.1%
Black Males Awarded (all student total)	876 (64,602)	1.4%	128 (11,589)	1.1%	1,004 (76,191)	1.3%

To better understand some Black males' motivation to persist despite these challenges, we first describe existing theories and literature pertaining to the motivation of students in general, students in STEM, and Black students in particular.

Throughout the extant literature, understandings of what motivation is, and how it operates, vary. Some scholars explore how individuals' thoughts and beliefs translate into actions and behaviors (Ames & Ames, 1984; Griffin, 2006), whereas others examine the time-bound nature of the motivational process related to one's commitment and effort toward achieving a goal (Burrell et al., 2015; Kanfer, 1990). In addition, our investigation of motivation aligns with scholars focused on the motivation to achieve a goal (e.g., persist, complete a graduate degree, become an engineer). These scholars conceptualize motivation as being related to individuals' choices to make progress in a particular area of interest (Eccles, 2011; Eccles & Wigfield, 2002). However, how "achievement" is defined varies by theory. For instance, self-determination theory—an example of an achievement motivation model—refers to an individual's perceived competence in a particular domain, relatedness to a group or community, and ability to function autonomously (Deci & Ryan, 1985;

Ryan & Deci, 2000). This theory suggests that both intrinsic and extrinsic elements influence individuals' motivations to achieve a goal. That is, when individuals are "intrinsically" driven, they engage in activities without the need for material rewards or constraints; intrinsic motivation is reflected in behaviors enacted for one's own benefit (Deci & Ryan, 1985). Alternatively, when individuals are "externally" driven, they engage in activities prompted by external sources; extrinsically motivated behaviors are "performed not out of interest but because they are believed to be instrumental to some separable sequence" (Deci et al., 1991, p. 328). In another achievement motivation example, socio-cognitive theory highlights the relationship between an individual's goals, motivation, and achievement (Zimmerman et al., 1992). This theory suggests that individuals' goals are based on their beliefs concerning their abilities and the probability of successful completion (Zimmerman et al., 1992). In other words, there is an interdependence between one's self-motivation, one's views of one's ability to complete a goal (i.e., self-efficacy), and one's implementation of tasks to achieve that goal. Both examples above focus on the motivation to achieve, yet from slightly different perspectives: one focuses on an individual's behaviors and the forces (intrinsic and extrinsic) that motivate those behaviors; the other focuses on an individual's goals and self-assessments.

As illustrated above, existing motivation theories tend to be broad in scope, in that the theories are not specific to particular types of individuals based on their characteristics (e.g., gender, educational level, field of study). An exception to this is the work of Eccles and colleagues, who did consider the roles that gender and other characteristics play in individuals' motivation to achieve (Eccles, 2011; Eccles et al., 1990; Eccles & Wigfield, 2002). In addition to gender, studies on motivation tend to treat race separately, or as a demographic variable that can be parsed, which fails to acknowledge the much stronger—and inextricably interconnected—relationship between motivation and race (Andersen & Ward, 2013; DeCuir-Gunby & Schutz, 2014). By not foregrounding race and racism, models of motivation merely shadow how larger social and historical structures interact with individuals' motivations.

A growing corpus of research, however, shows that race and racism influence motivation and how it functions, including how students may or may not be motivated to persist from matriculation through graduation (Anderson et al., 2016; Smith et al., 2007). For instance, when considering motivation to achieve at the K–12 and postsecondary levels, students' educational systems can provide support or barriers, and because of this, students' success is not solely a function of their individual efforts. The educational system, an institutionalized function of social and historical structures, interacts with individual students' sense of agency, influencing their motivations to achieve.

RACE AND STRUCTURES

Existing research shows that Black students experience campuses differently than non-historically underrepresented students because of differential treatment, inequitable policies, and cultural isolation (Johnson-Ahorlu, 2012; McGee, 2016). Harper's (2012) study of 255 articles published across 10 years indicated that academic assessments of students, faculty, and administrators of color have failed to discuss racism and racialized experiences on college campuses. Findings showed that hostile racial climates as well as racial inequities embedded in university policies and practices not only exist but also dramatically affect students of color. Similarly, Johnson-Ahorlu's (2012) study of 17 African American undergraduate students (7 male and 10 female) indicated that at one large research institution, racism restricted the achievement of Black students. Not only did racism on campus play a part in widening the already present achievement gap but it also impacted students' emotional well-being. These examples highlight what some scholars label as "chilly," "isolating," and "hostile" campus climates, related to students' race (DeFour & Hirsch, 1990; Gay, 2004; Herzig, 2004; Johnson-Bailey et al., 2009). Black students struggle to find interdependence with the institutions they attend as a result of their constant fight against the behavioral and psychological stress of coping with inequities experienced on campus (Griffin, 2006; Harper, 2015; McGee et al., 2016). This additional taxation on Black students is a factor in why "traditional" models of motivation are inadequate for understanding Black students' motivation (DeCuir-Gunby & Schutz, 2014). And while there may be differences in how students experience postsecondary education at historically Black colleges and universities (HBCUs) versus predominantly White institutions (PWIs) (Allen, 1992; McGee et al., 2016), recent research suggests that there are larger racist structures that transcend institutional type (McGee et al., 2019). McGee et al.'s (2019) study of 48 (29 men and 19 women) Black doctoral students and postdoctoral researchers in engineering and computing departments reported that despite the assumption that Black students have extensively better educational experiences at HBCUs, when being in STEM is constant across institutional types, Black students at HBCUs and PWIs both describe interacting with racist and psychologically violent professors (of varying racial and ethnic backgrounds). These negative experiences, similar to experiences reported by other scholars (Burt et al., 2018, 2019; McGee & Martin, 2011), suggest that science and engineering environments—as structures of oppression—can have negative impacts on students' motivations to persist in postsecondary education broadly and STEM pathways specifically.

Black students in science and engineering fields are not immune to unwelcoming climates. Students in these fields also describe, in ways specific to their educational contexts, experiences related to racial microaggressions, discrimination, and invisibility, while also describing hypervisibility, likely due to their grave underrepresentation in these fields (Harper 2015; McCoy et al., 2015). For example, McGee et al. (2019) found that Black students put their health second to their success in work, preparation for training, and search for employment. This tax on their health, described as a function of racialized experiences in the academy, was a result of stressors that caused doubt about their qualifications. Further, these racialized stressors prevented students from finding proactive solutions. According to the authors, this "John Henryism" phenomenon—the strong desire to persevere regardless of the emotional, physical, and mental toll—influenced students to push through negative racialized encounters. Similarly, Figueroa and Hurtado's (2013) study of underrepresented African American, Latinx, and multi-racial graduate students in STEM fields described these students as excluded, facing microaggressions, and experiencing overt discrimination in their graduate programs because of their race. Relatedly, Burt, Williams, and Smith (2018) explained how Black graduate students were unable to gain access to study groups with White and Asian peers. The Black participants described being rejected from study groups because their peers assumed they were admitted to their graduate programs only through affirmative action and were not smart enough. As a result of feeling isolated and different in the White- and Asian-dominated academic space, the Black participants became more determined to prove their peers wrong by working hard by themselves.

RACE AND AGENCY

While there is a growing corpus of scholarship that highlights the compounding challenges of being Black and navigating science and engineering educational pathways (DeCuir-Gunby et al., 2017; McGee & Robinson, 2020), some research is beginning to explain how some students agentically negotiate their educational environments. For example, in Cokley's (2003) quantitative study of undergraduate college students attending three HBCUs and one PWI, Black men reported receiving external motivation in the form of confirmation of their academic aptitude and achievement (Cokley, 2003). Affirmations from external sources (i.e., faculty members) heightened their self-esteem and confidence in their ability to achieve in STEM fields. In another study conducted by Cokley (2001), Black women attending HBCUs tended to have a racial awareness that positively influenced their academic self-concept and intrinsic motivation.

In the above examples, students made progress in their academic pursuits through their individual efforts. Even for the Black male students in Cokley's (2003) article who received external motivation from faculty members, that affirmation appeared to re-ignite their motivation to persist in their scholastic efforts.

The nine students in Griffin's (2006) study on high-achieving Black college students' academic motivation cited their racial background as a source of motivation. One participant, Julian, expressed his need to disrupt dominant stereotypes concerning Black students: "It's important for me to prove that, you know, I can do everything that you [his White counterparts] can do" (Griffin, 2006, pp. 393). Julian's motivation to persist was inspired by his need to eradicate the common misperception that Black students are less intelligent than their White counterparts. He used his academic performance as proof that this stereotype is incorrect. Another participant, Katrina, spoke of a need to succeed to address the disproportionately small numbers of Black persons, particularly Black women, in medicine. Katrina's aim to represent her racial identity group in the medical field motivated her to succeed in her coursework. McGee et al.'s (2016) study also explored students' individual motivations to persist. Across their sample of 44 students (28 men and 16 women, from first-year doctoral students to recently minted PhDs, representing different institutional types and engineering disciplines), they found that seeing themselves as role models for future Black students served as a source of intrinsic motivation for students to continue in their graduate programs.

In whole, narratives of Black collegians reveal how some students' sources of motivation, in conjunction with race, can influence their academic outcomes. Some students appear to be further motivated in their scholastic pursuits when explicitly dealing with race and systemic racism in education. These examples show that race is at least one source of motivation that can influence some students to persist in postsecondary education.

While we separate structure and agency for the purposes of clarity, they interact to influence individuals' motivation. For instance, DeCuir-Gunby et al. (2017) argued that race is insufficiently accounted for in the educational knowledge base. This limitation, according to the authors, neglects to identify how students with racialized backgrounds navigate stressful barriers—often in the form of educational structures—and stay motivated to persist in their educational context. They recommend that researchers take race-centered approaches to decrypting underrepresented racially minoritized students' agentic motivations to persist. Similarly, Yu et al. (2017) suggested that as it relates to underrepresented undergraduate students' persistence and motivation in STEM, students are mutually and symbiotically motivated by environmental factors and

race and ethnicity. In their view, students' persistence and motivation in STEM are functions of a complex linkage between students' race (i.e., structure), the engineering educational environment (i.e., structure), and the motivation to remain in STEM career pathways (i.e., agency). Taking these arguments together, educational systems and structures influence students' motivations to persist. However, existing research rarely investigates how systems, structures, and student outcomes are interrelated, specifically for historically underrepresented students, nor how they manifest in students' specific fields of study. This limitation in the educational knowledge base provides opportunities for further clarification of motivation theories.

Grand theories like those that tend to explain motivation to achieve (e.g., Eccles, 2011; Eccles et al., 1990; Eccles & Wigfield, 2002) are useful in their ability to broadly hypothesize about behavior and broadly apply theories to a wide range of individuals. However, their lack of specificity to different kinds of individuals with different social identities and disparate life experiences offers a challenge in applying and interpreting all individuals' motivations to achieve. While numerous conceptualizations of motivational achievement exist, what appears to be undertheorized in the literature are motivational theories that provide both scope (an ability to capture multiple individuals) and nuance (an ability to offer specification by particular variables, for example race and gender). To more holistically understand a student's motivation to achieve, more theoretical attention should be paid to the interplay between race, motivation, structure, and agency. In the case of this study, a theory that captures the motivation to persist for Black men in engineering at the graduate level offers some specificity in terms race, gender, field of study, and educational level may be useful in better understanding the motivational processes for students on the margins of STEM. Without more specificity regarding individuals' social identities, personal characteristics, and connections to structure and agency, researchers may be under-identifying key mechanisms in motivations to achieve, especially for historically underrepresented populations.

Based on the existing theory and literature on motivation to persist in STEM, particularly for Black students, additional questions remain regarding the nuanced experiences of Black men in engineering graduate programs. Drawing on the extant theory and literature, we infer that the experiences of being Black and male at the graduate level in engineering likely affect the way individuals conceptualize their motivation to persist. Thus, in this study we explore the motivation to persist of Black male graduate students in engineering as experienced through a gender- and race-specific lens. We examine the following research questions:

1. What are the motivational factors that influence Black men in graduate engineering programs at predominantly White institutions (PWIs) to persist?
2. How are these graduate students' motivational factors [inter]related with regard to persistence?

METHODS

This study centers on 42 Black men graduate students attending engineering colleges at four public, predominantly White institutions (PWIs) that were members of the Association of American Universities between 2010 and 2018. These engineering colleges were selected in part because of their recognition as leading engineering graduate programs in the United States (*U.S. News* annual ranking, 2019), and because they were identified as top producers of Black graduate students in engineering (Diverse: Issues in Higher Education, 2018). Although HBCUs have historically produced the most Black graduates in STEM fields and continue to do so, no HBCUs were included in the current study; this methodological decision was made in an effort to reduce potential explanatory factors related to institutional type. That is, this study was not designed to comparatively examine students' motivational sources by institutional type. Of the four participating institutions selected in the current study, the percentages of Black men enrolled in engineering programs ranged from approximately 2% to 8%; at some of these institutions, the men in this study represented the critical mass of Black men in their graduate programs. Thus, we assumed that students' experiences at their PWIs would likely be more similar to one another's than they would to the experiences of students attending HBCUs.

In this article, "African American" and "Black" are not used synonymously; some participants considered themselves "Black" but not "African American" (e.g., Cameroonian, Caribbean, Ethiopian, Jamaican, Ghanaian, Nigerian, Togolese, West African). Therefore, we use "Black" to denote the more global diaspora of race; however, we provide students' ethnicities to provide greater nuance to our findings. Students' class levels (i.e., their year in graduate school at the time of data collection) varied, as did their engineering specializations (fields included agricultural, aerospace, biomedical, chemical, civil, computer, design, electrical, industrial, material science, and mechanical engineering). Of the 42 participants, 33 had mothers with postsecondary education, 5 of whom had doctorates. Similarly, 30 had fathers with postsecondary education, 3 of whom had doctorates (see Table 2). Upon graduation, 18 participants intended to pursue opportunities in industry, 10 in academia as faculty, 1 in policy, 1 in government, and the remaining 12 were unsure at the time of data collection (see Table 3). See full participant profiles in Table 4.

Table 2. Parents' Highest Level of Educational Attainment

	Mothers (%)	Fathers (%)
Elementary	1 (2.3%)	1 (2.5%)
Middle	2 (4.8%)	3 (7.5%)
High	6 (14%)	5 (12.5%)
Vocational	2 (4.8%)	2 (5%)
Some College	5 (12%)	7 (17.5)
Associate	1 (2.3%)	0 (0%)
Bachelor's	11 (26%)	11 (26%)
Master's	9 (21%)	8 (20%)
Doctorate	5 (12%)	3 (7.5%)
Total	**42 (100%)**	**40 (100%)**

Table 3. Post-Graduate Career Intentions

	Number (%)
Faculty	10 (24%)
Government	1 (2.4%)
Industry	18 (43%)
Policy	1 (2.4%)
Unsure	12 (29%)
Total	42 (100%)

DATA COLLECTION

Participants were recommended by peers, administrators, or other study participants (i.e., snowball sampling) (Merriam & Tisdell, 2016) and had to meet the study's criteria (i.e., be a Black man who was a graduate student in engineering). Data were collected by the principal investigator (PI; this study's first author) between 2010 and 2018. Participants first completed an eight-item demographic form (which helped derive the data presented in the previous section). Next, students participated in one, one-on-one, semi-structured interview (Merriam & Tisdell, 2016). Analytical memos written throughout data collection helped the PI note possible findings within participants' narratives and connections across participants' experiences. Focus group interviews then offered the opportunity to check preliminary findings and hypotheses (i.e., member checking) related to persistence in engineering graduate programs and in STEM (Creswell, 2012).

Table 4. Demographic Data for Study Participants

Pseudonym*	Class Level	Engineering Specialization	Ethnicity	Mother Education	Father Education	Post-Graduate Career Intention
Ali	2nd	Aerospace	AA	Bachelor's	Bachelor's	Industry
Alphonso*	5th	Electrical	AA	Bachelor's	Some College	Industry
Ben	2nd	Mechanical	AA	Bachelor's	High School	Industry
Braxton	2nd	Electrical	AA	Associate's	N/A	Industry
Chris*	5th	Chemical	Nigerian	Bachelor's	Master's	Industry
Christian	3rd	Civil	AA	Some College	Some College	Faculty
Courtney*	2nd M	Civil	AA	Some College	Some College	Unsure
Daniel	1st	Industrial	Nigerian	Vocational	Master's	Unsure
Daryl	7th	Aerospace	AA	Bachelor's	High School	Industry
David	1st	Design	AA	High School	Community College	Unsure
Dean	1st	Electrical	AA	High School	High School	Faculty
Isaac*	4th	Agricultural	AA	Master's	High School	Unsure
Jackson*	3rd	Mechanical	AA	Some College	Bachelor's	Unsure
Jacob**	3rd	Chemical	AA	Doctorate	Bachelor's	Policy
Jaden*	2nd	Electrical	AA	Doctorate	Doctorate	Industry
Jai*	5th	Mechanical	Cameroonian	Bachelor's	Some College	Faculty
Jalen	1st	Mechanical	Jamaican	Vocational	Vocational	Faculty
James*	4th	Biomedical	West African	Master's	Master's	Faculty
Jesse*	5th	Electrical	AA	Bachelor's	Bachelor's	Faculty
Joseph*	4th	Material	AA	Doctorate	Doctorate	Unsure
Kemani	2nd	Electrical	AA	Doctorate	Master's	Industry
Kendall*	2nd M	Mechanical	Cameroonian	Bachelor's	Bachelor's	Industry
Logan*	5th	Electrical	AA	Master's	Master's	Industry
Lucas	2nd	Electrical	AA	Master's	Some College	Faculty

Pseudonym*	Class Level	Engineering Specialization	Ethnicity	Mother Education	Father Education	Post-Graduate Career Intention
Marco	1st	Aerospace	AA	High School	Vocational	Industry
Marcus*	3rd	Mechanical	Caribbean	Doctorate	Master's	Unsure
Martin*	2nd M	Industrial	AA	Master's	Master's	Industry
Micah*	3rd	Industrial	AA	Bachelor's	Bachelor's	Faculty
Norman	1st	Mechanical	Ghanaian	High School	Bachelor's	Industry
Paul*	4th	Electrical	Ethiopian	Elementary	Elementary	Unsure
Quentin*	5th	Electrical	Nigerian	Some College	Bachelor's	Unsure
Ricky	4th	Electrical	Cameroonian	Middle School	Some College	Faculty
Robert*	2nd M	Industrial	AA	Master's	Bachelor's	Government
Samuel	5th	Civil	Togolese	Middle School	Middle School	Faculty
Shawn*	4th	Material	AA	High School	High School	Industry
Terrence*	2nd	Material	Ghanaian	Bachelor's	Doctorate	Unsure
Thomas	3rd	Mechanical	Jamaican	High School	N/A	Industry
Titus*	2nd	Civil	AA	Master's	Master's	Unsure
Trai*	4th	Mechanical	AA	Bachelor	Master's	Industry
Tristan	1st	Aerospace	AA	Master's	Bachelor's	Unsure
Victor*	5th	Chemical	AA	Master's	Bachelor's	Industry
Xavier	4th	Computer	AA	Some College	Some High School	Industry

*Denotes that student has graduated since data collection.

** Denotes that a student graduated with a Master's degree, and departed from the doctoral program since data collection.

"Class Level" refers to the number of years a student has been in graduate school.

"M" = Master's student

"AA" = African American

Protocols guided the interviews to provide standardization. Yet, their semi-structured nature allowed for probing when necessary. During interviews participants were asked to describe their collegiate backgrounds, graduate school experiences, and identification with and intention to remain in engineering. While the interviews elicited valuable information about challenges and barriers to persistence, most germane to this study are participants' discussions of motivational factors that allowed them to persist despite their challenges (see Table 5 for sample interview questions).

Table 5. Sample Interview Questions

1.	What influenced your decision to go to graduate school in engineering?
2.	Did you ever consider leaving [institution] (dropping out or transferring)? If so, why?
3.	Who has influenced your decision to stay in graduate school?
4.	What have been your other sources of support in staying in graduate school?
5.	Can you describe your experiences with your advisor?
6.	In what ways—if at all—does your advisor support your development?
7.	By staying in graduate school and STEM, you're defying the odds. How are you doing it?

Interviews were audio recorded and transcribed verbatim to capture participants' vernacular (the majority were transcribed by a transcription company).

DATA ANALYSIS

Data analysis was conducted using adapted grounded theory techniques. That is, although we were aware of existing conceptualizations of motivation for Black students (see for example Griffin, 2006; McGee et al., 2016; Zimmerman et al., 1992), limited pre-existing codes based on a priori findings (i.e., sensitizing concepts [Corbin & Strauss, 2008] of internal and external motivation) were used to generate the codes in this study. In this regard, rather than seeking evidence that supported existing research, we were interested in how the data, the voices of student participants, might illuminate students' sources of motivation to persist in their engineering graduate programs.

After the completion of data collection and multiple iterations of analyses (both inductive and deductive), existing conceptualizations of motivation (i.e., the sensitizing concepts related to internal and external motivation) were used to help make sense of data. That is, the sense-making and connection to existing literature regarding the codes, their placement into

categories, and placing categories into themes, occurred after analyses were completed. Our findings then led us to create a substantive, practice-informing theory based on a limited number of observations (Merriam & Tisdell, 2016), which will be described in the discussion section.

To further explain: in an inductive wave, the principal investigator identified small chunks of text (i.e., codes) describing experiences of Black men in engineering graduate programs (Corbin & Strauss, 2008; Merriam & Tisdell, 2016). During this wave of analysis, the principal investigator was open to all possible accounts explaining participants' motivations for persistence. Codes were continuously scrutinized to ensure that their properties were distinct from those of other codes (i.e., constant comparison) (Corbin & Strauss, 2008). Codes that could not be easily distinguished were reanalyzed and assigned new labels and definitions. Saturation was reached when no additional new codes were identified. Some examples of codes include peers, family members, [under]representation, self-coaching practices, and career and professional goals. Axial coding, where like codes were combined into categories explaining participants' motivations for persistence, followed the initial coding process. As an example, the previously listed codes coalesced into a single category: sources of motivation to persist.

A final round of data analysis was conducted with additional researchers, focused exclusively on the category above, "sources of motivation to persist." Transcripts were reread and selectively coded for this core category (Strauss & Corbin, 1990). The goal was to focus on the codes in the "motivation to persist" category to gain a deeper understanding of the motivational factors students activated to persist in graduate school. However, the researchers also remained open to new codes, or more nuanced definitions of codes that might better explain students' motivations to persist.

ENSURING TRUSTWORTHINESS AND RIGOR

Ensuring trustworthiness and rigor included several steps (Creswell, 2012; Merriam & Tisdell, 2016). First, the research team engaged in ongoing discussions about the data and our identities as researchers. Specifically, we had regular conversations about codes and themes in which we negotiated our interpretations of students' meanings until consensus was reached. These conversations were guided by iterative discussions of our positionalities, worldviews, and potential biases regarding the data (Cooper et al., 1998; Peshkin, 1988). For instance, data collection and the first wave of analysis were conducted by the PI, a Black man and faculty member in the social sciences (not engineering). The third author is a Black man and doctoral student in the social sciences, and the second and fourth authors, a Black man and a White woman, respectively, were master's students at

the time of the second wave of analysis. Collectively, we discussed whether our interpretations were based on our experiences and understandings from social science, our roles as graduate students or faculty, our former professional higher education experiences, and our own social identities (e.g., native-born, Black or White, African American ethnicity, intersections of gender and race/ethnicity within a U.S. context). This crucial peer review process (Merriam & Tisdell, 2016) provided early and ongoing checks and balances as well as confidence that the codes and themes held up among 42 participants and across four institutional contexts and several engineering specializations.

Second, we have confidence in the "goodness" of our findings because multiple forms of data were collected. Specifically, the research design included a pilot study, which led to a refined two-wave, one-on-one interview data collection process and follow-up focus groups. This design produced richly descriptive in-depth data. Further, though data were collected in different years (between 2010 and 2018), using a similar interview protocol elicited similar results. This suggests that despite being collected in different years and from different institutions, the systemic patterns within colleges of engineering remained relatively unchanged, promoting similar persistence practices among Black men in engineering graduate programs. It also suggests that the interview protocol may continue to be a valuable instrument in the future.

Third, to check for accuracy, transcriptions were compared with the audio recordings. This helped ensure that participants' meanings were captured as they intended. It was often important to hear participants' speaking, inflection, and occasional nonverbal expressions of pain or joy to fully understand what they wanted to convey.

Finally, memos tracking procedural decisions and noting potential relationships between interviews, research questions, and prior research were written throughout the research process (Merriam & Tisdell, 2016). Memo writing helped develop early and ongoing hypotheses for testing and helped create this study's new theoretical model.

LIMITATIONS

Two main limitations are apparent. First, the sample of 42 is not representative of all Black men in engineering graduate programs; our findings may relate to the types of students who attended this particular set of public, top-ranked, predominantly White engineering colleges and institutions. There may be unexplored forms of motivational strategies and support used by students attending other types of institutions (e.g., minority-serving institutions, smaller institutions, private institutions). Second,

we recognize that Black men are not a monolith. Though we considered how within-group ethnic diversity may have influenced students' motivational forces (e.g., students from Ghana, Nigeria, Jamaica, etc. may have some different motivations than those from the United States), it is possible that their ethnic differences played a larger role than was accounted for in this study.

FINDINGS

NEW THEORETICAL MODEL

The theoretical model of "Black Men's Graduate Engineering Motivation" (BMGEM) is a "substantive theory," defined by Merriam and Tisdell (2016) as a theory based on a limited number of observations that generally informs practice. The BMGEM explains the overlaying factors that have varying influences over individuals' experiences and motivations to persist (i.e., sociocultural factors, personal factors, social identities, pre-graduate school experiences), and external and internal motivational sources that influence students' motivations to persist (i.e., desire to earn a graduate degree, desire to become an engineer, challenges during graduate school, peers, family members, [under]representation, self-coaching practices, career and professional goals), their interplay, and movement between the factors for Black men in engineering graduate programs (see Figure 1).

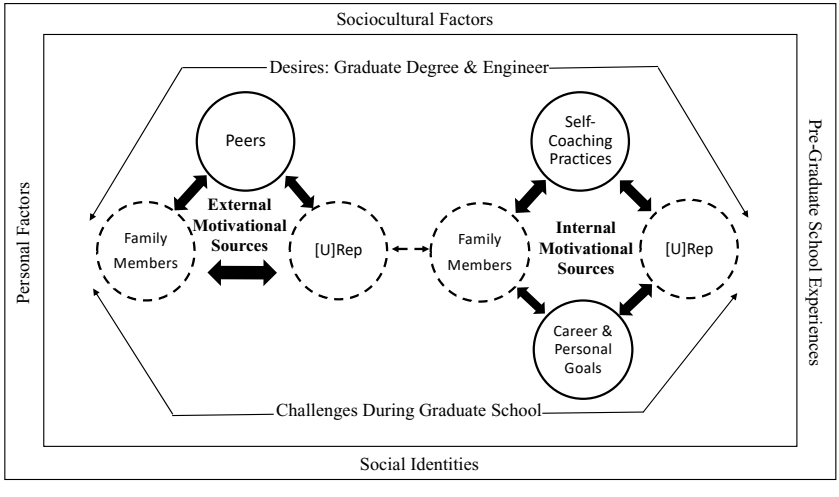

Figure 1. Theoretical model of "Black Men's Graduate Engineering Motivation" (BMGEM)

The theory starts with an acknowledgement of overlaying factors that influence students' motivation to persist: sociocultural factors, personal factors, social identities, and pre-graduate school experiences. These factors are represented as the outer layers of the model. Moving closer to the center of the model are ever-present motivational sources that appear to influence the inner workings of students' persistence: the desire to earn a graduate degree and the desire to become an engineer, and challenges experienced during graduate school. These sources are represented as arcs surrounding the inner motivational sources. The inner workings of the motivational process, this study's primary focus, is located in the center of the model with additional motivational sources: peers, family members, [under]representation, self-coaching practices, and career and personal goals. The process of the motivation to persist is not linear. That is, the internal and external sources do not operate separately or in sequential order. Rather, these motivational sources are both simultaneous and continuous in nature, as denoted by the cyclical circles operating in tandem. The simultaneous nature of the motivational process was captured in the BMGEM when participants illustrated that both types of motivation occurred at the same time. The continuous nature of the motivational process was captured in the BMGEM when participants described external forces, and the motivational practices resulting from those external forces—at different times in their graduate career.

Based on our data, the BMGEM also highlights movement between external and internal factors that influence students' motivations to persist. This finding suggests that for some Black men, motivational sources can be discrete (i.e., either external or internal motivational sources), whereas for others, they may begin as external sources of motivation but come to operate as internal ones, and continue to oscillate back and forth. An example of this movement is initially seeing family members as external sources of motivation but then, through internalization, coming to see family members as an internal motivational source, particularly when viewing persisting and being successful in engineering as a responsibility owed to family members. In another example, the underrepresentation of Black people in engineering and graduate school (labeled as [U]Rep in the model) was for many students an external motivational source that became an internal one.

While some of the sources within the BMGEM are interrelated and cannot be easily pulled apart, below we present them independently for clarity.

OVERLAYING FACTORS THAT INFLUENCE MOTIVATION

While not the central focus of this study, we would be remiss if we did not acknowledge how overlaying factors influence all students' motivations to persist.

Sociocultural Factors

Existing literature acknowledges the roles that sociocultural factors (e.g., history, contexts, systems, and structures) play in students' experiences (Baker & Lattuca, 2010; Burt, 2019, 2020; DeCuir-Gunby et al., 2017; Wertsch et al., 1995). For the purposes of this study, we agree that sociocultural factors are the larger contextual structures (contextual structures may include but are not limited to the historical, political, economic, cultural, and institutional) that influence individuals' experiences. Our data suggest that sociocultural factors overlay the experiences had by individuals, and thus they are represented in the BMGEM as the outermost box to illustrate that sociocultural factors are always at play at the macro level. As an example, in the current study, at the time in which data were collected, some participants were witnessing state and federal attacks on affirmative action, which had direct implications for the recruitment of prospective historically underrepresented students in engineering. Trai, a fourth-year doctoral student in mechanical engineering, situates his graduate experiences at his institution within the sociopolitical climate of his institution's state and the United States:

> A lot of times there's a misconception, especially now in this Barack Obama age, that somehow you know, really there's no need for affirmative action. Being Black and being oppressed is a thing of the past. There's none of that that happens. Everyone is kind of living in this colorblind world, and that's really not true, still.

The sociocultural factors—sociopolitical in nature, in this case—highlight the connections that at least Trai is able to make between his graduate experiences and the larger state- and country-level policies, rhetoric, and practices that contribute to his feeling underrepresented and oppressed as a Black male in engineering. At a different point, Trai made further connections to sociopolitical—and thus, sociocultural—factors influencing his graduate experiences:

> I expected [the mechanical engineering program at my institution] to be a pretty challenging program. I mean it was [highly] ranked for engineering, and with my specific program [ranked even higher] that year at least. I expected a challenging environment. But I also expected one that was somewhat not cutthroat. I mean that's the feeling I had. That's why I went to a couple of these recruiting events they had before the passing of [the legislation to ban affirmation action] I think it was here in the state. [The college-level policies and practices prior to the passing of

> the anti-affirmation action ban] specifically targeted bringing minority students in to [the institution] for STEM [broadly] and engineering specifically. So, when I was there [college's targeted recruitment visit program] I met some people there, and one of the recruiters, and like seeing and interacting with some of the current minority grad students in engineering and just hearing some other people talk, I felt like [the institution] was a good fit.

In the above passage, Trai offers several glimpses into his life in the engineering college, one that is challenging, which could be a common description for any graduate student. However, the challenge that he describes does not appear to be solely related to the academic rigor of his program. Rather, it appears that part of Trai's challenge is related to the hidden curriculum of navigating the engineering college as an underrepresented Black man who chose to attend his top engineering institution based on the belief that there would be a steady increase in students who looked like him; that is, until a state-level policy (i.e., ban on affirmative action) negatively impacted the institution-level recruitment practices that made students like Trai feel like they belonged and could thrive at the institution. The changing sociopolitical climate— "the Barack Obama age" referenced by Trai—had some students in this study questioning their presence in their engineering graduate school, not because they did not feel qualified but because the sociopolitical climate of the institution and local community made them second-guess their admission. One particular student, Victor, a fifth-year doctoral candidate in chemical engineering, commented, "I questioned that my second year. I said, 'Am I just here for numbers sake or am I here for what I can offer to this department?'" Through these examples, we call attention to the roles that sociohistorical and federal and state policies (as forms of sociocultural systems and structures) play in higher education practices (e.g., graduate recruitment and admission). While sociocultural factors are not always apparent to individuals, it is important to acknowledge that these factors exist at all times and to consider how they influence students' experiences.

Personal Factors

An existing corpus of research investigates the roles that students' personal factors (e.g., early interests and engagements with STEM, K–12 and collegiate educational experiences, family members' socioeconomic status, family members' educational attainment, family members' occupation) play in their educational experiences (Andersen & Ward, 2013; Maltese & Tai, 2011; Maltese et al., 2014; McCallum, 2016). However,

much less research explores these factors as they relate to graduate students' outcomes, and specifically, to those of Black men in engineering graduate programs. In our data, all participants referenced ways that their unique personal factors influenced their educational pathways. Alphonso, a fourth-year student in electrical engineering shared how "Going into college, I was considering grad school. I [saw] my sister was in graduate school and going for a PhD." At a formative age, Alphonso was inspired by his sister, already a college graduate and now in graduate school, to consider—or at least begin thinking about—graduate school himself. Marcus, a third-year doctoral student in mechanical engineering, was similarly inspired to pursue advanced education by a family member when he saw his mom "going to school and making sure that no matter what she gets her education." Marcus is confident that witnessing his mom being a college student "imparted that [the desire for educational pursuits]" to him and his sister. Joseph, a fourth-year doctoral student in material science and engineering, also alluded to his parents' educational attainment when asked who his sources of support were and why: "My mom, and I called my dad, because they've been through graduate school before." Joseph was not the only student in our sample for whom both parents attended graduate school; 17 other students also had parents who both held advanced or terminal degrees (see Table 4). At a later point, Joseph further shared how he chose his doctoral institution:

> My mom went here to get her PhD. [Then] she took her sabbatical here back when I was in middle school, when I was 14. So I had exposure to [the city where the institution is located] and the surrounding area and knew that . . . [it was a] place where I could see myself living for four or five years. Obviously, the prestige of the school doesn't hurt.

Although Joseph acknowledges the prestige of the institution, it cannot be ignored that his exposure to the institution—due to his mom's attendance there, as well as his presence there while she was on her one-year faculty sabbatical at her alma mater—would to some extent influence his consideration of and desire to pursue graduate education.

In these examples, family members' experiences with education promoted students' educational desires. These findings highlight that for some students, the desire to pursue a college or advanced degree may be prompted by personal factors (e.g., people to whom students are exposed to in formative years). As will later be discussed, family members, in particular, play both external and internal roles in students' motivations to persist. However, for now, it is necessary to acknowledge how personal factors and desires can interact, thus having an influence on a student's motivations.

Social Identities

Like students' personal factors, their social identities (e.g., race and ethnicity, gender, citizenship status) also in part shape how they experience graduate school, and thus influence their motivation to persist. For the purpose of providing illustrations, and not an exhaustive set of examples, we show how some students holding multiple social identities (Black, male, and foreign-born) describe their identities in relation to their experiences as graduate students. Marcus, a third-year doctoral student in mechanical engineering, acknowledged that even though he "didn't have any engineering role models," growing up in Jamaica, what he did have was a culturally rich and culturally representative community: "When I looked around me . . . I saw Black people in power." Like Marcus, those holding foreign-born identities had similar stories of values and expectations being shared between same-race, same-ethnicity peers from their home countries. Many times, these values and expectations related to the importance of educational attainment. Chris, a fifth-year doctoral candidate in chemical engineering, mentioned, "From talking with fellow Nigerian friends that I have there [in Nigeria], it's like, getting an advanced degree is . . . expected." Growing up in a Black-rich and representative culture (not necessarily rich in terms of wealth, but rich in terms of community, support, role-models, and educational values) appeared to influence many students' confidence and influence their desire to pursue higher education.

Having a strong sense of Black community and sense of self growing up, and then not having it when one attends a PWI, has already been noted in existing literature as a challenge for Black students (Fries-Britt, 2002; Fries-Britt & Griffin, 2007). However, the challenge of being Black and foreign-born likely exacerbates feelings of isolation and otherness. Some Black, foreign-born students describe difficulties adjusting to graduate school at a PWI within a United States context steeped in sociohistorical and racialized politics that they did not always fully understand during their transition (Burt et al., 2017; George Mwangi et al., 2019). Several foreign-born participants noted that they were Black, but not Black American. Paul, for instance, a fourth-year doctoral candidate in electrical engineering from Ethiopia, stated:

> I am Ethiopian. I have my brothers, and we are all Black, right. The problem there is a completely different problem [than here in the U.S.]. There you don't have access. Here you have access, but the things that happened in the past are still dragging you down.

Paul recognizes the privilege he has to study in the United States when he mentions that there is greater access—broadly speaking, not only related to education. Yet, even with more access, he recognizes that taking advantage of opportunities is difficult because of sociohistorical occurrences related to race. Similarly, Jai, a fifth-year doctoral student in mechanical engineering from Cameroon, began making sense of his Blackness within the world and American-specific sociohistorical contexts:

> I am not Black American. So the Black American History that is around, I came to learn about it, just as I learned about other history. I share the same color, I share the same everything, and I'm part of that history, but the African side of that history, not the American side of the history. So I didn't know a lot about those things [racism in the United States]. But the general conception of how Black people are regarded worldwide, not just in America, worldwide is what I have . . . there's a general consensus of what Black people are like and then there's a specific of the regard of how Black American people are like.

With Jai, race came up when he first mentioned that graduate school can be "daunting" for some students, especially "if you are the only Black person in the lab." When asked how he navigated being Black in the lab, he further described the complexities of race in the United States as a foreign-born Black student.

For some, the pursuit of advanced education is not considered a right, but rather an appreciated privilege. For them, the opportunity to attend school in the United States carries with it reminders of the immense sacrifices they and their family had to make in order to pursue an education. Norman, a first-year doctoral student in mechanical engineering, describes some of his experience in Ghana, which led him to study in the United States:

> The main influence [for persisting] is from my origin. I'm from Ghana . . . Luckily for us, just as I indicated, part of my family [has] at least an education . . . So, many people had free education and as a result, as of now, at least 70% of the whole country can go to school. . . The economy is so bad. The social structure is still a little bit backward to understand because people are caught up in a really inescapable cycle where it is very difficult to earn food, to earn money, and things like that. Somebody like me . . . I lived with a guardian. If you want to go to school, you have to leave the village.

Norman's story about having to leave his parents in the village and go to the city to live with a guardian provides some indication of the long-term sacrifices he and his family made to ensure that he received an education. Norman's words also show the value he places on education; education, according to Norman, is one avenue for making it out of the "inescapable cycle" he witnessed growing up in Ghana.

The examples in this section provide glimpses of the interplay between some students' social identities (e.g., Black and foreign-born), personal factors (e.g., educated family), and sociocultural factors (e.g., nature of their home country's economy). From these examples, it is clear that students have different background experiences—in some cases pre-dating graduate school, rooted in sociohistorical realities, that influence their present educational experiences in engineering. Yet, despite their differences, the issue of underrepresentation still matters for them. By considering the interplaying factors, we can better understand why some students have strong commitments to their education, and better see their motivations to persist.

Pre-Graduate School Experiences

The Black male participants in our study consistently made references to how their experiences prior to matriculating in graduate school in part influenced their interest in STEM, desire to pursue graduate education and become engineers, and motivation to persist, which is consistent with findings from existing research (Andersen & Ward, 2013; Maltese & Tai, 2011; Maltese et al., 2014). Some of the pre-graduate school experiences participants referenced include K–12 schooling experiences, early engagement in STEM-related activities and practices, undergraduate mentoring, and participation in undergraduate research experiences. For the purposes of illustration, we provide examples of interactions between pre-graduate school experiences and personal factors (e.g., interactions with parents, and possibly parents' level of education when parents are able to help their children do math). Joseph, for example, mentioned that he "started doing math pretty early," taking algebra and geometry in the sixth grade. Chris, a fifth-year doctoral student in engineering, also referenced his academic experiences and confidently reflected, "I did pretty well in most of my classes in elementary and middle and high school." However, he referenced becoming engaged in the learning of math and science through interactions with his parents:

> [My parents] were really focused on "How [were] your algebra grades? How [were] your chemistry grades? Your biology grades"? You know, those were the best and they pushed those on me, you know.

It is not entirely clear from Chris's comments when he said "those were the best" if he was referring to algebra, chemistry, and biology as the subjects his parents were most interested in him performing well in, or if what was "best" was the supportive push he received from his parents, or some combination of the two. Similarly, Alphonso, a fifth-year doctoral student in electrical engineering, referenced his parents when reflecting on his early academic experiences:

> Working with me on my homework and my math and, you know, teaching me not only the stuff I was doing, but then kind of expanding on that—like [my parents] taught me how to do these fractions and squares and stuff before everyone else was doing it. So . . . when I got to, like, fourth grade in my school, I was actually put in fifth grade math.

Again, evident through Alphonso's words is another example of a participant engaged in the learning process through engagement with his parents. In this sense, the doing of math appeared to be a social practice with his parents. Further, it appeared that doing homework and math in conjunction with his parents connected doing math with enjoying math.

While these examples portray a through-line of interactions with students' parents, we wanted to illustrate the kinds of pre-graduate school experiences students shared that helped to connect their learning, interests, desires, and later motivations. Further, these examples show how their pre-graduate school experiences were not necessarily individualistic experiences but rather that they sometimes involved interactions with other people (e.g., parents).

Although much existing scholarship tends to suggest that factors influencing students' experiences and motivations are merely background demographic characteristics (Chavous et al., 2017; DeCuir-Gunby et al., 2017), we started by highlighting the importance of these factors in students' motivational processes. While in this study we are more focused on the process of motivation to persist, influenced in part by the above interplaying factors, future research should further investigate the nuances of those factors. Below, we present empirical evidence to illustrate the sources of motivation and inner workings of the Black Men's Graduate Engineering Motivation theoretical model. See Table 6 for sources of motivation definitions, and Table 7 for a summary of participants' motivational sources.

Table 6. Sources of Motivation Definitions

Source of Motivation and Definition (*Example codes*)	Representative Quotation
Desire to Earn One's Graduate Degree. An explicit interest, passion, and/or commitment to earning one's graduate degree. *passion toward education; commitment to degree completion*	"I can stop at the master's and go elsewhere, but I said, you know 'if I want to set myself up to be able to one day go back into a teaching role, I really need that PhD.'"
Desire to Become an Engineer. An identification with the field of engineering, and an interest in doing the work of an engineer. *enjoyment of math and science; interest in building things; long-term interest in the field*	I knew, or at least I thought I knew anyway, at the time that I wanted to be an engineer. I didn't really know what type of engineer I wanted to be, so I just did research of all the engineering fields.
Challenges During Graduate School. The academic, psychological, and physical obstacles participants alluded to as creating barriers to persistence. *academic (time management, preparedness, grades, and qualifying exams); psychological (imposter syndrome, pressure to succeed); physical (faculty advisor and research supervisor microaggressions, study groups conflicts, anti-Black campus climate and institutional community)*	"In the science fields, or engineering, or PhD, you will want to drop out at some point." It's just something that has been told by many people even before I came here. I tell students now, "You will want to leave at some point. So the battle is trying to get through that point." The other thing is, I wanted to leave because nothing was going according to my plan.
Peers. Instances when peers within a participant's social network (inside and outside of academia) provided support that added to a participant's motivation to persist. *empathic friendship; candid conversations; modeling persistence and success*	I met strong . . . Black males [and] Black females . . . It's just talking, keep talking to my colleagues, my friends, my peers. When I say colleagues, friends, and peers, I'm referring to the other Black students in my field. If they're struggling, I feel like I need to be stronger for them. Somehow when I'm struggling, they're there . . . It's like when I keep surrounding myself with my like-minded peers there, we keep pushing each other. It's like we might be stuck at this same one level and someone figures out something to go up, and [they] try to pull me up or vice-versa.
Family Members (External). Instances when an action taken by a family member provides or strengthens a participant's motivation to persist. *family member(s)' encouragement; offering navigational recommendations; consistent communication*	"I don't know how I'm going to make this work." They kind of helped me manage taking things just one step at a time, managing the little things between each of these big deadlines I had, and ultimately got through that rough patch.

Source of Motivation and Definition (*Example codes*)	Representative Quotation
Family Members (Internal). Instances of a participant reflecting on and making meaning of one's family member(s)–not prompted by an action between a participant and his family member(s). *role model for younger siblings; family's high value of education; generational expectations*	My mom had a master's [degree]. I need to get a PhD, that's just how it is.
[Under]representation (External). Instances of a participant's interactions with and reflections of Black individuals and anti-Black practices/policies. *external underrepresentation (anti-affirmative action policies; anti-black admission policies; anti-Black faculty hiring practices); external representation (presence of Black faculty and peers in engineering; presence of Black faculty and peer role models in engineering; knowledge of and/or participation in campus affinity groups)*	Those two [Black Graduate Student Association (BGSA); Alliance for Graduate Education and the Professoriate (AGEP)] have been very helpful in my career just because as Black people, forget about engineering, because Black people in grad school, period. There's not a lot of us. To be able to get together in a room and see like-faces and like-minded people who are going and aspire to get those advanced degrees, that also provides a form of hope to keep you going forward because you know you're not alone.
[Under]representation (Internal). Instances of a participant reflecting on their persistence resulting from observations and meaning-making of the lack or presence of other Black individuals in engineering (peers and role models). *isolation in the classroom, department, research lab; tokenism*	While in undergrad and graduate school, I have not seen many [Black] professors in my field, and I don't know if that is wise. I don't see a lot of people of color in my field. So my thing is, yeah, if I can go through this, maybe I become a professor, then that means maybe I can attract more people of color to go to graduate school and then influence others.
Self-Coaching. Instances of a participant's reliance on his sense of self and implementation of practices to assist in making progress. *self-talk; visual motivational management*	"Hey, I can really do this, although it's hard." I've told myself that I don't think I want to get a job here [laughs]. I didn't know this was how the weather was before I came here. [But] I was like, "Oh I'm going to the U.S. for grad school." But I came here and it's cold. But I can cope with the weather. No, I didn't think of dropping out. I kept telling myself, "It's hard but I can do it."
Career and Personal Goals. Instances of a participant drawing on his ambitions to pursue self-imposed future goals. *short- and long-term lifestyle goals; financial; start and provide for a future family; support existing family members; support home community*	Maybe with the understanding of helicopters that I've gotten through my graduate school degree, and working in the [engineering] industry for some years, I will be able to have something for myself in terms of entrepreneurial pursuit, so that I won't be working for someone for the rest of my life; I decided that in 2015. So that linear path of thinking that I'm here . . . at point A and I need to get to point B, how am I going to get there? That avenue is what keeps me going. That's the only thing.

Table 7. Participants' Sources of Motivation

Pseudonym	DE	DD	CDGS	P	FE	FI	RE	RI	SC	CP
Ben		■	■	■	■			■		
Braxton	■	■		■	■	■				
Chris	■	■	■		■			■	■	■
Christian	■	■	■	■					■	■
Courtney				■					■	■
Daniel	■	■	■	■	■		■	■	■	
Daryl	■	■	■	■		■				■
David	■	■	■		■				■	■
Dean	■	■	■						■	■
Isaac			■	■					■	■
Jackson	■	■	■	■	■	■			■	■
Jacob	■	■	■		■	■			■	
Jaden	■	■	■	■		■		■	■	
Jai	■	■	■	■	■		■	■	■	
Jalen	■	■	■	■		■			■	
James	■	■	■					■	■	
Jesse	■	■	■	■	■			■	■	
Joseph	■	■	■	■					■	
Kemani	■	■			■	■			■	■
Kendall	■	■		■	■	■	■		■	■
Logan	■	■	■	■	■	■			■	
Lucas	■	■	■		■					
Marco	■	■	■	■		■				
Marcus	■	■	■			■		■	■	
Martin	■		■							
Micah	■	■		■						
Norman	■	■	■							
Paul	■	■	■	■	■	■			■	
Quentin	■	■	■	■	■	■		■		
Ricky	■	■	■	■				■	■	■
Robert	■		■						■	
Samuel	■	■	■	■			■	■	■	
Shawn	■	■	■	■	■			■	■	

Pseudonym	DE	DD	CDGS	P	FE	FI	RE	RI	SC	CP
Terrence	■	■	■		■	■			■	■
Thomas	■		■	■				■	■	
Titus	■	■	■						■	
Trai	■	■	■	■			■	■	■	■
Tristan	■	■		■	■			■	■	
Victor	■	■	■							■
Xavier	■	■							■	

Desire for Engineer = DE
Desire for Degree = DD
Challenges During Grad School=CDGS
Peers = P
Family (External) = FE
Family (Internal) = FI
[U]Representation (External) = RE
[U]Representation (Internal) = RI
Self-Coaching = SC
Career and Personal = CP

SOURCES OF MOTIVATION TO PERSIST

Our findings reveal the following sources of motivation to persist, which will be discussed individually below: desire to earn a graduate degree, desire to become an engineer, challenges during graduate school, peers, family members, [under]representation, self-coaching practices, career and professional goals.

Desires

Our data revealed that students described having two desires that in part influenced their motivation to persist. The first was the desire to obtain a graduate degree. Participants varied in terms of when they became interested in pursuing a graduate degree in engineering. Some, like Jalen and Jacob, knew they were interested in pursuing a graduate degree at a younger age. However, all participants described a confident resolve to persist through degree completion. Victor, for instance, stated, I can stop at the master's and go elsewhere, but I said, "You know, if I want to set myself up to be able to one day go back into a teaching role, I really need that PhD." In addition to the desire to pursue a graduate degree, some participants shared their early and ongoing desire to become an engineer. Courtney, a second-year master's student in civil engineering,

for example, mentioned that as early as undergraduate studies he knew he "wanted to be an engineer." However, at that time, he was not entirely clear about "what type of engineer" he wanted to be, referring to the wide range of engineering sub-disciplines (e.g., mechanical, material science, electrical engineering). As a result, he recalled that he "just did research of all the engineering fields" so that he could learn about the different sub-disciplines, and what opportunities might be available to him should he graduate with that degree. Across the "desires" factors, it appeared that these demonstrated students' focus on earning their degrees and strong commitment to engineering, influencing their motivation to persist.

Challenges During Graduate School

To this point, we have acknowledged the mainly positive aspects of the BMGEM that influence students to persist. However, the majority of participants also described challenging incidents or ongoing barriers to their persistence. We refer to challenges as mental, physical, or structural obstacles to students' goals. Some internal challenges included insufficient graduate-level preparedness, imposter syndrome, and pressure to prove one had not been admitted because of affirmative action. Externally based challenges included faculty-advisor conflicts around racial microaggressions, limited access to peer-led study groups, and negative racial campus and town climates. One representative example shared by Thomas, a third-year doctoral student in mechanical engineering, demonstrates the multi-layered nature of challenges students faced:

> "In the science fields, or engineering, or PhD. you will want to drop out at some point." It's just something that has been told by many people even before I came here. I tell students now, "You will want to leave at some point. So the battle is trying to get through that point." The other thing is, I wanted to leave because nothing was going according to my plan.

Although it might appear that what Thomas is explaining might be experienced by all engineering and graduate students, regardless of race, the participants in this study explained that their challenges were exacerbated because of their race and gender. Worthy of note, Thomas's words highlight that rather than completely derailing him from persisting, his challenges served as a source of motivation to persist and reminders of his desire to earn a degree and become an engineer. For Thomas and others, such challenges helped refuel their passion to persist.

Additionally, his words highlight how generations of Black students attempt to encourage younger generations to push past challenges. In this

sense, part of how most students described persevering past their challenges was through encouragement and support from their peers; participants helped their peers recommit to degree completion, further highlighting the interplay between challenges, desires, and motivation to persist.

Peers Serve as External Sources of Motivation

Many participants cited their peers as sources of external motivation; their peer groups were social networks that provided them with inspiration, similar to findings from existing research on undergraduate collegians (antonio, 2004; Brooms, 2019; Druery & Brooms, 2018; Martinez, 2000; McCabe, 2016). In the present study, Titus, a second-year doctoral student in civil engineering, discussed how his friend helped him throughout his graduate program:

> It's nice to be able to talk candidly with people because some of them are older than me, too. I know one of my friends, he's a fifth year so he's on his way out, PhD student. Just to be able to learn from them, see what they went through. Talk to them like "Oh, does it get easier sometimes or harder? What was it like in your program?" That's always nice.

Being able to have candid conversations with his friend about the graduate school process allowed Titus to gain not only insight into the process but also the ability to see others achieve their goals. Through their common experiences of writing papers or studying, Titus was able to channel the connection he had with his friend to aid in his persistence. Similarly, Thomas spoke directly to how his friends motivated him throughout graduate school:

> I met strong . . . Black males [and] Black females . . . It's just talking, keep talking to my colleagues, my friends, my peers. When I say colleagues, friends, and peers, I'm referring to the other Black students in my field. If they're struggling, I feel like I need to be stronger for them. Somehow when I'm struggling, they're there . . . It's like when I keep surrounding myself with my like-minded peers there, we keep pushing each other. It's like we might be stuck at this same one level and someone figures out something to go up, and [they] try to pull me up or vice-versa.

Thomas's quotation shows the significance for some Black students of having positive relationships with other Black students during graduate school. Also important to note, Thomas, and a few other participants in this study, did not solely discuss Black male peers; they also explained that

Black women served as valuable sources of motivational support. Further, while Thomas explained how his Black peers motivated him, he also described a reciprocal process whereby he helped to motivate them to persist as well. Although not specific to the STEM fields, existing research provides evidence of the importance Black peer groups play in the socialization and persistence of Black graduate students (Gaston-Gayles & Kelly, 2004). Students in the current study, like Thomas, routinely noted that drawing on their same-race peers for encouragement helped them continue pushing toward the finish line. Also important is the role of community that Thomas mentioned when he described one person learning something, then sharing it with the group. This type of bond—shared because of race and because of the isolation caused by being underrepresented in engineering—provides a counter to hegemonic Eurocentric practices of competition endemic in STEM fields (Green & Glasson, 2009; Seymour & Hewitt, 1997). By rejecting the practice of competition, Thomas and his Black peers found solace, safety, and success.

Having a social circle could increase participants' sources of motivational support. Christian, a third-year doctoral student in civil engineering, provided an example:

> I have a long-time friend from high school, undergrad, and then through graduate school that we were able to at least relate on just coming from Baltimore and infiltrating [this] White space . . . Just having one good friend that I've known for a long time around has been instrumental in my progress.

Although Christian entered a space that was not truly representative of his racial identity, he was able to lean on his long-term friendship to progress through the program. His friend was not someone he met during graduate study, but they had a lasting relationship, rooted in the motivation to succeed academically. Also worthy of note was that they were able to support one another though they were not in the same field of study. This was also true for Samuel, a fifth-year doctoral student in civil engineering, who had friends in a different graduate program who served as sources of external motivation. Samuel explained where his friends resided:

> [One is] in Massachusetts, two in Nebraska, one in Maryland. So, we keep talking. If there is someone, like my friend in Maryland, he's reluctant at finishing his degree. We all sometimes keep pushing him to keep taking the classes one-by-one.

Samuel asserted that his group of friends would offer each other advice in an effort to troubleshoot any issues they encountered. Taking Samuel and Christian's comments together shows that when you attend an

institution in which you are grossly underrepresented, you often must stay connected to former friends, and/or those you meet at other institutions.

The trend of friend groups motivating the participants in our study was also seen in Courtney's description of a strategy attempted by his friend group:

> My one friend, he actually did something kind of cool. In our group chat that we have, he tried to start this whole monthly, weekly goals thing. We would set a weekly goal and a monthly goal, and then we would hold each other accountable. Um, it didn't pan out so well, just because in a group of eight people and only two people are interested in it, it didn't really work out so well, but he did try something like that.

Courtney's quotation shows an example of a strategy to help support and hold others accountable. The group chat practice allowed Courtney and his peers to share their individual successes, rally around those who needed additional support, and then celebrate their collective process. Although Courtney told us that the practice was unsustainable because of the number of people in the group chat (i.e., eight), the fact that they were testing out different strategies to influence persistence is significant. Jai offered a similar account of how his peers outside the academy helped him make steady progress:

> And so a lot of my friends are very cool people to hang out with. We all—they help keep me sane, right?! Because this thing can make you insane. But many of them don't have high education or anything like that, but it does not hinder anything because, like, if I'm with them, I never talk about anything scientific or anything like that. It's just "Oh, let's go play basketball. Hey, hi." . . . This is my work, just as they have their own jobs . . . So nobody has ever told me, these people have never told me, you keep going or whatever, but just the environment of support is very nice.

Jai's quotation highlights that some participants had peers outside of the academy. Because of this, they were able to have non-academic conversations with peers, a valuable chance to not be "on." This finding, which shows that individuals from the college town's community can also serve as valuable sources of peer motivation to persist, relates to existing research on the roles of students' villages (in this case, the basketball court) (Burt et al., 2019).

These findings suggest that students' peer groups do not always have to be in their field of study, nor do they have to comprise graduate students or affiliates of the institution; further, peers may not solely be Black. This

finding appears to be a minor departure from the findings of existing research on college (generally undergraduate) peer friendships (see for example, antonio, 2004; Brooms, 2019; Martínez Alemán, 2000; McCabe, 2016) that suggest that students of color tend to exclusively have same-race, academic peers as sources of support in socially isolating PWIs. While that holds true in our data, our data *also* suggests the benefits of students holding non-university affiliated, non-STEM, and for some non-Black friendships. These friendships were described by a small subset of participants as essential components of fuller lives. That is, they described these friendships as being important so that they did not always have to think and talk about academic issues, and instead could engage in other activities like video games, sports, and fun passions they held outside of the academy. Nonetheless, the symbiotic relationship between motivation to persist and having a peer group was apparent throughout our findings.

Family Members Serve as Sources of External and Internal Motivation

Family members were another source of motivation for the men in this study. Whether they served as representations of perseverance, or "just basically gave advice," as stated by Logan, family members offered inspiration throughout graduate school. To illustrate, Isaac mentioned that his mother was a first-generation college student who later pursued a master's degree: "My mom had a master's [degree]. I need to get a PhD, that's just how it is." By simply earning an advanced degree, Isaac's mother served as a source of motivation for him. Joseph, a fourth-year doctoral student in material sciences engineering, also had parents with advanced degrees. Because of this, he was able to receive advice from them about the graduate school process:

> I had to call my mom, and I called my dad because they've been through graduate school before and was just like, "I don't know how I'm going to make this work." They kind of helped me manage taking things just one step at a time, managing the little things between each of these big deadlines I had, and ultimately got through that rough patch.

The "rough patch" Joseph described occurred over his graduate career and included consistent critiques from his advisor concerning failed experiments, writing research papers, and his preliminary qualifying exam. Such issues caused Joseph to question his progress. Fortunately, Joseph, like other participants with parents who held advanced degrees, appeared to borrow lessons from the graduate school experiences of

his parents to inform his approach to challenges. Thus, consonant with existing research (McCallum, 2016; Scott & Sharp, 2019), some parents aided persistence because participants could draw on parents' or family members' knowledge and experiences and apply them to their own graduate school challenges.

At times, applying "external" and "internal" theoretical constructs to participants' experiences became complex. For some students, there was movement between external and internal motivation that was not easy to disentangle. For example, Marco described how his sister served as both an external and an internal source of motivation for his persistence:

> [My sister] ended up taking a break [from school], and went to work in a lab. Like I said, her degree was in microbiology or something because she said she wanted to be a pharmacist. She took a break. So I'm actually the first person in my family to go to grad school. She's kind of following in my steps, and she's starting grad school coming in January. Well, aside from my parents, she's been the in-home motivator like, "If you are thinking about quitting, then there's no chance that I will be able to make it," because I've always been—to her I've always been the educational person.

For Marco, it was his sister's earlier model of going to school that provided him with a view of what college—and STEM—might be like. Even though his sister took a break, and he is now further along in the graduate school journey than she, he can still relate to his sister given her professional experience working in the lab. Because of her job, she is able to understand his experiences in the research laboratory, including the long hours, failed experiments, and the fatigue and disappointment that can result. Also significant is the shift in motivational forces that Marco describes. On one hand, his sister served as a source of motivation to enter and persist in STEM. On the other hand, however, we see that he now views himself as a model for his sister, given that he is the first in his family to pursue graduate studies. From this perspective, what started out as external motivation has shifted to internal motivation to persist as a model for family members behind him. Similar to Marco, Ben, a first-year doctoral student in mechanical engineering, explained how having his own family internally motivated him to persist:

> If you don't have family . . . you really have don't have any motivation to keep going; it's like you're only worried about yourself. If yourself drops out, only yourself is going to be hurt from that. Whereas, if I drop out, I have a son, I have a fiancée. I'm more motivated by that. So there is no choice. I can't just drop out.

Ben's account speaks to how completing his graduate studies is linked to supporting his family in the long term. For Ben, the pursuit of the graduate degree goes beyond fulfilling a personal goal for himself. It is about supporting his family and providing them with the best life possible. Consequently, as Ben progresses through the program, his family serves an external motivational force as he persists toward the completion of his graduate degree.

[Under]representations of Black Students and Faculty Serve as External and Internal Motivational Factors to Persist

As the Black men in this study reflected on what motivated them to stay in graduate school and in engineering, many described the representational roles Black men play. According to them, the presence of other Black men—even in small numbers—served as a source of motivation. Logan, a fifth-year doctoral student in electrical engineering, provides an example:

> Those two [Black Graduate Student Association (BGSA); Alliance for Graduate Education and the Professoriate (AGEP)] have been very helpful in my career just because as Black people, forget about engineering, because Black people in grad school, period. There's not a lot of us. To be able to get together in a room and see like-faces and like-minded people who are going and aspire to get those advanced degrees, that also provides a form of hope to keep you going forward because you know you're not alone.

Logan's quotation touches on numerous issues. Perhaps most significant is the relationship between [under]representation and student motivation. Logan acknowledges that there are not a lot of Black students anywhere at his institution. At predominantly White institutions like those in this study, affinity groups like the BGSA and AGEP become necessary safe spaces where Black students can see people who look like them (Carter-Veale et al., 2016; Lynch & Sears, 2011). As expressed by Logan, opportunities to see or connect with other Black people, regardless of their fields, helps him "keep going." This finding suggests that for some Black men, self-motivation is connected to not only "know[ing] you're not alone" but also physically not being alone in the struggle, similar to what Brooms (2019) and Andersen and Ward (2013) found with undergraduate collegians. Logan's quotation above also suggests that the representation needed to provide "hope" is not solely based on the presence of Black men but "Black people." Though this study is focused on Black men, and the questions posed to students centered their Blackness and

maleness, several participants made clear references to equally needing more representation of Black women. As suggested by Logan, Black people—irrespective of gender—are underrepresented in engineering and the in academy more broadly. Thus, representation and connection to one's Black peers—across genders—is needed to help provide "hope" that earning an advanced degree together is possible.

Titus, like Logan, saw other Black students as sources of motivation, regardless of their disciplinary backgrounds:

> I do know some Black males in [other] PhD programs. Three of them are my intramural team. They're all older, too. Probably fifth-year, at least about to graduate. It's nice to be able to talk to them. Having a sense of community, I guess, that helps. Even if we don't talk that much about academics, just knowing that they're that far in their program already, that's enough for me sometimes.

For Titus, it was important to have same-race same-gender friendships in graduate school. The community of Black men pursuing PhDs, at least at Titus's institution, helped him gain insight into the graduate school process. But as he articulated, it was also important for him to see others who shared similar racial and gender identities progress through graduate school. This in turn motivated him to remain committed.

Several participants also shared how reflecting on their current and future representation as Black men in engineering served as an internal source of motivation to persist. As an example, Samuel reflected on his underrepresentation:

> While in undergrad and graduate school, I have not seen many [Black] professors in my field, and I don't know if that is wise. I don't see a lot of people of color in my field. So my thing is, yeah, if I can go through this, maybe I become a professor, then that means maybe I can attract more people of color to go to graduate school and then influence others.

Because of their underrepresentation in engineering, it is rare for Black men to see others who share their racial and ethnic identities (Andersen & Ward, 2013; Long & Mejia, 2016). Samuel considers becoming a professor so that he can serve as a representative of Black men in engineering. His postgraduate career interest in the professoriate appears to be related to his lived experiences as an underrepresented student in engineering. Samuel's quotation suggests that he can help broaden participation in engineering through the platform of a faculty career. He seeks to be a professor both for professional gain and to help the field of engineering diversify.

Others offered similar sentiments. Dean, for instance, explained that he wanted to become a faculty member to "bridge the gap" in engineering faculty ranks. This finding regarding some students' commitment to representing the future of Black engineers appears to align with the findings of previous research (McGee et al., 2016). In the current study, many viewed earning their graduate degree as an opportunity to be in a position (e.g., faculty career) where future students might see them as a role model. This finding illustrates that some men pursue a graduate degree not only to fulfill promises to their family or out of personal interest but also in part to represent Black men in engineering. In this case, there is psychological meaning-making that causes some participants to be more motivated to persist.

The voices presented in this subsection are illustrative of students across each of the institutions in this study's sample. This suggests that "[under] representation" is a phenomenon influencing motivation regardless of institutional differences. This highlights the necessity of increasing the representation of Black men in engineering programs, not for the sake of achieving quotas but because present and future Black men need each other to persist.

Self-Coaching Practices Serve as Internal Sources of Motivation

The Black men in this study overwhelmingly described the significance of self-coaching practices to persist in their graduate studies. That is, in efforts to continue making progress through degree completion, students relied on their sense of self and implementation of self-guided practices to assist. For instance, Jai, a fifth-year student in mechanical engineering, stated a commitment to earning his engineering degree despite challenges along the way: "I'm a very determined person. Like if I'm putting myself to something, I'm going to do it, I don't care what obstacles are along the way." As evident in Jai's words, a large part of the motivation to persist is related to the commitment to pursuing graduate studies to begin with. As Jai stated, "If I'm putting myself to something"—in this case, graduate school—he has an unwavering resolve to do whatever is needed to complete it. Other Black men in this study offered similar sentiments illustrating that self-coaching is a driving force of persistence in graduate school.

Yet, while some participants provided examples of unwavering commitment to completing their degrees, a more nuanced (or zoomed in) view of how self-coaching occurred became apparent through data analysis. We identified several self-coaching practices that aided students' motivation. First, most participants engaged in "self-talk," a psychological

process whereby participants provided themselves with affirmations, made sense of and reframed challenging experiences and encounters, and generally encouraged themselves to continue making progress. For example, Terrence, a second-year student in material sciences engineering from Ghana, described challenges in adjusting to his new graduate school environment:

> I kept telling myself that "Hey, I can really do this, although it's hard." I've told myself that I don't think I want to get a job here [laughs]. I didn't know this was how the weather was before I came here. [But] I was like, "Oh I'm going to the U.S. for grad school." But I came here and it's cold. But I can cope with the weather. No, I didn't think of dropping out. I kept telling myself, "It's hard but I can do it."

The quotation from Terrence illustrates one way students self-coached. In addition to meeting the demands of the graduate program, Terrence also had to acclimate to life in the United States as an international student. While this could have posed a threat to his ability to persist in the material sciences program, Terrence affirmed his existence in the program by telling himself that he could indeed push through the challenges. Similarly, Thomas, a third-year student in mechanical engineering, used self-talk to persevere. For instance, Thomas discussed how he doubted his ability to be a graduate student but later stated, "The truth of the matter is I am good enough to be a grad student." He recalled other times he succeeded in his academic pursuits, such as being accepted into the graduate program, which through self-coaching he was able to view as a sign that he could indeed succeed. Self-talk, in the form of bold affirmations and attempts to maintain one's sense of self, will continue to be evident throughout the findings.

The second set of practices appeared to be physical in nature, a kind of visual motivational management. These self-initiated tools served to promote visual accountability and reminders of progress and were at times holistic. Isaac, a fourth-year student in agricultural engineering, described how he stayed on track with deadlines and tasks:

> At the beginning of each semester . . . You know the big note pads, where you can tear one off? I used to tear one off, tack it to my wall, my little area. I used to plan out, "Okay, [Isaac] you need to finish this part of chapter 1. This part of chapter 2. You need to wrap-up this lit review. You need to submit your abstract for this conference coming in November. You need to submit your abstract for this conference in January. You need to apply

> for this funding." I would put all of that out there. .. .I want other people to see what I am doing, that I am really serious and have things planned out. I might not achieve everything . . . but I can come to the office every day and see that, "Okay [Isaac] how far are you on this? What do you need to work on this week to achieve that goal?"

In the quotation above, Isaac motivated himself to meet the demands of his program by visually documenting his goals. Taking the initiative to plan out his goals for the semester allowed him to see the document as a source of motivation to stay on task. There was also an element of self-coaching embedded in the visual aid of the notepads that allowed him to interrogate his progress daily, which appeared to serve as a proactive strategy for accountability. In addition, there appeared to be some external motivation involved in this practice; the fact that he wanted others to know that he had a plan to be productive might be a function of his research laboratory, the expectations of his department, and so on. This practice of Isaac's could also be a part of the phenomenon described by scholars (Burt et al., 2019; Fries-Britt, 2002; Fries-Britt & Griffin, 2007; McGee et al., 2019; Moore et al., 2003) whereby high-achieving Black students feel as if they have to overcompensate in their academic performance in predominantly White environments to be viewed as worthy (i.e., "really serious," as expressed by Isaac). Visually capturing immediate tasks, as well as documenting progress they had made—by accomplishing one's immediate tasks—appeared to help motivate some participants by helping them to see that they had made steady progress toward degree attainment.

Career and Personal Goals Serve as Internal Sources of Motivation

The career and personal goals of the Black men in this study also served as internal motivation to persist. Marco, a doctoral student in aerospace engineering, discussed how his career goals helped him remain motivated:

> Maybe with the understanding of helicopters that I've gotten through my graduate school degree, and working in the [engineering] industry for some years, I will be able to have something for myself in terms of entrepreneurial pursuit, so that I won't be working for someone for the rest of my life; I decided that in 2015. So that linear path of thinking that I'm here . . . at point A and I need to get to point B, how am I going to get there? That avenue is what keeps me going. That's the only thing.

A first-year doctoral student at the time of data collection, Marco already had a clear vision for himself in the engineering workforce post-graduation. In the quotation above, Marco wants to leverage his previous classroom and professional experiences with helicopters for an industry career. He already sees how his expertise can open up avenues for entrepreneurial pursuits. Because he is forward-looking, his career and personal goals serve as motivation to amass skills and experiences to help him fulfill his goals, which motivates him to persist in graduate school.

Not all participants' career goals were well defined yet. However, many nonetheless articulated a connection between earning their graduate degree, future career and personal success, and persistence. For example, as a first-year doctoral student in industrial engineering, Martin was not yet able to explain exactly what his long-term goals were beyond working in engineering industry. He stated, "I just want to succeed, be a success. What that is, I'm not necessarily sure, but I know that being in graduate study helps." Though "success" was not explicitly defined, what was clear was his goal of obtaining an industry job that would complement his background in industrial engineering and statistics. That goal served as a source of motivation to persist. Similarly, as a second-year master's student, Courtney talked broadly about post-graduate goals:

> I have goals that I set for myself . . . so I think pursuing my goals and actively working towards my goals also helps me be successful—because I mean, at least I know what I'm trying to reach. I have things that I'm going for or that I'm pursuing, so yeah.

In its broadest sense, Courtney described his persistence in graduate school as a function of pursuing his professional interests. Like some other students, Courtney was not convinced that a career in engineering was right for him post-graduate school. However, he was determined to complete the requirements for his master's degree in civil engineering. For Courtney, finishing his degree, in part, would honor a personal educational goal and commitment which, once completed, would free him up to pursue career options outside of STEM.

Like Courtney, most participants articulated how personal or career goals guided them to persist. For many, these goals served as internal reminders of why they elected to pursue an engineering graduate degree and remained at the forefront of their minds when times were challenging. Jalen, a first-year doctoral student in mechanical engineering, said:

> I did have challenges. I just knew how to deal with them quickly. I had a goal in mind, basically. I set myself goals per semester. I try to meet them. I try to meet them as quickly as possible so that I will have time to relax.

In the quotation above, Jalen references challenges he faced. Through further conversation, he revealed that he struggled with course-related concepts (e.g., modeling) and what he perceived to be a competitive institutional and departmental culture. Additionally, part of his challenge included reaching out for help for fear that he would be perceived by his peers and faculty as lacking the ability to succeed in graduate school. However, as shown in his quotation above, Jalen was determined to overcome obstacles and continue making progress. Like Courtney and others in this study, he drew upon his professional goal—of becoming a professor—to help with his short-term goal-setting and personal accountability strategies. Dean, a first-year doctoral student in electrical engineering, similarly discussed overcoming obstacles:

> No matter how hard it gets, I don't think I would leave. One, because I want this [to earn a doctorate]. And two, because…I just don't see myself stopping. If you try to rationalize it, you're like, "Even if I stop right now, I've still got a computer engineering bachelor's degree, I can still—" I had job offers once already, so I can continue. I feel like that's not enough now because, one, I know that bachelor's degrees are almost at the point where years ago it was for a high school degree; everybody had one kind of… To get a step up, get your master's or something. Because that thought is in the back of my head and also because I want to get my PhD, that's the only future I see is with my PhD, I wouldn't leave. Even though it gets difficult, I wouldn't leave.

Dean and his peers do not require doctorates to be employed in STEM. In fact, approximately 36% of those in the STEM workforce have only bachelor's degrees (Graf, Fry, & Funk, 2018). Dean was aware that he could have a lucrative career without an engineering doctorate. However, his vision of himself included holding a PhD. For participants like Dean, the future benefits of holding a graduate degree were enough motivation to weather the storm of graduate school.

DISCUSSION

This article tells the story of 42 Black men in engineering graduate programs. To date, several have either graduated with their degrees (24) or are still in the process of earning them (18). In helping to explain their persistence, the Black Men's Graduate Engineering Motivation (BMGEM) theoretical model takes into consideration other broad theories of motivation (e.g., Deci & Ryan,1985; Eccles, 2011; Eccles & Wigfield, 2002; Eccles et al., 1990; Zimmerman et al., 1992), motivation conceptualizations

focused on Black collegians (Griffin, 2006; Yu et al., 2017), and literature describing the motivational experiences of Black students (undergraduate and graduate) in science and engineering fields (Chavous et al., 2017; DeCuir-Gunby et al., 2017; McGee et al., 2016, 2019; Moore, 2016; Yu et al., 2017). This previously mentioned scholarship provides essential background on the ways in which motivation has been studied, hypothesized, conceptualized, and theorized. Even though Black men may share some experiences with other students, including their same-race, different-gender counterparts and other historically underrepresented students of color (McGee, 2016; McGee & Martin, 2011), Black men also face unique experiences related to their gendered and racialized experiences in society and academe that should not be conflated with the experiences of other students (Burt et al., 2018; Chavous et al., 2017; Curry, 2017; Harper, 2015, 2005; Smith, 2010). To that end, because nuanced investigations of motivation—specific to individuals' race and ethnicity, gender, and fields of study—are needed to inform educational policies and practices, we set out to better understand the motivational sources that aid some Black men in persisting through their educational pathways. As a result, this study offered the new BMGEM theoretical model.

As noted by other scholars (Anderson et al., 2016; DeCuir-Gunby & Schultz, 2014), a challenge with determining persistence, perseverance, and other motivation-influenced outcomes relates to where the source(s) of motivation originates. That is, do individuals draw motivation from structure, agency, or some combination of the two? Our findings from the BMGEM suggest that for some Black men, motivation to persist is both structural and agentic. One's motivation to persist includes factors and sources that might be influenced by structural forces and individualized agentic efforts. In addition, it appears that structural motivational factors and sources operate in tandem without the manipulation or control of students (e.g., parent's level of education, parent's occupation). Because these set of factors are continuous, in some cases predate graduate school matriculation, and are out of an individual student's control, we consider these structural factors as "overlaying." This particular finding adds to the growing amount of research illustrating how structure and agency must be considered as inextricably linked in efforts to provide more balanced accounts of individuals' lives and experiences (Griffin, 2006; Johnson-Ahorlu, 2012; McCoy et al., 2015). In the present study, some students explicitly mentioned how particular structures influenced their educational pathways (e.g., affirmative action policies and practices in graduate recruiting and admission, K–12 schooling experiences, sociopolitical environment for foreign-born Black students), which influenced their agentic motivational responses to those structures (e.g., enjoyment of math and science,

passion toward education, commitment to degree completion, long-term interest in science and engineering). A challenge we faced was visually capturing this interplay between structure and agency, especially as we balanced using students' temporal understandings of their experiences and our interpretations of sociohistorical policies and practices undergirding their experiences and educational pathways. However, while not explicitly denoted as "structure" and "agency," through multiple visual iterations of the BMGEM, we were able to illustrate the interplay of structure (e.g., sociocultural factors, personal factors, social identities, pre-graduate school experiences, challenges in graduate school) and agency (e.g., desire to get a graduate degree and become an engineer, self-coaching practices, interactions with peers and family members, setting career and personal goals). Had we not considered both structure and agency, we might have missed valuable insights into students' more intricate motivations to persist.

Our study, and the BMGEM specifically, offers additional contributions to the educational knowledge base on Black male motivation. Specifically, our data show that motivations to persist are both continuous and simultaneous. That is, motivations to persist do not emerge at one point in time in a student's graduate experience. Rather, they appear to happen at various continuous points in time throughout one's graduate experience. In addition, the strategies students implement to motivate themselves to persist can be used simultaneously. The simultaneous nature of the processes of motivation suggests that for some students, motivation may be both internal and external at the same time, warranting the use of multiple strategies at the same time to motivate themselves to persist. This finding means that for some students, some motivational strategies are ongoing and are influenced by both internal and external stimuli.

Our model does not make definitive claims about when certain motivational strategies begin, nor what triggers students (and when) to develop particular motivational reactions; the PI did not intentionally design the interview protocol to identify origins and sources of motivation. For instance, it is not exactly clear when some participants' desires to become an engineer emerged; the model accounts for participants' current desires (or lack thereof) to become engineers. Similarly, we do not purport to offer an exhaustive account of the various challenges that students faced during and before graduate school. Our data show that consonant with existing research on challenges experienced by Black students attending PWIs (Brooms, 2019; DeFour & Hirsch, 1990; Gay, 2004; Harper, 2015; Herzig, 2004; Johnson-Bailey et al., 2009) and specifically those in STEM graduate programs (Burt, Williams, & Smith, 2018; Burt et al., 2019; Chavous et al., 2017; McGee & Martin, 2011; McGee et al., 2019), all students experienced challenges in graduate school that to some extent

served as motivating forces to persist. However, it is likely that some of the challenges that students tend to report in graduate school (e.g., racism, racial microaggressions, underrepresentation, tokenism) also take place in pre-graduate education schooling experiences (Berry, 2008; Brand, Glasson, & Green, 2006; Jett, 2016; Strayhorn, 2015; Wright et al., 2016). Given this, it is possible that students were describing persistent challenges related to the slow-to-change traditions and legacies of science (Burt, Williams, & Smith, 2018). If so, these challenges extend well before the motivational factors in graduate school. We attempted to account for this possibility in the model through the "Pre-Graduate School Experiences" box. However, future research that intentionally investigates pre-graduate school challenges will further refine that component of the BMGEM.

A benefit of the BMGEM is its nuanced specificity, based on empirical data, to Black males in engineering graduate programs at select PWIs. While broad literature on graduate education, engineering education, persistence, and motivation was consulted, the existing literature on the experiences of historically underrepresented students of color at PWIs suggests that students experience educational pathways in unique ways based in part on their social identities. Because we aimed to extend existing understandings of motivations specific to Black men in engineering graduate programs, we chose not to try to account for other genders or other historically underrepresented racial/ethnic groups. Similarly, we acknowledge the important roles that HBCUs play in the preparation of Black scholars, especially those in STEM fields (National Science Foundation, 2017); HBCUs matriculate more Black students in STEM than do PWIs. Our decision to focus on the experiences of Black students attending graduate school in engineering at PWIs reduces the number of explanatory factors that may arise when considering differences by institutional type. That is, it is possible—yet unconfirmed—that students' motivations to persist might be similar or different by institutional type. This might be especially true for institutional types where there are more same-race and same-gender peers (and faculty) in STEM. It is possible that students attending HBCUs—with a different student (and faculty) demographic population than the current study participants—could add nuance to our findings on students' understandings of being underrepresented in engineering and how their underrepresentation influences their motivations to persist. Important to note, some scholarship suggests that some students in STEM attending HBCUs experience similar patterns of racial discrimination as their peers attending PWIs in STEM fields (McGee et al., 2019). Taken together, we acknowledge that it is possible that some of the findings from this study may relate to other populations (e.g., undergraduate students, those in fields outside of engineering, Black women and other historically

underrepresented populations, students attending different institutional types). However, future research is needed to either confirm or disconfirm the ways in which this study's findings might relate to other populations. To further conflate Black male students' motivations to persist in engineering with those of STEM students writ large and non-STEM majors, and with students attending other types of institutions, might miss the goal that this study's substantive theory strives to reach.

While the BMGEM clarifies that the phenomenon of motivation includes movement between external and internal factors and is a continuous and simultaneous cycle, among a host of other contributions to existing motivational literature and theory, the BMGEM should be considered a starting point rather than a conclusive one in conceptualizing motivation to persist. We offer further directions for future extensions of the theoretical model, and offer implications for practice (see Table 8).

Table 8. Implications for Future Research and Theory and Practice

Type of Implication	Recommendations
Research and Theory	• Identify a wide range of sociocultural factors and directly test the ways they individually and interactionally influence students' academic experiences. Translate the broad category of "sociocultural factors" into smaller testable variables. • Expand understandings of the motivational process for some Black men in engineering graduate programs by investigating the effects of students' challenges and their responses to those challenges. • Clarify when the desire to earn a graduate degree and the desire to become an engineer emerge, as well as "how" and "from whom" these desires originate. • Further refine understandings of the continuous and simultaneous nature of students' motivation to persist over time, and whether students test out different motivational strategies throughout their graduate careers. • Identify and examine the wide array of family members who serve as sources of motivation. • Test the BMGEM on other student populations (e.g., Black men at different institutional types, Black undergraduates, Black women, Latinx students).
Practice	• Create programs that address both internal and external motivation, such as connecting students with faculty who can serve as models of success. • Provide programming that promotes multiple forms of motivation (i.e., internal and external) at all class levels (during the transition into graduate school, through coursework, through passing a qualifying exam and dissertation proposal, defending the dissertation, and all of the milestones in between). • Increase Black representation—at the student and faculty levels—in the engineering college.

IMPLICATIONS FOR FUTURE RESEARCH AND THEORY ON BLACK MEN'S MOTIVATION

Our findings and the BMGEM offer directions for future research and theory on Black men's motivation to persist. First, further research is needed to better understand how the overlaying factors influence students' motivations to persist. In particular, as acknowledged through the BMGEM, sociocultural factors—larger economic, political, historical, societal systems and structures—undergird students' educational experiences. Researchers will want to identify a wide range of sociocultural factors and more directly test the ways in which these factors individually and interactionally influence students' academic experiences. Such a study would be useful translating the broad category of "sociocultural factors" into smaller testable variables. Such results might better inform the specific ways in which sociocultural factors—which may currently seem to only anecdotally influence students' experiences—shape the policies and practices of institutions, colleges, departments, fields of study, and community members within academic environments.

Second, our findings point to the role challenges play in motivating students to achieve. That is, challenges (e.g., advisors, peers, racism) served as motivators to persist. We recognize that this finding may be counterintuitive. We *are not* recommending introducing challenges to students' academic careers; we believe that Black men and other historically underrepresented students of color already endure enough challenges in their daily experiences as minoritized people. Rather, based on our study's data, we recognize that some challenges did promote motivation to cope and persevere. Future research may more directly investigate the effects of challenges and students' responses to them. Further, it is possible that isolating a challenge (e.g., conflicts with advisors; tokenism within classrooms; being expected to prove one's academic abilities in the pursuit of peer study groups) might yield different forms of motivational strategies.

Third, two "desires" emerged from the data that help influence students to persist: the desire to earn a graduate degree and the desire to become an engineer. Similar to above recommendations, now that we understand that desires influence motivation, more clarification regarding "when," "how," and "from whom" these desires originate would be useful. For instance, if specifically asked, some students might clarify how their family members' or teachers' regular encouragement fueled their desire to become an engineer. Other students may detail how their desires were solely initiated by intellectual curiosity. New knowledge about students' desires would offer insights into practices that could be used in K–12 (and perhaps undergraduate studies, depending on whom students identify as helping to fuel their desires and when their desires begin). In addition, it is possible that there are other desires that

other students may have that influence motivation. For instance, although not representative of the findings in our data, for some students, earning a graduate degree in engineering and becoming an engineer might be markers of social status, financial stability, or professional accomplishment. A more expansive sample would be able to identify additional desires Black male students have and the roles these desires play in students' motivations to persist.

Fourth, although the BMGEM indicates that motivation to persist is continuous throughout students' graduate careers, future research is needed to understand whether students test out different motivational strategies over time. Different strategies may be associated with different phases of one's graduate career. This research would extend existing work that argues that graduate education (particularly doctoral education in business fields) has different phases with different challenges and learning outcomes ([Baker] Schweitzer, 2009). Much of our data resulted from two one-on-one interviews and a follow-up focus group; a longer longitudinal design may more fully answer the questions above. Scholars may consider a longitudinal study from matriculation through degree completion focused on motivational forces and practices over time. Such a rigorous study could provide further robust evidence of the continuous and simultaneous nature of student motivation to persist, as described in the BMGEM.

Fifth, existing research shows that networks are important to learning and professional identity development (Baker & Lattuca, 2010; Baker & Pifer, 2011; Baker et al., 2013). In the current study, family members were recognized as contributors to students' motivation to persist. However, while many participants described parents, uncles and aunts, and siblings, less evidence was available regarding how other family members (e.g., partners, children) also served as external—or external turned internal—sources of motivation. Future research could more intentionally examine how other family members also serve as sources of motivation.

Finally, while our study centered on the motivational factors of Black men in engineering graduate programs at four institutions, some of the factors identified may be applicable to Black men in other disciplines (e.g., biology, medicine, psychology, education), and at different institutional types (e.g., public and private, research and teaching-focused institutions, Historically Black Colleges and Universities programs), as well as to Black men in undergraduate studies. Our decision to focus exclusively on Black men appears to align with Eccles and colleagues' (Eccles, 2011; Eccles, Jacobs, & Harold, 1990; Eccles & Wigfield, 2002) work conceptualizing individuals' motivation to achieve as related values, goals, and choices developed through socialization, and informed by gender, race,

and ethnicity. Thus, based on our study, while it is unclear if the motivational factors would be similar or different for men and women of other racial and ethnic backgrounds (e.g., Black women, Latina women, Latino men, White women), it is possible that the continuous and simultaneous nature described by the BMGEM theoretical model would hold. Further research is needed to test the above hypotheses regarding the applicability of the BMGEM to other student populations.

IMPLICATIONS FOR PRACTICE

Our findings also have implications for practice. Black men in graduate engineering programs face challenges that can threaten their persistence. Our findings, however, suggest that motivational factors can help students succeed. The Black men in this study have persisted because of both internal ways they encourage themselves and external sources of motivation. Our findings extend conventional perspectives on motivation as a binary phenomenon (internal or external); when practitioners do not use a both/and approach, they may miss opportunities to tap into students' sources of motivation. Thus, faculty, staff, and administrators should create programs and practices that address both internal and external sources of motivation (Lynch & Sears, 2011). For example, intentional programming that both affirms students and provides external motivation by bringing together peers and faculty of color to serve as models of success (Carter-Veale et al., 2016) could be particularly helpful for Black male students. Such strategic planning could foster support networks for Black men and incorporate strategies to increase students' academic and professional self-efficacies.

The BMGEM clarifies that there is no single point in students' graduate careers when motivation occurs; motivational strategies are ongoing and needed throughout. Efforts to influence student progress only upon matriculation may miss the mark; programming should take into account the continuous and simultaneous nature of students' motivational sources. That is, students need programming that ignites multiple forms of motivation (i.e., internal and external) at all class levels (during the transition into graduate school, through coursework, through passing a qualifying exam and dissertation proposal, defending the dissertation, and all of the milestones in between). More holistic programming that takes into account components of the BMGEM may more fully address students' needs over the course of their academic careers.

While the Black men in this study were able to reframe their challenges into sources of motivation to persist, students should not have to develop strategies to counteract systems and structures in STEM that create

barriers. Instead, we should dismantle these systems and structures so that students' motivational efforts can be devoted to learning, doing research, and preparing for their postgraduate careers. One obvious correction is reducing student underrepresentation in engineering. Most participants mentioned the need for more same-race or same-gender (i.e., Black men and women) representation at the faculty and student levels. If broadening participation is a goal, those in charge of recruitment, admission, and retention will partner to create strategies that increase Black representation. This need is not anecdotal. Based on this study's empirical evidence, having more Black representation at the faculty and student levels motivates students to persist. Granted, most students were able to identify some non-Black peers within their institution, and others were able to connect with Black students in other fields and disciplines. But some Black men are ostracized within their engineering college communities (see Burt, Williams, & Smith, 2018), exacerbating their isolation and increasing their chances of dropping out and departing from the STEM workforce. Administrators, faculty, and staff may be able to directly improve students' experiences, and thus, their motivation to persist, by tackling their underrepresentation.

CONCLUDING THOUGHTS

Despite the alarming statistics about their small presence in the STEM workforce, there is a long history of contributions by Black men and members of other historically underrepresented populations. Unfortunately, when Black men are stereotyped as deficient or incapable of learning technical fields like engineering, it makes it more difficult for them to achieve in those fields. Their burden becomes proving their capacity to succeed. The men in this study illuminate how they have been able to push past such barriers preventing them from broadening participation in STEM.

Because the Black men in this study had fervent desires to earn their graduate degrees and become engineers, the challenges that threatened their persistence (e.g., being Black men enrolled in engineering programs, as well as the challenges of living in the predominantly White college towns) also served as motivators to persevere. Their experiences are illustrated by the Black Male Graduate Engineering Model. The BMGEM centers Black men as achievers in STEM broadly, and engineering specifically. This is important as it might be assumed that because there are few Black men in graduate school, they do not have the sophistication to create success strategies. The BMGEM shows how 42 Black men have earned or are striving to earn their graduate degrees in engineering. To be clear, we are not arguing for institutions to admit more Black men students and

faculty as a quick fix to students' motivational challenges. Thoughtless strategies, without plans for retention and motivation, will merely achieve quotas for the sake of institutional and programmatic rankings, glossy promotional brochures, and institutional bragging rights (i.e., interest convergence, Bell, 2005; Delgado & Stefancic, 2001). This is not the answer. Rather, we charge engineering colleges to make true commitments to broadening participation, which from our perspective means centering students—in this case, Black men—as contributors to STEM. In doing so, engineering colleges need to commit to helping Black men succeed. Assisting in their motivation to persist is a key to meeting this charge.

ACKNOWLEDGEMENTS

We would like to thank the participants who courageously shared their stories with us. Rachael Blansett and other members of the Burt Research Group (BRG) who assisted with ideation and peer review. Dr. Chrystal George Mwangi, Dr. Jennifer Johnson, and Dr. Krystal Williams for their formative feedback on iterations of this study's model. And the reviewers for providing valuable feedback that helped to strengthen this work. This work was supported by the National Academy of Education/Spencer Postdoctoral Fellowship Program; the National Science Foundation-Iowa EPSCOR (under grant EPS- 1101284), and the National Science Foundation CAREER Award (under grant 1651808).

REFERENCES

Allen, W. R. (1992). The color of success: African-American college student outcomes at predominantly White and historically Black public colleges and universities. *Harvard Educational Review, 62*(1), 26–44.

Ames, C., & Ames, R. (1984). Systems of student and teacher motivation: Toward a qualitative definition. *Journal of Educational Psychology, 76*, 535–556.

Andersen, L., & Ward, T. J. (2013). Expectancy-value models for the STEM persistence plans of ninth-grade, high-ability students: A comparison between Black, Hispanic, and White students. *Science Education, 98*(2), 216–242.

Anderson, C., Turner, A. C., Heath, R. D., & Payne, C. M. (2016). On the meaning of grit…and hope…and fate control…and alienation…and locus of control…and…self-efficacy…and…effort optimism…and…*Urban Review, 48*(3), 198–219.

antonio, a. l. (2004). When does race matter in college friendships? Exploring men's diverse and homogeneous friendship groups. *Review of Higher Education, 27*, 553–575.

Baber, L. D., & Jackson, J. (2018). From the edge of success to the center: Development of LSAMP Alliances, 1987–2017. *IINSPIRE LSAMP Research Brief No. 2*. Iowa State University.

Baker, V. L., & Lattuca, L. R. (2010). Developmental networks and learning: Toward an interdisciplinary perspective on identity development during doctoral study. *Studies in Higher Education, 35*(7), 807–852.

Baker, V. L., & Pifer, M. J. (2011). The role of relationships in the transition from doctoral student to independent scholar. *Studies in Continuing Education, 33*(1), 5–17.

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. *Journal of Higher Education, 84*(4), 449–476.

Bell, D. (2005). Brown v. Board of Education and the interest-convergence dilemma. In R. Delgado & J. Stefancic, (Eds.), *The Derrick Bell reader* (pp. 33–39). New York University Press.

Berry, R. (2008). Access to upper-level mathematics: The stories of successful African American middle school boys. *Journal for Research in Mathematics Education, 39*(5), 464–488.

Brand, B. R., Glasson, G. E., & Green, A. M. (2006). Sociocultural factors influencing students' learning in science and mathematics: An analysis of the perspectives of African American students. *School Science and Mathematics, 106*(5), 228–236.

Brooms, D. R. (2019). Not in this alone: Black men's bonding, learning, and sense of belonging in Black male initiative programs. *Urban Review, 51*(5), 748–767.

Burrell, J. O., Fleming, L., & Fredericks, A. C., (2015). Domestic and international student matters: The college experiences of Black males majoring in engineering at an HBCU. *The Journal of Negro Education, 84*(1), 40–55.

Burt, B. A. (2019). Toward a theory of engineering professorial intentions: The role of research group experiences. *American Educational Research Journal, 56*(2), 289–332.

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. https://doi.org/10.1002/jee.20353

Burt, B. A., & Johnson, J. (2018). Origins of STEM interest for Black male graduate students in engineering. *School Science and Mathematics, 118*(6), 257–270.

Burt, B. A., Knight, A., & Roberson, J. (2017). Racializing experiences of foreign-born and ethnically diverse Black male engineering graduate students: Implications for student affairs practice, policy, and research. *Journal of International Students, 7*(4), 925–943.

Burt, B. A., McKen, A., Burkhart, J., Hormell, J., & Knight, A. (2019). Black men in engineering graduate education: Experiencing and coping with racial microaggressions within the advisor-advisee relationship. *Journal of Negro Education, 88*(4), 493-508.

Burt, B. A., Williams, K. L., & Palmer, G. J. M. (2019). 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.

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.

Campbell, C. A., Dortch, D., & Burt, B. A. (2018). Reframing rigor: A modern look at challenge and support in higher education. In C. Campbell (Ed.) *Reframing Rigor: New Understandings for Equity and Student Success* (pp. 11–23). New Directions for Higher Education 181.

Carter-Veale, W. Y., Tull, R. G., Rutledge, J. C., & Joseph, L. N. (2016). The dissertation house model: Doctoral student experiences coping and writing in a shared knowledge community. *CBE-Life Sciences Education, 15*(3), 1–12.

Chavous, T. M., Drotar, S., Fonseca-Bolorin, G., Leath, S., Lyons, D., & Mustafaa, F. (2017). Identity, motivation, and resilience: The example of Black college students in science, technology, engineering, and mathematics. In J. T. DeCuir-Gunby, & P. A. Schutz (Eds.), *Race and ethnicity in the study of motivation in education*, 117–132. Routledge.

Chubin, D. E., May, G. S., & Babco, E. L. (2005). Diversifying the engineering workforce. *Journal of Engineering Education, 94*(1), 73–86.

Cokley, K. O. (2001). Gender differences among African American students in the impact of racial identity on academic psychosocial development. *Journal of College Student Development, 42*(5), 480–487.

Cokley, K. O. (2003). What do we know about the motivation of African American students? Challenging the "anti-intellectual" myth. *Harvard Educational Review, 73*(4), 524–558.

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

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

Curry, T. J. (2017). *The man-not: Race, class, genre, and the dilemmas of Black manhood*. Temple University Press.

Deci, E., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Springer Science & Business Media.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist, 26*(3–4), 325–346.

DeCuir-Gunby, J. T., & Shutz, P. A. (2014). Researching race within educational psychology contexts. *Educational Psychologist, 49*(4), 244–260.

DeCuir-Gunby, J. T., Shutz, P. A., & Harris, S. D. (2017). A future agenda for research race and ethnicity in the study of motivation in educational contexts. In J. T. DeCuir-Gunby & P. A. Schutz (Eds.), *Race and ethnicity in the study of motivation in education*, pp. 201–211. Routledge.

DeFour, D. C., & Hirsch, B. J. (1990). The adaptation of Black graduate students: A social network approach. *American Journal of Community Psychology, 18*(3), 487–503.

Delgado, R., & Stefancic, J. (2001). *Critical race theory: An introduction*. New York University Press.

Diverse: Issues in Higher Education. (2018). Top 100 producers of graduate degrees, 2018. https://diverseeducation.com/top100/pages/GraduateDegreeProducers2018.php

Druery, J. E., & Broom, D. R. (2018). "It lit up the campus": Engaging Black males in culturally enriching environments. *Journal of Diversity in Higher Education, 12*(4), 330-340. http://dx.doi.org/10.1037/dhe0000087

Eccles, J. S. (2011). Gendered educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *International Journal of Behavioral Development, 35*(3), 195–201.

Eccles, J. S., Jacobs, J. E., & Harold, R. D. (1990). Gender-role stereotypes, expectancy effects, and parents' role in the socialization of gender differences in self-perceptions and skill acquisition. *Journal of Social Issues, 46*, 182–201.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology, 53*, 109–152.

Figueroa, T., & Hurtado, S. (2013). Underrepresented racial and/or ethnic minority (URM) graduate students in STEM disciplines: A critical approach to understanding graduate school experiences and obstacles to degree progression. *Proceedings of Association for the Study of Higher Education.* Retrieved: http://www.heri.ucla.edu/nih/downloads/ASHE2013- URM-Grad-Students-in-STEM.pdf

Fries-Britt, S. (2002). High-achieving Black collegians. *About Campus, 7*(3), 2–8.

Fries-Britt, S. R., Burt, B. A., & Franklin, K. (2012). Establishing critical relationships: How Black males persist in physics at HBCUs. In Palmer, R. T. and Wood, J. L. (Eds.), *Black Men in Black Colleges: Implications for Diversity, Recruitment, Support, and Retention* (pp. 71–88). Routledge.

Fries-Britt, S. L., & Griffin, K. (2007). The black box: How high achieving Blacks resist stereotypes about Black Americans. *Journal of College Student Development, 48*(5), 509–524.

Fries-Britt, S. L., & White-Lewis, D. (2020). In pursuit of meaningful relationships: How Black males perceive faculty interactions in STEM. *Urban Review.* Advance online publication: https://doi.org/10.1007/s11256-020-00559.

Gasiewski, J. A., Eagan, M. K., Garcia, G. A., Hurtado, S., & Chang, M. (2012). From gatekeeping to engagement: A multicontextual, mixed method study of student academic engagement in introductory STEM courses. *Research in Higher Education, 53*(2), 229–261.

Gaston-Gayles, J., & Kelly, B. (2004). Preparing the next generation of African American scholars mentoring and professional development experiences. *NASAP Journal, 7*(1), 46–62.

Gay, G. (2004). Navigating marginality en route to the professoriate: Graduate students of color learning and living in academia. *International journal of Qualitative Studies in Education, 17*(2), 265–288.

George Mwangi, C. A., Changamire, N., & Mosselson, J. (2019). An intersectional understanding of African international graduate students' experiences in U.S. higher education. *Journal of Diversity in Higher Education, 12*(1), 52–64.

Graf, N., Fry, R., & Funk, G. (2018). *7 facts about the STEM workforce.* Pew Research Center. http://www.pewresearch.org/fact-tank/2018/01/09/7-facts-about-the-stem-workforce/

Green, A., & Glasson, G. (2009). African Americans majoring in science at predominantly White universities (A review of the literature). *College Student Journal, 43*(2), 366–374.

Griffin, K. (2006). Striving for success: A qualitative exploration of competing theories of high-achieving Black college students' academic motivation. *Journal of College Student Development, 47*(4), 384–400.

Hagedorn, L. S. (2005). How to define retention: A new look at an old problem. In A. Seidman (Ed.), *College student retention: Formula for student success* (pp. 89–106). Praeger.

Harper, S. R. (2005). Leading the way: Inside the experiences of high-achieving African American male students. *About Campus, 10*(1), 8–15.

Harper, S. R. (2012). Race without racism: How higher education researchers minimize racist institutional norms. *Review of Higher Education, 36*(1), 9–29.

Harper, S. R. (2015). Black male college achievers and resistant responses to racist stereotypes at predominantly White colleges and universities. *Harvard Educational Review, 85*(4), 646–674.

Harper, S. R., & Palmer, R. T. (2016). Improving attainment, experiences, and career outcomes among Black male students in doctoral degree programs. In S. R. Harper & L. T. Wood (Eds.), *Advancing Black male student success from preschool through Ph.D.* (pp. 141–163). Stylus.

Herzig, A. H. (2004). Becoming mathematicians: Women and students of color choosing and leaving doctoral mathematics. *Review of Educational Research, 74*(2), 171–214.

Hrabowski III, F. A. (1991). Helping gifted Black males succeed in science. *Journal of Health Care for the Poor and Underserved, 2*(1), 197–201.

Hrabowski, F. A., & Pearson, W. (1993). Recruiting and retaining African-American males in college science and engineering. *Journal of College Science Teaching, 22*(4), 234–238.

Ingram, T. N. (2007). *From challenged to triumphant: Factors contributing to African American male doctoral students' persistence at predominantly White institutions* (Unpublished doctoral dissertation). Indiana University.

Jett, C. C. (2016). Ivy leagues bound: A case study of a brilliant African American male mathematics major. *Spectrum: A Journal of Black Men, 4*(2), 83–97.

Johnson-Ahorlu, R. N. (2012). The academic opportunity gap: How racism and stereotypes disrupt the education of African American undergraduates. *Race Ethnicity and Education, 15*(5), 633–652.

Johnson-Bailey, J., Valentine, T., Cervero, R. M., & Bowles, T. A. (2009). Rooted in the soil: The social experiences of Black graduate students at a southern research university. *The Journal of Higher Education, 80*(2), 178–203.

Kanfer, R. (1990). Motivation theory and industrial and organizational psychology. *Handbook of industrial and organizational psychology, 1*(2), 75–130.

Lane, T. B. (2016). Beyond academic and social Integration: Understanding the impact of a STEM enrichment program on the retention and degree attainment of underrepresented students. *CBE-Life Sciences Education 15*, 1–13.

Long, L. L., III, & Mejia, J. A. (2016). Conversations about diversity: Institutional barriers for underrepresented engineering students. *Journal of Engineering Education, 105*(2), 211–218.

Lynch, C., & Sears, K. G. (2011). *Impact of professional development activities in preparing scholars to become future faculty.* Paper presented at the American Association for Engineering Education (ASEE) annual conference, Vancouver, B.C.

Maltese, Adam V., & Robert H. Tai. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among U.S. students. *Science Education, 95*(5), 877–907.

Maltese, A. V., Melki, C. S., & Wiebke, H. L. (2014). The nature of experiences responsible for the generation and maintenance of interest in STEM. *Science Education, 98*(6), 937–962.

Martínez Alemán, A. M. (2000). Race talks: Undergraduate women of color and female friendships. *Review of Higher Education 23*, 133–152.

McCabe, J. (2016). Friends with academic benefits. *Contexts, 15*(3), 22–29. doi:10.1177/1536504216662237

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.

McCoy, D. L., Winkle-Wagner, R., & Luedke, C. L. (2015). Colorblind mentoring? Exploring white faculty mentoring of students of color. *Journal of Diversity in Higher Education, 8*(4), 225–242. https://doi.org/10.1037/a0038676

McGee, E. O. (2016). Devalued Black and Latino racial identities: A by-product of STEM college culture? *American Educational Research Journal, 53*(6), 1626–1662.

McGee, E. O., & Martin, D. B. (2011). "You would not believe what I have to go through to prove my intellectual value!": Stereotype management among academically successful Black mathematics and engineering students. *American Educational Research Journal, 48*(6), 1347–1389.

McGee, E. O., & Robinson, W. H. (2020). *Diversifying STEM: Multidisciplinary perspectives on race and gender.* Rutgers University Press.

McGee, E. O., & Robinson, W. H., & Houston, S. L. (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.

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.

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

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.

Moore, J. L., Madison-Colmore, O., & Smith, D. M. (2003). To prove-them-wrong syndrome: Voices from unheard African American males in engineering disciplines. *Journal of Men's Studies, 12*(1), 61–74.

Muñoz, S. M., & Maldonado, M. M. (2011). Counterstories of college persistence by undocumented Mexicana students: Navigating race, class, gender, and legal status. *International Journal of Qualitative Studies in Education, 25*(3), 293–315.

National Science Foundation. (2017). Women, minorities, and persons with disabilities in science and engineering. www.nsf.gov/statistics/wmpd/

Pascarella, E. T., & Terenzini, P. T. (1991). *How college affects students: Findings and insights from twenty years of research.* Jossey-Bass.

Pascarella, E. T., & Terenzini, P. T. (2005). *How college affects students: A third decade of research.* Jossey-Bass.

Perez, R. J., Harris, L. W., Robbins, C. K., & Montgomery, C. M. (2019). Graduate students' agency and resistance after oppressive experiences. *Studies in Graduate and Postdoctoral Education,* advance online publication, doi.org/10.1108/SGPE-06-2019-0057.

Peshkin, A. (1988). In search of subjectivity. One's own. *Educational Researcher, 17*(7), 17-21.

Reason, R. D. (2009). An examination of the persistence research through the lens of a comprehensive conceptual framework. *Journal of College Student Development, 50,* 659–682.

Russell, M. L., & Atwater, M. M. (2005). Traveling the road to success: A discourse on persistence throughout the science pipeline with African American students at a predominantly White institution. *Journal of Research in Science Teaching, 42*(6), 691–715.

Ryan, R. M., & Deci, E. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78.

Scott, L., & Sharp, L. A. (2019). Black males who hold advanced degrees: Critical factors that preclude and promote success. *Journal of Negro Education, 88*(1), 44–61.

Seymour, E., & Hewitt, N.M. (1997) *Talking about leaving: Why undergraduates leave the sciences.* 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*, 551–578.

Smith, W. A., Yosso, T. J., & Solórzano, D. G. (2007). Racial primes and Black misandry on historically White campuses: Toward critical race accountability in educational administration. *Educational Administration Quarterly, 43*(5), 559–585.

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and*

techniques. Sage.

Strayhorn, T. L. (2015). Factors influencing Black males' preparation for college and success in STEM majors: A mixed methods study. *Western Journal of Black Studies, 39*(1), 45–63.

(Baker) Sweitzer, V. (2009). Towards a theory of doctoral student professional identity development: A developmental networks approach. *The Journal of Higher Education, 80*(1), 1–33.

U.S. News. (2019). 2020 Best Engineering Schools. https://www.usnews.com/best-graduate-schools/top-engineering-schools

Wright, B. L., Counsell, S. L., Goings, R. B., Freeman, H., & Peat, F. (2016). Creating access and opportunity: Preparing African-American male students for STEM trajectories PreK–12. *Journal for Multicultural Education*, *10*(3), 384–404.

Yoder, B. L. (2017). *Engineering by the numbers*. American Society for Engineering Education. https://www.asee.org/documents/papers-and-publications/publications/college-profiles/2017-Engineering-by-Numbers-Engineering-Statistics.pdf

Yu, S. L., Corkin, D. M., & Martin, J. P. (2017). STEM motivation and persistence among underrepresented minority students: A social cognitive perspective. In J. T. DeCuir-Gunby, & P. A. Schutz (Eds.), *Race and ethnicity in the study of motivation in education* (pp. 67–81). Routledge.

Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *American Educational Research Journal*, *29*(3), 663–676.

BRIAN A. BURT is an assistant professor in the Department of Educational Policy and Leadership Analysis in the School of Education at the University of Wisconsin-Madison. He also serves as Research Scientist in the Wisconsin Equity & Inclusion Laboratory (Wei LAB). Burt uses qualitative methodological approaches to study the experience of graduate students and the institutional policies and practices that influence students' pathways. His current research falls into two strands: understanding team-based science and exploring the experiences of underrepresented graduate students of color in engineering. Through his research, Burt seeks to provide new ways to understand science participation and the experiences that might attract students to or turn them away from science pathways. Burt's work has been supported by the National Academy of Education/Spencer Postdoctoral Fellowship, a grant from the National Science Foundation–Iowa Experimental Program to Stimulate Competitive Research (EPSCoR), and the National Science Foundation's Early CAREER Award. Recent publications include: Burt, B. A., Williams, K. L., & Palmer, G. J. M. (2019). 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; and, 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.

JUSTIN J. ROBERSON serves as a residence hall director at Iowa State University. He is interested how Black men navigate predominantly white spaces and the manifestation of resilience against oppression. Recent publication includes: Burt, B. A., Knight, A., & Roberson, J. (2017). Racializing experiences of foreign-born and ethnically diverse Black male engineering graduate students: Implications for student affairs practice, policy, and research. *Journal of International Students, 7*(4), 925-943.

JARREL T. JOHNSON investigates higher education organizational practices; the intersecting identities that faculty, staff, and students hold; and the influence of these identities in shaping their higher education experiences. Recent publication includes: Burt, B. A., & Johnson, J. (2018). Origins of STEM interest for Black male graduate students in engineering. *School Science and Mathematics, 118*(6), 257-270.

ANNE BONANNO serves as an academic advisor in the Farmer School of Business at Miami University. She is interested in low-income, first generation college students' success.