Exploring Within-Group Differences in Student-Faculty Interactions among Black Engineering Students at a Selective Four-Year Engineering College

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Introduction

Across all disciplines in higher education, faculty support is especially important for facilitating student success (Tinto, 2010; O'Keefe, 2013; Shelton, 2012). Tinto (2010) asserts, for example, that professors are crucial to helping students understand what is necessary to succeed in their courses as well as assisting them with general advising-related questions. At the same time, evidence exists that students frequently do not receive the clear information from faculty that they need to navigate their academic pathways (Tinto, 2010). This suggests that undergraduate students are potentially devoid of valuable institutional knowledge that professors and lecturers may have at their disposal. This is not necessarily due to malicious intent, but may rather have to do with an inability, or unawareness of means by which, to communicate this type of knowledge.

Students in engineering disciplines, in particular, may suffer from challenges associated with a lack of faculty engagement. While faculty interactions have been found to be correlated with a *sense of belonging* (Hoffman, Richmond, Morrow, & Salomone, 2002) and the intention to persist in engineering (Morrow & Ackermann, 2012), in reality these interactions can be at best insignificant, and at worst extremely damaging. Marra, Rodgers, Shen, and Bogue (2012) described challenging issues of uncomfortable "classroom climates," which could adversely impact student retention rates in engineering. Hong and Shull (2010) found undergraduates who described professors as unkind, demeaning, or uninterested in aiding them in a holistic manner. Undergraduates in Hong and Shull's (2010) work also bemoaned professors who provided limited advising information. This type of classroom culture can undoubtedly impact retention and persistence among students who feel unwelcome by these perceived gatekeepers in engineering.

Instructional practices also seem to be another common area of concern. Previous studies have lamented tendencies among engineering educators to pay little attention to how students learn or training them to be dynamic and adaptive in a global context (National Academy of Engineering, 2004; National Academy of Engineering, 2005). To address these and other concerns, the American Society for Engineering (2009) has offered a number of recommendations that directly impact instructional practices, including fostering more connections to the industry stakeholders, integrating curricula, and enhancing the overall faculty experience (Besterfield-Sacre, Cox, Borrego, Beddoes, and Zhu (2014). A positive classroom experience can lead to further interactions with a professor, which is especially important when considering that students are more likely to seek advice from a professor than a peer when attempting to determine the best path toward success in an engineering course (Meyers, Silliman, Gedde, & Ohland, 2010). In other words, if undergraduates have had a valuable experience during lectures, they may seek out these same instructors for assistance after class (e.g., office hours); they may also be more likely to want to talk to these instructors about career advice and other information needed to become more fully integrated into their respective engineering disciplines.

As we discuss in this paper, the emphasis on faculty engagement as a determinant of success in engineering is especially crucial for underrepresented racial and ethnic minority students. We provide evidence of a population of Black engineering alumni who were able to navigate through

engineering curricula. Among the data obtained from these alumni, we explore the degree to which support from professors was critical to allowing them to persist in these majors. In the sections that follow, we review extant literature on the topic of faculty support for Black college students including those in engineering, describe our research method and data, and offer an analysis of how our work informs the literature on the trajectories of students of color in these disciplines.

Literature Review

A sizeable body of scholarship underscores the crucial nature of high-quality and positive student-faculty interactions for the integration, achievement, and persistence of Black college students, whether at Historically Black Colleges and Universities (HBCUs) (e.g., Langley, 2017), Predominantly White Institutions (PWIs) (e.g., Franco, 2012; Harrison, 2014), or community colleges (e.g., Bauer, 2016; Wood & Newman, 2017; Wood & Turner, 2010). Paradoxically, however, encounters between Black undergraduates and instructors, as evidenced in extant studies, often take less positive, and sometimes outrightly negative, forms (Cole, 2010; Davis, 1994; Harper, 2009; Solórzano, Ceja, & Yosso, 2000; Willie, 1971). In a study on the nature and quality of student-teacher relationships experienced by Black collegians at PWIs, Willie (1971) finds the perceptions of Black collegians regarding their interactions with faculty to differ markedly from those of their White peers. More specifically, Willie notes that Black students were more likely than their White counterparts to express distrust of professors, voice complaints about being blatantly disregarded or avoided by faculty, and demonstrate discomfort with seeking academic guidance from their instructors.

In Thomas and Michel's (1972) study on Black students' perceptions of prejudice and grade deflection, the vast majority of Black respondents noted having taken courses with instructors who seemed to be prejudiced against Blacks. Additionally, most of the Black undergraduates who reported having prejudiced instructors perceived that their course grades were negatively impacted by their instructors' prejudices. More recent research, in line with the aforementioned studies, has largely rendered negative interactions with professors as commonplace for Black college students. Solórzano and colleagues (2000) remark that the academic aptitude of Black students is routinely doubted or challenged by faculty who sometimes accuse them of cheating following high performances on examinations. Harper (2009) opines that Black male college students, despite being high-achieving and very involved on campus, are sometimes stereotyped by faculty members who appear to be "offensively shocked" when they provide valuable, thoughtful contributions to class discussions (p. 707).

Notwithstanding the disproportionate amount of research findings that principally depict the interactions between Black college students and professors as distant, unfavorable, and detrimental to Black students' academic self-concept and psychological well-being, there are nonetheless instances when these encounters are positive, frequent, nurturing, uplifting, and mutually beneficial for Black students and their professors. Strayhorn and Terrell (2007) find that Black college students sometimes have meaningful and regular encounters with their instructors which in turn, aid to improve their satisfaction with their college experiences. In Wood and Turner's (2010) study, Black male community college students noted that their acclimation to college life and academic success was facilitated by their faculty. The participants in this study described their faculty as very friendly, attentive to their concerns,

intentional in keeping up with their academic progress, encouraging of their success, and proactive in addressing their academic challenges.

Franco (2012) notes that Black college students are sometimes able to overcome their negative first impressions of White faculty and cultivate strong relationships with them; these relationships are usually developed when White instructors reach out to students, offer advice and encouragement, actively seek to know students on a personal level, and act in ways that demonstrate multicultural competence. While Black faculty are underrepresented in the professoriate, Griffin (2013) notes that they are often able to relate, and provide academic and socioemotional support, to Black students in ways that are often unmatched by other faculty. This act of "othermothering" is rewarding to Black professors who report that their support of Black students both reflect their commitment to uplifting their communities and provides them with opportunities to discuss with individuals with whom they have a shared understanding of academic life (p.180).

For Black students in STEM fields, interactions with faculty can also take on opposing orientations. On the one hand, Black STEM students may be fortunate to cultivate valuable and affirming relationships with professors (Fries-Britt, 2000; Gasman, Nguyen, Conrad, Lundberg, & Commodore, 2017; Griffin et al., 2010; Schwartz, 2012). Such was the experience of the Black STEM undergraduates in the study by Griffin and colleagues (2010) who reported developing relationships with minority and non-minority faculty members alike who supported them academically in ways that family members could not. These instructors were recognized by participants for helping to nurture their talents and interests in STEM, encouraging them to ask questions, and inviting them to collaborate on research studies, publications, and presentations. Gasman and colleagues (2016) opine that Black STEM students at Morehouse College are exposed to "teacher scholars" who understand learning to be a two-way process, hold high and consistent expectations for all students, assist students in overcoming academic and emotional obstacles, and engage students in consistent, ongoing discussions about studying science and working as scientists (p. 12).

On the other hand, Black STEM students may be thrust into a chilly climate, particularly at PWIs, that is fostered in part by faculty who appear unwelcoming and inaccessible (Hurtado et al., 2011; Johnson, Ong, Ko, Smith, & Hodari, 2017; McCoy, Luedke, & Winkle-Wagner, 2017). In a study by Hurtado and colleagues (2011), Black STEM students at PWIs, in contrast to their peers attending HBCUs, were more likely to report feeling intimidated and unsupported by professors, having impersonal and less frequent interactions with faculty, and being exposed to instructors who are more invested in research than teaching and mentoring. In McCoy and colleagues' (2017) study, Black STEM students at PWIs also reported similar experiences, noting being taught by "very condescending" faculty and having no professor in their departments who affirmed their academic potential (p. 664).

As it concerns Black engineering students in particular, there are more unpublished theses and doctoral dissertations (e.g., Hayes, 2013; LaMotte, 2016; Newman, 2011a; Sanders, 2010) than peer-reviewed articles (e.g., Newman, 2011b, 2015) that have addressed, whether briefly or in detail, their experiences with faculty. Additionally, virtually all of these scholarly works have originated outside of the engineering education literature. To be sure, a number of studies from

engineering education have addressed the experiences of engineering students with faculty and the influence of such interactions on students' sense of belonging and persistence in the field (e.g., Hoffman et al., 2002; Morrow & Ackermann, 2012). However, very few if any of these studies have centered the nuanced narratives of Black engineering students.

As the findings of extant research reveal, Black engineering students' encounters with faculty, like those of their peers in STEM and non-STEM departments, vary somewhat notably. The findings of some research studies suggest that some Black engineering students have mostly positive experiences with faculty in their disciplines; these participants note that their professors provided them with opportunities to participate in research as undergraduates, informed them about internships in the field of engineering, and played a significant role in their persisting and graduating in engineering (Igbinoba, 2015; LaMotte, 2016; Sanders, 2016). Alternatively, the findings of other research studies suggest that Black engineering students mostly receive negative and differential treatment from faculty members and in rare and fortunate cases, may encounter a "lone wolf" or atypical faculty member who mentors, encourages, and affirms them (Newman, 2011, p. 200).

In consideration of the shortage of research, and inconsistencies of findings, on the experiences of Black engineering students with faculty, a study that further investigates this topic would add value to the existing literature. Our present study pursues this line of inquiry as its sole objective. To further extend the body of work in this area, we disaggregate the experiences of Black engineering students with faculty by gender, ethnicity, and immigrant parentage. We also seek to understand the role, if any, that participants' interactions with faculty had on their success and persistence in engineering. The site of this study, a selective PWI, presents an added benefit as studies are more in disagreement about the nature of Black STEM and engineering students' encounters with faculty in this institutional context.

Methods

Site of Study

The broader project from which this current study draws was conducted at the A. James Clark School of Engineering at the University of Maryland, College Park. The University of Maryland, College Park is a large, more selective Mid-Atlantic public university with a Carnegie Classification of "Doctoral University/Highest Research Activity" and a current enrollment of 37,430 students as of the spring of 2017 (University of Maryland, Institutional Research, Planning, and Assessment, 2017). In the fall of 2018, 4,370 students were enrolled in its Clark School, of whom 54% were White, 22% Asian, 8% Black, 7% Hispanic, 8% undisclosed or biracial, and 1% Native American or Hawaiian (University of Maryland, Clark School of Engineering, 2018).

The choice to conduct our study at the Clark School is an important one given its status as a PWI and ranking in recent years as one of the top 10 producers of Black bachelor's and master's engineering degree recipients (Diverse Issues in Higher Education, 2018). To date, Historically Black Colleges and Universities (HBCUs) have been heralded by scholars and practitioners as being the most successful at bolstering the enrollment and retention of Black students in STEM fields (Gasman & Nguyen, 2014; Palmer, Davis, & Thompson, 2010; Utpon & Tanenbaum,

2014; Solórzano, 1995). PWIs, on the other hand, have been largely regarded as inhospitable to minority students in STEM fields whose experiences have been detailed in extant research as one colored by cultural dissonance, invisibility in classroom settings, racial prejudice, alienation, isolation, and low expectations by peers and faculty (Berhan, Kumar, Goodloe, Jones, & Adams, 2018; Dortch & Patel, 2017; Fries-Britt & Holmes, 2012; Russell & Russell, 2015; Strayhorn, 2009; Winkle-Wagner & McCoy, 2018). The reputation of the Clark School as a major producer of Black undergraduate and graduate engineering degree holders, when viewed alongside the aforementioned dominant narrative on the experiences of Black STEM students at PWIs, motivates our investigation into our research topic.

Data Collection

Research instruments. Our larger project employed both quantitative and qualitative modes of data collection. It sought to investigate the college experiences of Black baccalaureate engineering degree recipients at a selective PWI, as well as pinpoint the factors that were most crucial for their success and degree attainment. The project attended to a myriad of demographic characteristics (e.g., parental educational attainment, family background in engineering, gender, and ethnicity). Given the shortage of research on Black undergraduates in STEM fields, and engineering in particular, attention to these demographic factors allowed us to account for within-group differences and their impact on students' experiences and outcomes. This specific paper focuses on survey responses concerned with participants' interactions and experiences with engineering faculty (Table 1).

Robustness of research design. Researchers who have published widely on the experiences of Black collegians and their retention in STEM fields provided constructive feedback on our survey and interview protocols. For example, one of the researchers is an engineering education scholar at a PWI, whose background includes the creation of survey instruments that explore the academic and extracurricular experiences of STEM collegians. Another scholar is a higher education researcher whose work explicates within-group differences among college students representing multiple areas of the African diaspora. Both the survey and the interview protocols were pilot tested with participants who provided valuable suggestions that the research team subsequently integrated into the research design.

Table 1

Student-Faculty Interactions (SFI) Scale

Item #	Response Items
1	The faculty members at the Clark School were supportive of me during my baccalaureate career.
2	The availability and support of the engineering faculty played a significant role in my persistence and success at the Clark School.
3	My engineering professors did not seem to hold any negative stereotypes about me because of my race/ethnicity.
4	I did not experience racial microaggressions or discrimination from faculty at the Clark School.
5	My professors at the Clark School seemed to hold negative stereotypes about me because of my gender/gender identity.
6	I went to my professors' office hours to get assistance with my engineering courses.

Note. Response options for Items 1-5 were: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree. Response options for Item 6 were: 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = all the time.

Participants

Recruitment. In the fall of 2017, the Office of Alumni Engagement and Outreach at the Clark School identified 1,046 alumni from their records who met our study's eligibility criteria: In order to be eligible, alumni had to have graduated from the Clark School at some point; the team did not limit the graduation years to any specific points in time. Students also had to have been classified as Black or African American based on institutional data.

During the same semester in which they were identified, all 1,046 Black baccalaureate engineering degree recipients were invited by our research team to participate in one or both phases of our study. The electronic invitation that we sent to them included a link to our survey and instructions for how to participate in the interview. Of the 1,046 Black undergraduate engineering alumni, 456 (43.6%) opened the survey link and 120 (11.4%) submitted their surveys. Of the 120 submitted surveys, only 98 (9.4% of the 1,046 alumni) were included in our analysis. We discarded 22 of the 120 submitted surveys because they were either completely empty or had unintelligible information. Although our survey response rate is low, we note that responses to academic surveys have been steadily declining in the United States (Knight & Novoselich, 2017). Additionally, our survey sample of 98 participants is generally larger and, as we describe below, more culturally and ethnically heterogeneous than the samples in many research studies on Black students in STEM fields (e.g., Dortch & Patel, 2017; Newman, 2011b; Russell & Russell, 2015). Previous studies have often included less than fifteen participants; additionally, many of these studies have given little attention to within-group differences among participants as we do in our study.

Demographics. Table 2 provides an overview of the demographic characteristics of the 98 survey participants. Participants graduated between 1969 and 2017. The majority of participants identified as male (66.3%, $n = 65$) and a little over one third identified as female (33.7%, $n = 33$). As it concerns ethnicity, slightly more than half of participants were determined to be African American (57.1%, $n = 56$), meaning that neither the participant nor their parents indicated that they immigrated to the U.S. The remaining participants were either of African-immigrant origin (35.7%, $n = 35$) or Caribbean immigrant-origin (5.1%, $n = 5$). We ground the terms *African American* and *African/Caribbean immigrant-origin* in prior studies that indicate considerable differences between Black students born in the U.S. and their peers who were born - or whose parents were born - in other countries (George Mwangi, 2014).

Almost a quarter of participants identified their first parent's highest educational attainment as a bachelor's degree (23.7%, $n = 22$) or a master's degree (23.7%, $n = 22$). However, the overwhelming majority of participants were the first in their families to receive a degree in an engineering field (77.9%, $n = 74$). Over half of participants were first-time-in-college (FTIC) students (59.2%, $n = 58$) and more than a third were transfer students (40.8%, $n = 40$). Participants received their baccalaureate degrees in engineering from a variety of disciplines, but the primary disciplines cited were electrical engineering (27.8%, $n = 27$) and mechanical engineering (24.7%, $n = 24$).

Table 2

Demographics of Black Engineering Bachelor's Degree Recipients Study Sample

	Sample	
	Number	**Percentage**
Gender		
Male	65	66.3
Female	33	33.7
Ethnicity		
African American	46	47.9
Black Immigrant-Origin	50	52.1
Immigrant Parentage		
One or No Immigrant Parents	56	58.3
Two Immigrant Parents	40	41.7
First Parent's Educational Attainment		
No H.S.	4	4.3
H.S./GED	17	18.3
Vocational/Technical Certificate or Diploma	4	4.3
Some College	13	14.0
Bachelor's Degree	22	23.7
Master's Degree	22	23.7
Advanced Graduate Work or Ph.D.	11	11.8
Second Parent's Educational Attainment		
No H.S.	8	8.3
H.S./GED	24	25.0
Vocational/Technical Certificate or Diploma	7	7.3
Some College	14	14.6
Bachelor's Degree	23	24.0
Master's Degree	18	18.8
Advanced Graduate Work or Ph.D.	2	2.1
Generational Status in Engineering		
First-Generation (FG) Engineer	74	77.9
Continuing-Generation (CG) Engineer	21	22.1
Enrollment Status		
First-Time-in-College (FTIC) Student	58	59.2
Transfer Student	40	40.8
Engineering Discipline		
Aerospace	6	6.2
Bioengineering	2	2.1
Chemical	11	11.3
Civil	12	12.4
Computer	7	7.2
Electrical	27	27.8
Fire Protection	4	4.1

Material Science and Engineering	2	2.1
Mechanical	24	24.7
Biological Resources (no longer offered)	2	2.1

Research Questions

Consistent with the focus of our current study which we noted earlier, this paper seeks to answer the following questions:

1. What are the experiences of Black engineering bachelor's degree recipients at a selective PWI with engineering faculty?
2. To what extent do the experiences of Black engineering bachelor's degree recipients at a selective PWI with engineering faculty vary by gender, ethnicity, and immigrant parentage?

Variables and Analyses

The six proxies for student-faculty interactions enumerated in Table 1 serve as the dependent variables for our study. Five of the six items were rated using a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The last, or sixth, item was also rated on a 5-point scale, however ranging from 1 (Never) to 5 (All the time). Our choice for these six items was informed by our review of extant research studies on Black students in STEM and engineering, which are overwhelmingly qualitative in nature. We were also motivated to curtail the number of items included in the Student-Faculty Interactions (SFI) scale, and more generally our survey instrument, given the influence that time commitment often has on survey dropout and completion rates (Kanekar, Sharma, & Atri, 2010; Nair, Ataseven, Habermann, & Dreyfus, 2016). We acknowledge that the SFI scale therefore may not provide an exhaustive account of participants' experiences with engineering faculty. The qualitative portion of our study, which we do not discuss in this paper, may allow for a more comprehensive and nuanced understanding of these experiences.

Three survey items, gender (levels: male, female), ethnicity (levels: African American, being of Black immigrant-origin), and immigrant parentage (levels: having one or no immigrant parent, having two immigrant parents) are our chosen independent variables. It is important to note here that participants were allowed to self-report their gender and all chose to either identify as male or female. Because of their low numbers, biracial participants were excluded from our analysis of differences by ethnicity and immigrant parentage. Ethnicity is recoded with participants who identified as being of African or Caribbean immigrant-origin grouped into the category of Black immigrant-origin.

Descriptive statistics of participants' responses to the six items in Table 1 provide the basis for answering our first research question. To answer our second research question, one-way ANOVA and Bonferroni post-hoc tests were conducted. One-way ANOVA tests permitted an understanding of whether the dependent variables (student interactions with faculty) were significantly predicted by the independent variables (gender, ethnicity, and immigrant parentage). When relationships between the dependent and independent variables were found to be significant ($p < 0.10$, $p < 0.05$, $p < 0.01$, $p < 0.001$), Bonferroni post-hoc tests provided insight into the nature of the relationships.

Definition of Terms

As it concerns ethnicity, we use the terms "African-American" or "native Black" to denote participants who were born in the United States to U.S.-born parents (Rimer & Arneson, 2004; Pew Research Center, 2013; Alba & Foner, 2015). The term "Black immigrant-origin" is used to characterize participants who are either foreign-born, or U.S. natives with at least one foreign-born parent (Brown, 2009; Trevelyan et al., 2016). The need for differentiating between African American and Black immigrant-origin students was first brought to national attention by Drs. Gates and Guinier in 2004 when they decried the overrepresentation of Black immigrant-origin students in the population of Black students at Harvard College (Rimer & Arneson, 2004). More recent scholarly works suggest that the significant representation of Black immigrant-origin students at elite colleges and universities, and the underrepresentation of African Americans, may still be an ongoing trend (Jaschik, 2017). Disaggregating between these sub-populations of Black students thus permits a richer understanding of an institution's level of and commitment to diversity. It is also necessary as some research studies have noted qualitative differences in the secondary school (Weis, Cipollone, & Jenkins, 2014) and college (George Mwangi, 2014) experiences of African Americans and Blacks of immigrant-origin.

With regards to the term "immigrant parentage," it is used to distinguish between participants born to two immigrant parents and those born to one or no immigrant parents; this distinction is relevant as the findings of past research suggests that the former group (individuals born to two immigrant parents) may possess a unique academic advantage (Thomas, 2009).

Study Limitations

Here, we address a few limitations to our study. First, we do not take into account time period of enrollment and its impact on the experiences of Black engineering students with faculty. So, for example, we do not explore emergent differences in the responses of Blacks who graduated with engineering degrees in the 1970s and those who graduated in the 2000s. Second, given the size of our sample, we were unable to disaggregate participants by the engineering disciplines in which they were enrolled, and observe for any similarities or differences in their encounters with faculty. For instance, it is general knowledge that bioengineering tends to attract a disproportionately greater number of women than other engineering majors. In light of this, it is probable that the experiences of female students in bioengineering may differ in some respects from those of their peers in engineering disciplines that enroll lower numbers of women. We would like to call attention to a few extant studies on engineering students (e.g., Lord, Layton, Ohland, Brawner, & Long, 2014; Orr, Lord, Layton, & Ohland, 2014) that utilize larger, secondary data sets and have been able to explore the nuanced experiences of engineering students in specific disciplines.

Findings

General Perceptions of Black Engineering Bachelor's Degree Recipients about their Experiences with Engineering Faculty

In response to the first subscale, "the faculty members at the Clark School were supportive of me during my baccalaureate career," 73% of participants indicated that they agreed or strongly agreed. This statistic, combined with the mean score of 3.93 on the 5-point scale (SD = 1.01, 95% CI [3.72, 4.14]), suggests that participants were generally more in agreement that their

engineering professors were supportive of them during their undergraduate careers (Table 3 provides the means and standard deviations of all six survey items).

When queried about whether "the availability and support of the engineering faculty played a significant role in my persistence and success at the Clark School," 64% of participants indicated that they agreed or strongly agreed, and 21% noted that they disagreed or strongly disagreed. These findings, along with the mean rating of 3.67 (*SD* = 1.18, 95% CI [3.42, 3.91]), imply that most participants were of the opinion that faculty members in the engineering school played a significant role in their persistence and success.

As it concerns the third subscale, "my engineering professors did not seem to hold any negative stereotypes about me because of my race/ethnicity," the majority of participants (63%) indicated that they agreed or strongly agreed with the statement. Twenty-three percent of participants, however, neither agreed nor disagreed with the statement, and another 14% opined that they disagreed or strongly disagreed. These statistics, combined with the mean rating of 3.74 (*SD* = 1.15, 95% CI [3.50, 3.98]), evidence that participants were, overall, slightly more of the belief that their engineering professors held no race- or ethnicity-related stereotypes against them.

With regard to the fourth statement, "I did not experience any racial microaggressions or discrimination from faculty at the Clark School," 59% of participants expressed that they agreed or strongly agreed with the statement. An important minority of participants (25%), however, indicated that they disagreed or strongly disagreed with the statement. These findings, analyzed alongside the mean rating of 3.55 (*SD* = 1.28, 95% CI [3.28, 3.82]), indicate that participants were slightly more likely to attest that they experienced no racial microaggressions or discrimination from the faculty at the Clark School.

The fifth subscale, "my professors at the Clark School seemed to hold negative stereotypes about me because of my gender/gender identity," was intentionally worded negatively to gauge how carefully participants were reading and responding to the survey items. In answer to this particular statement, the majority of participants (66%) opined that they disagreed or strongly disagreed with it, while 13% agreed or strongly agreed, and another 20% neither agreed nor disagreed. These findings, alongside the mean rating of 2.16 (*SD* = 1.18, 95% CI = 1.91, 2.41), suggest that participants were more endorsing of the view that their engineering professors did *not* hold gender- or gender identity-related stereotypes against them.

With respect to the sixth, and final, subscale, "I went to my professors' office hours to get assistance with my engineering courses," the vast majority of respondents (79%) indicated that they did so sometimes, often, or all the time. Only 21% indicated that they rarely or never did. These findings, combined with the mean rating of 3.35 (*SD* = 1.03, 95% CI = [3.14, 3.57]), evince that participants were somewhat more receptive of the idea that they attended their engineering professors' office hours to seek help with their courses.

Table 3
Characteristics of SFI Scale Items

Item	Mean	Standard Deviation
1	3.93	1.01
2	3.67	1.18
3	3.74	1.15
4	3.55	1.28
5	2.16	1.18
6	3.35	1.03

Differences between Demographic Groups of Black Engineering Bachelor's Degree Recipients Regarding their Perceptions of their Experiences with Engineering Faculty

Gender. One-way ANOVA and post hoc tests were employed to ascertain if participants' perceptions about their experiences with engineering faculty are predicted by gender (see Table 4). Statistically significant effects of gender on participants' perceptions of their interactions with engineering professors were found in three of six subscales. First, female participants were significantly more likely than males to agree with the statement that "the availability and support of the engineering faculty played a significant role in my persistence and success at the Clark School" ($F = 2.97$, $p < 0.10$). Second, females were also significantly more likely than males to opine that "my professors at the Clark School seemed to hold negative stereotypes about me because of my gender/gender identity" ($F = 12.23$, $p < 0.001$). Third, male participants were significantly more likely than females to concur with the view that "I did not experience any racial microaggressions or discrimination from faculty at the Clark School" ($F = 3.40$, $p < 0.10$). Lastly, although not statistically significant, females were noticeably more likely than males to agree that "I went to my professors' office hours to get assistance with my engineering courses" ($F = 2.67$, $p = 0.11$). Table 5 provides the one-way ANOVA and Bonferroni results for all six subscales.

Ethnicity. One-way ANOVA and Bonferroni tests revealed that Black immigrant-origin participants were significantly more likely than African Americans to agree that "I did not experience any racial microaggressions or discrimination from faculty at the Clark School" ($F = 3.03$, $p < 0.10$). Other important, albeit not statistically significant, differences were found in participants' responses to the first and fifth subscales. Black immigrant-origin participants were more likely than African Americans by 0.3 points to opine that "the faculty members at the Clark School were supportive of me during my baccalaureate career" ($F = 1.84$, $p = 0.18$). African American participants, however, were more likely than their Black immigrant-origin peers by 0.3 points to note that "my professors at the Clark School seemed to hold negative stereotypes about me because of my gender/gender identity" ($F = 1.70$, $p = 0.20$).

Immigrant Parentage. The results of one-way ANOVA tests indicate that participants who have two immigrant parents held significantly different opinions from their peers who have one or no immigrant parents with regards to the first and fourth subscales. As the results of Bonferroni tests further reveal, participants who have two immigrant parents were significantly more likely than those with one or no immigrant parents to agree with the first statement that "the faculty members at the Clark School were supportive of me during my baccalaureate career" ($F = 3.80$, $p = 0.05$). Additionally, participants with two immigrant parents were also significantly more likely than their peers with one or no immigrant parents to opine that "I did

not experience any racial microaggressions or discrimination from faculty at the Clark School" ($F = 5.97$, $p < 0.05$). While not statistically significant, differences were also found in participants' responses to the third and fifth subscales. Participants with two immigrant parents were more likely than those with one or no immigrant parents by 0.4 points to assert that "my engineering professors did not seem to hold any negative stereotypes about me because of my race/ethnicity" ($F = 2.26$, $p = 0.14$). Participants with one or no immigrant parents were likely than those who have two immigrant parents by 0.4 points to agree that "my professors at the Clark School seemed to hold negative stereotypes about me because of my gender/gender identity" ($F = 2.28$, $p = 0.14$). The results are presented in Table 6.

Table 4

One-way ANOVA and Bonferroni Tests Comparing Male and Female Participants' Responses to SFI Scale Items

Group	Scale Item	Sample Mean	F-Statistic	P-value
Male	1	3.92	0.05	0.83
Female		3.97		
Male	2	3.52	2.97	0.09*
Female		3.97		
Male	3	3.79	0.35	0.55
Female		3.63		
Male	4	3.72	3.40	0.07*
Female		3.20		
Male	5	1.86	12.23	0.0007****
Female		2.73		
Male	6	3.23	2.67	0.11
Female		3.60		

Note. * p < 0.10, ** p < 0.05, *** p < 0.01, **** p < 0.001

Table 5

One-way ANOVA and Bonferroni Tests Comparing African American and Black Immigrant-Origin Participants' Responses to SFI Scale Items

Group	Scale Item	Sample Mean	F-Statistic	P-value
African American	1	3.80	1.84	0.18
Black Immigrant-Origin		4.09		
African American	2	3.57	0.81	0.37
Black Immigrant-Origin		3.80		
African American	3	3.67	1.06	0.31
Black Immigrant-Origin		3.91		
African American	4	3.36	3.03	0.09*
Black Immigrant-Origin		3.82		
African American	5	2.30	1.70	0.20
Black Immigrant-Origin		1.98		
African American	6	3.42	0.23	0.64
Black Immigrant-Origin		3.32		

Note. * p < 0.10, ** p < 0.05, *** p < 0.01, **** p < 0.001

Table 6
One-way ANOVA and Bonferroni Tests Comparing Responses of Participants with One or No Immigrant Parents and Two Immigrant Parents to SFI Scale Items

Group	Scale Item	Sample Mean	F-Statistic	P-value
One or No Immigrant Parents	1	3.77	3.80	0.05*
Two Immigrant Parents		4.19		
One or No Immigrant Parents	2	3.58	1.00	0.32
Two Immigrant Parents		3.83		
One or No Immigrant Parents	3	3.64	2.26	0.14
Two Immigrant Parents		4.00		
One or No Immigrant Parents	4	3.32	5.97	0.02**
Two Immigrant Parents		3.97		
One or No Immigrant Parents	5	2.29	2.28	0.14
Two Immigrant Parents		1.91		
One or No Immigrant Parents	6	3.40	0.08	0.78
Two Immigrant Parents		3.33		

Note. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Analysis

Positive Reflections about Clark School Faculty

Across all sub-groups (e.g., female, male, African American, Black immigrant-origin), the majority of alumni who completed the survey tended to perceive that Clark School faculty were generally supportive and helpful. Most respondents also seemed to not have negative impressions of the ways in which they were treated by faculty. These perceptions align with previous works cited earlier that indicate that some Black students in engineering earn their degrees with generally good impressions of and interactions with their undergraduate engineering instructors (LaMotte, 2016; Sanders, 2016; Strayhorn & Terrell, 2007). At the same time, it may be prudent to consider whether for some students - and alumni - of color, their racial or cultural identities may be somehow subordinated to their identities as engineers. This negotiation between dual identities - one that is discipline-focused and one that is racially/ethnically-focused - has been addressed somewhat in science education (Hazari, Sadler, and Sonnert, 2013) as well as mathematics education (McGee and Martin, 2011). Engineering education research has also begun to unpack this tension (Foor, Walden, & Trytten, 2007), but across all STEM disciplines, further research is needed to fully conceptualize the ways in which current and former undergraduates make meaning of their multiple lived experiences in academia.

Results from this study suggest that among some students, the notion that "I am an engineer" may for some be more salient than the idea that "I am Black" or a person of color. This is not an entirely new idea in scholarship. Younger's work on Black collegians - several of whom were engineering or other STEM majors - who transferred from several community colleges indicated that their transfer identities "trump[ed]" their racial identities (Younger, 2009). These students

tended to see their status as a student who transferred as more salient in their post-secondary experience than their classification as an underrepresented racial/ethnic minority. Previous work also suggests that engineers need to have a greater awareness of the "social context" in which they function (Conlon, 2008, p.1; Leydens & Lucena, 2017). Conlon (2008) asserts that the social science disciplines can help engineers develop a broader consciousness of their environment. By implication, without this "context," engineers and engineering students may tend to understate the relevance of race, ethnicity, gender, and other demographic variables.

Collectively, this paper and other publications suggest two points: 1) For many engineering undergraduates or alumni, a discipline-focused identity may carry greater weight than a racial or cultural identity. This may be largely because of the tremendous academic requirements placed upon engineering majors - leaving room for few non-engineering electives - and the emphasis on math-based responses that do not implicitly require an understanding of social issues (Leydens & Lucena, 2017). 2) Engineering undergraduate curricula themselves tend to deemphasize social context, thereby offering little to no training for how to identify or respond to racial or other societal challenges. For the engineering undergraduate or degree recipient, there are considerable ramifications if "success" in the classroom or workplace is not measured by a deep attention to issues of race, ethnicity, gender, etc. Conceivably, many Clark School alumni represented in the study were trained in more of a traditional engineering pedagogical tradition, and therefore did not explicitly need to grapple with issues of race in order to persist in their courses. Foregrounded by these prior studies and the implications described here, it may not be especially surprising that some study participants did not respond strongly to the idea that there was any type of negative treatment based upon their race or gender identity. At the same time, the lack of attention to identity based on race may have allowed these alumni to see faculty in a more positive manner.

Notwithstanding, there is still reason to reflect on the positive experiences reported by these alumni. Considering the generally positive interactions with faculty among undergraduates at HBCUs (Langley, 2017), especially when compared to unpleasant environments in some PWIs (Cole, 2010; Davis, 1994; Harper, 2009; Solórzano, Ceja, & Yosso, 2000; Willie, 1971), the results suggest that the Clark School environment was perhaps more conducive to the success of some Black students of color than other PWIs. There may be two explanations for this finding. First, the Clark School may foster a culture of diversity and inclusion that promotes retention and persistence among all of its students. Second, and in contradiction to this first explanation, the fact that there was a majority of respondents who indicated that they had generally positive experiences does not suggest that positive experiences were entirely normative. In the next subsection, we provide more of a discussion about these more negative reflections and reactions.

Negative Outcomes Reported about Engineering Faculty

Data reveal that a considerable number of respondents did not agree or strongly agree with the statements provided in the survey. For example, while 64% of alumni agreed or strongly agreed that Clark School professors played a significant role in their persistence, by extension, 36% of alumni either disagreed, strongly disagreed, or felt neutral about this statement. Similarly, whereas 63% and 59% of alumni did not concur with the ideas that faculty held negative stereotypes and displayed microaggressions, respectively, 37% and 41% of respondents did not have these same impressions. Collectively, these data imply that a substantial portion of alumni

felt neutral about the notion of an unwelcoming culture, or in fact directly noted the existence of this culture. This suggests that the types of prejudicial or discriminatory behaviors cited by Black students in other STEM majors may still be salient for some Blacks who are pursuing engineering degrees (Hurtado et al., 2011; Johnson, Ong, Ko, Smith, & Hodari, 2017; McCoy et al., 2017).

The literature about the underrepresentation of females in engineering and in computing fields has documented numerous reasons for their perennially lower representation in these fields (Fox, Sonnert, & Nikiforova, 2011; Marra, Rodgers, Shen, & Bogue, 2009; Ong, Wright, Espinosa, & Orfield, 2011). Given the nature of the challenges that females have faced in these types of majors, which can include chilly interactions with faculty, it is not particularly surprising that female respondents were more likely than their male counterparts to report challenges due to their gender or gender identity. Although women were not the majority of respondents, it would be interesting to analyze the responses of a group of exclusively female participants. Among female alumni alone, the impact of gender-based treatment by faculty might become more salient. In other words, by isolating female alumni responses from male alumni responses, one could in greater detail unpack trends specific to this population. In the broader study, we looked more closely at the specific responses of subgroups of alumni - including women - and in future manuscripts we plan to discuss those findings in greater detail.

Similarly, the literature around students of immigrant origin or immigrant parentage suggests that their perspectives and experiences are at times different from those of students with more of a U.S.- racialized lens. Over the past five years, sociologists and education scholars have begun to interrogate the ways in which Black immigrants - and the children of immigrants - make meaning of their experiences with race in the U.S. (Fries-Britt, George Mwangi, & Peralta, 2014; George Mwangi & Fries-Britt, 2015; Griffin, Cunningham, & George Mwangi, 2016; Weis et al., 2014). On the one hand, some scholars have noted that the experiences of these students are often markedly different from those of their African American peers (Weis et al., 2014; Williamson, 2010). These scholars opine that for reasons not limited to their socioeconomic backgrounds, levels of academic achievement, and status as "foreigners," Black immigrant-origin students are often “ideologically Whitened” or treated as “not really Black” by their White peers and faculty and as a result, relatively shielded from the stereotypes and negative treatment that their African American counterparts endure (Weis et al., 2014, p. 161). On another hand, some scholars opine that Black immigrants and their children are not necessarily avoiding the same types of treatment in the classroom that their African American colleagues are facing. Instead, they suggest that the identity-based lens through which they *view* their treatment - which are largely centered around a cultural or ethnic people group specific to a country or tribe in Africa or the Caribbean, rather than the U.S. - makes them less likely to cite issues like racism or prejudice than their colleagues who were raised in an entirely American context. For either of these reasons, it is conceivable that Black alumni of immigrant-origin more generally, and those with two immigrant parents in particular, were prone to indicate that they were not negatively affected by race. Without a negative view of faculty, it is also not surprising that alumni of immigrant-origin tended to see faculty as more supportive of their educational endeavors than African Americans.

Discussion

In the context of increasing numbers of Black Americans from sub-Saharan Africa and the Caribbean, some African American college/university graduates have decried the tendency to treat Blacks in the U.S. as a monolithic group (Jaschik, 2017). Some refer to the infamous Harvard College alumni gathering in which many protested that while the Black immigrant population on campus was growing, the numbers of African Americans were in fact declining (Massey, Mooney, Torres, & Charles, 2006). Cornell University also recently made headlines when African American students on campus, noting considerable growth in the university's Black immigrant population, demanded that administrators do more to recruit Black students whose families have been in the U.S. for generations (Jaschik, 2017).

To date, this tension on campus has not been examined as it relates to particular disciplines. Most of the criticism has been leveled at campus-level policies, rather than toward college/major-specific trends. This study suggests, however, that engineering college faculty and other leaders may need to be as thoughtful as campuses as a whole are becoming, with regard to their student demographics. While faculty may not be in a position to respond in as nuanced a way as senior administrators, they can certainly be thoughtful with regard to who is - and who is not - actively engaged in classroom discussion. To the extent that faculty and administrators can intentionally create a welcoming environment that welcomes diverse students from multiple racial, cultural, and ethnic groups, these students may experience better outcomes in regards to their performance.

Female engineering students, alumni and other professionals, as compared to immigrant minorities, have undoubtedly been studied much more in scholarly literature (Fox et al., 2011; Marra et al., 2009; Ong et al., 2011). However, just as Blacks have often not been disaggregated by subgroup, so too have women often been homogenized in discussions around STEM engagement. Articles on intersectionality, however, suggest that women of color in STEM must navigate especially challenging terrain in order to persist in colleges and universities (Ong et al., 2011). Not only must they often contend with unfair power dynamics that favor male participation, they also must consider the added pressure of being a person of color. This article suggests that while Black female engineering students may be able to graduate, the stress that they must withstand to do so may be more than their male and White counterparts.

Despite these challenges, findings from this study and other data suggest that the Clark School of Engineering is an interesting case study for future explorations around engineering persistence. Of note is the Clark School's location in a diverse metropolitan area, which may be why it is able to recruit and retain more minorities than institutions in other geographic areas. This article suggests that, at least to some extent, faculty may also aid in retention by fostering a culture of support and caring. The ways in which this support is provided should be further analyzed in order to determine whether the success of Black students is the result of an active set of factors (e.g., engaged engineering faculty, staff, and administrators) and/or passive components (e.g., geographic location, immigrant family relocation patterns). As the full set of factors emerge in response to our overarching research objectives, our larger study can inform future exploration into the culture and offerings available for diverse Black undergraduates within other colleges of engineering at PWIs.

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