



“Everything is Bigger and Different”: Black Engineering Transfer Students Adjusting to the Intensity and Academic Culture of the 4-Year Campus

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Abstract

Black engineering transfer students face unique challenges while navigating the transfer process from a community college to a 4-year institution. The purpose of this paper is to better understand the experiences of these students and the ways in which they adjust to the 4-year school. We identify specific challenges noted by Black engineering transfer students in their experiences related to: (1) heuristics of teaching and learning that they had to adapt to in order to successfully navigate new campus environments; (2) information gaps that students encountered in what faculty seemed to expect them to already know; and (3) problems in having to adjust to the differences in the academic demands of the 4-year engineering program. In addition to unpacking our findings along these specific domains, we attend to the potential impact of having these challenges in a large, urban, metropolitan area.

Keywords Black engineering students · Transfer student adjustment · STEM

Introduction

An educational journey that starts at the community college as a pathway to a 4-year STEM degree has become a roadmap that many minoritized students follow (Foley et al., 2020). Yet, while the transfer pathway has the potential to provide access to students given the affordability of a community college education, minoritized students continue to struggle throughout the transfer process. Currently, 40% of all community college students and 28% of Black community college students successfully earn a credential (i.e., certificate, associate degree, or bachelor's degree)

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within 6 years (Community College Research Center, 2021). In particular, when looking at the associate degree, the National Science Board (2018) reports that Black, Indigenous, and People of Color (BIPOC) undergraduates earn a higher proportion (28%) of science and engineering associate degrees than bachelor's or more advanced degrees in these same fields. Yet, while BIPOC learners are earning associate degrees at rates consistent with their share of the US population (US Census, 2019), only 13% of Hispanic students and 9% of Black students go on to earn a baccalaureate degree in science and engineering (National Science Board, NSB, 2018). These statistics are concerning given that Hispanic science and engineering student bachelor's degree attainment increased from 7 to 13% between 2000 and 2015, yet the percentage of Black students who earn a baccalaureate degree has been static at just under 9% during this time (NSB, 2018). The national trend for Black students in engineering presents significant challenges for the development of the nation's talent pool and efforts to address systemic racism. It also underscores the need to create more equitable opportunities for Black students who endeavor to study engineering. Black engineering students face unique challenges, including engagement with faculty and peers (London et al., 2020; Strayhorn et al., 2014). Black engineering *transfer* students may face even more unique challenges given the negative interactions and self-perceptions that transfer students generally can experience on baccalaureate degree-granting campuses (Minichiello, 2018). While a great deal is understood about why minoritized students struggle in STEM disciplines (Seymour et al., 2019), there is a gap in the literature when it comes to the unique experiences of Black engineering community college students and their experiences adjusting at a baccalaureate degree-granting institution post-transfer. Understanding these experiences may particularly be relevant for Black students who initially enroll in urban community colleges, given the types of challenges that students may face outside of the classroom (Weis, 2018).

The purpose of this paper is to better understand the academic experiences of these students and the ways in which they adjust to the 4-year school.¹ We identify specific challenges noted by Black engineering transfer students in their experiences related to: (1) Heuristics of teaching and learning that they had to adapt to in order to successfully navigate new campus environments; (2) Information gaps that students encountered in what faculty seemed to expect them to already know; and (3) Problems in having to adjust to the differences in the academic demands of the 4-year engineering program. In addition to unpacking our findings along these specific domains, we attend to the potential impact of having these challenges in a large, urban, metropolitan area.

¹ The terms community college, 2-year institution, baccalaureate-granting institution, and 4-year institution all appear in this paper. Terminology is a critical component of academic writing. Within the scope of this paper, we lean heavily on the terms 2-year and 4-year institutions to reflect the larger literature surrounding transfer student experiences as well as the language used by our participants throughout their interviews.

Conceptual Framework

While the focus population of this paper is Black community college transfer students in engineering, prior literature on this student population is severely limited. Therefore, when seeking to identify a conceptual framework to guide this work, we first turned broadly to literature examining the persistence of engineering transfer students. In a systematic review of engineering transfer student literature, Smith and Van Aken (2020) identified four primary frameworks that have been used to inform research on engineering transfer students' persistence: Astin's (1999) Theory of Involvement, Tinto's (1993) Theory of Integration, Laanan's (2004) Transfer Student Capital, and Schlossberg's (1984) Transition Theory. Of these theories, Laanan's is the only one developed to address transfer students specifically. Therefore, when seeking to develop a framework for our research, we chose to draw upon Laanan's (2001, 2004) description of transfer student adjustment.

Historically, research examining transfer student adjustment has focused exclusively on academic factors that impact the student's experience—often connected to the notion of “transfer shock” (Cejda et al., 1998; Hills, 1965). Over the years, Laanan's research has challenged this notion by highlighting the role of context and transfer student capital in the transfer adjustment process (e.g., Laanan, 2001, 2007; Laanan et al., 2010). In particular, Laanan (2001) notes that community college transfer students face not only academic but also psychological and environmental challenges upon transferring to a baccalaureate degree-granting school. For example, when describing psychological adjustment, Laanan draws on research examining “transitional trauma” (Bennett & Okinaka, 1990). He goes on to explain that transferring is a life event that can lead to stress and an overall impact on well-being. This stress can be particularly impactful for racial and ethnic underrepresented students who have been found to have additional stressors when transferring (Laanan, 2001). This is due to the psychological strain of transferring as well as the campus environment of the 4-year institution.

When describing environmental factors that impact the adjustment process, Laanan (2001) draws on research by Hurtado et al. (1996), stating that structural and climate characteristics of college campuses may “facilitate or impede a student's adjustment” (p. 10). One of the more significant structural characteristics noted by Laanan is the faculty at the 4-year institution. Laanan explains that faculty members have been found to directly impact student persistence and satisfaction at an institution. Another significant structural characteristic worth noting is the diversity of the student body at the 4-year institution as well as the size of the institution. Larger campuses can lead to feelings of anonymity and isolation for new transfer students who are more accustomed to the smaller, more diverse community college campus.

Laanan's (2001) work provides thoughtful insight into the various factors impacting transfer student adjustment. However, in this work, Laanan does not offer a framework to conceptualize the student experience. Further, while scholars such as Ogilvie and Knight (2019) describe the experiences of engineering

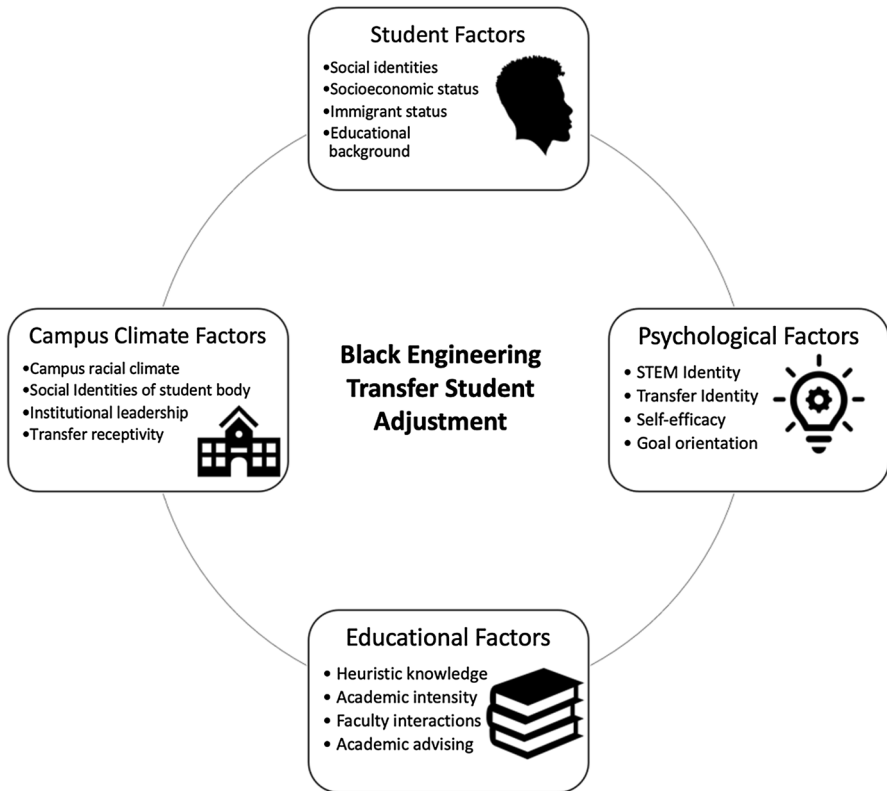


Fig. 1 A conceptual framework for black engineering transfer student adjustment

students post-transfer, no research to date has provided a framework that takes into consideration the various factors impacting Black engineering students' transfer adjustment process at a 4-year institution. In order to address this gap, our work offers a conceptualization of how various institutional and student factors come together to shape the transfer adjustment process for Black engineering students. See Fig. 1 for a visualization.

Within this framework, it is worth highlighting transfer receptivity in framing the role of campus climate factors. Rooted in Critical Race Theory (CRT), Jain et al. (2011) define transfer receptive institutions as those 4-year institutions who have a clear commitment to supporting students as they navigate the transfer process (e.g., enroll in courses, submit the application, enroll, and ultimately earn a baccalaureate degree). The authors argue that transfer should be a dual commitment between both the sending and the receiving institutions. They further posit that the receiving institution should believe that students can succeed *because* they are transfer students rather than in spite of their transfer student status.

In the following section, we will provide an in-depth review of the literature. Given the specific focus of this paper, the academic experiences of Black

engineering transfer students, our literature review focuses primarily on the student factors and educational factors impacting Black engineering transfer student persistence. However, a brief discussion of the campus climate factors and psychological factors is also included.

Literature Review

The literature base on Black community college students, while growing (e.g., Alvarez, 2014; Harris & Wood, 2013; Jackson, 2013; Strayhorn, 2011), is small and often not-discipline specific, meaning finding scholarship on Black community college transfer students in particular STEM disciplines is rare. Additionally, most literature on Black community college students focuses on these students' experiences prior to transfer (Kirkman, 2018; Strayhorn, 2011; Strayhorn, 2012; Wood, 2012; Wood, 2014; Wood & Ireland, 2014; Wood et al., 2015; Wood & Palmer, 2013; Wood & Turner, 2010; Wood & Williams, 2013). The literature that delves into the broader post-transfer student experience (Robles-Lopez, 2017; Shayestehpour, 2020; Townley et al., 2013; Townsend & Wilson, 2006; Walker & Okpala, 2017), the narrower STEM transfer student experience (Bacon & Packard, 2018; Jackson et al., 2013; Reyes, 2011), or the engineering transfer student experience more exactly (Allen & Zhang, 2016; Ogilvie & Knight, 2019, 2020) is often not specific to Black students. While there is an expanding body of literature on Black community college transfer students in STEM (Dounebaine, 2020; Gates, 2019; Jackson, 2013; Jackson-Smith, 2016), the literature that does focus on Black community college transfer students in engineering at the 4-year institutional level is not as widely studied (Berhane, 2017; Berhane et al., 2017, 2019; Cosentino et al., 2014; Onuma & Berhane, 2019; Qaqish, 2018; Qaqish et al., 2020). Again, this is because most literature on Black community college transfer students is not oriented towards individual disciplines (Flowers, 2006).

Given the aforementioned limitations, we chose to begin our literature review by first looking broadly at Black students in STEM at the 4-year level. There is a growing wealth of scholarly knowledge surrounding this population, particularly related to the factors that contribute to the success of Black non-transfer (or first-time-in-college) students in STEM (Collins, 2018; Fries-Britt & Holmes, 2012; George Mwangi et al., 2016). As such, focusing on this population's experiences more broadly will allow for better understanding of the shared experiences of Black transfer and Black non-transfer students in STEM. After analysis of the literature on Black non-transfer students in STEM, the knowledge base on Black transfers from community colleges will be discussed; as a note, we frequently refer to this population as "community college transfer students," drawing from language used by the Association of American Colleges and Universities (AACU, 2021).

It is crucial to understand that the Black student experience is not monolithic (George Mwangi & English, 2017). While Black transfer and Black non-transfer students may share similar racialized experiences, the additional minoritized identity of being Black *and* a transfer student adds a layer of complexity as well as new concerns that are distinct for Black community college transfer students (Berhane

et al., 2019; Younger, 2009). Because of this distinction, some specific concerns Black community college students face at the post-transfer stage will be addressed. Furthermore, because of the limited scholarship around Black community college transfer students, the additional concerns that transfer identity adds to the student experience will be centered through discussion of literature on the transfer shock and adjustment process for community college transfer students overall.

Factors Leading to Success for Black 4-Year STEM Students

Across the literature discussing academic factors that promote success for Black 4-year STEM students, the role of faculty comes up repeatedly (Figueroa et al., 2015; Fries-Britt, 2017; Fries-Britt & White-Lewis, 2020; Gasman & Nguyen, 2019; Lancaster & Xu, 2017; Vogt, 2008). Faculty interactions are considered central to the student experience, and positive faculty-student interactions are associated with several academic benefits for students (Figueroa et al., 2015; Gasman & Nguyen, 2019; Lancaster & Xu, 2017; Wood & Palmer, 2014). For example, faculty interactions with Black male STEM students both inside and outside of the classroom were found to improve students' academic skills, abilities, and aspirations (Wood & Palmer, 2014). Black STEM students also personally and professionally benefit from interacting with faculty. Receiving career advice from faculty or simply knowing that a faculty member is personally invested in one's success was shown to have a positive impact on Black STEM students (Gates, 2019).

Overall, Black STEM students understand the importance of making connections with faculty and, as such, many actively seek out opportunities to connect with their faculty members (Fries-Britt & White-Lewis, 2020). Particularly, students seek to build meaningful relationships with faculty who center their needs (Fries-Britt & White-Lewis, 2020; Gasman & Nguyen, 2019). Faculty who are deemed especially useful to students' achievement are those who prioritize students' needs, provide students with individualized attention, promote student collaboration, and validate students' experiences (Fries-Britt & White-Lewis, 2020; Gasman & Nguyen, 2019; Vogt, 2008).

Another factor that the literature addresses as key to Black STEM students' success is their peer support networks. Both socially and academically, peers play a significant role in Black STEM student success (Fries-Britt, 2017; Lancaster & Xu, 2017). Across the literature examining Black students in STEM, peer support networks have been found to aid students in feeling supported on their campus and persisting in their STEM discipline (Fries-Britt, 2017; Gasman et al., 2017; Hurtado et al., 2010; Lancaster & Xu, 2017; Maton et al., 2000, 2012; Newman, 2011; Stolle-McAllister, 2011; Strayhorn, 2015). Additionally, the literature highlights that, overall, Black STEM students have a vested interest in building their college social networks and support systems as early as possible (Lancaster & Xu, 2017). Even before officially beginning their college journeys, peer networks were identified by students as critical to their success. For example, Stolle-McAllister (2011) found that building support systems was important to Black STEM students in a pre-college bridge program because the students saw support systems as long-term aids that would

be helpful to them throughout their college careers. The students readily built peer relationships with the expectation that their peers would continue to be resources to them after the program ended. Expounding on the idea of peers as long-term sources of support, Lancaster and Xu (2017) found that Black STEM upperclass students relied on the same sets of friends throughout their college experience to assist them academically and socially. Additionally, programs such as the Meyerhoff Scholars Program, that serve considerable numbers of Black STEM learners, show the positive impact that peer networks can have on this population's academic performance, persistence, and success (Hrabowski et al., 2021; Maton et al., 2000, 2012).

Black STEM students build their support systems through various means including joining student organizations, creating study groups, and more. Several studies noted that Black STEM students actively seek out and join student organizations with a STEM focus to increase their opportunities to connect with other STEM students and to learn more about STEM fields (Jackson-Smith, 2016; Lancaster & Xu, 2017; Newman, 2011). In addition to STEM-based student organizations, Black STEM students also seek out opportunities to join race-based affinity groups on campus (Jackson-Smith, 2016; Lancaster & Xu, 2017). These race-conscious organizations provide safe spaces for Black students to connect with peers from similar racial backgrounds who may have similar racialized campus experiences. While STEM-based and race-based affinity groups separately benefit Black STEM students, studies found that student organizations such as the National Society of Black Engineers (NSBE) that married the two identity aspects (i.e., Black student organizations that were related to students' STEM majors) were most beneficial (Chang et al., 2014; Lancaster & Xu, 2017; Newman, 2011). Because these organizations appealed to students' multiple identities, they helped students to feel more represented and connected to their campuses.

Not only can certain peer support systems help BIPOC collegians feel more represented on their campuses, but peer support systems can also aid in increasing students' academic persistence. In her study examining college experiences that aid in the persistence of undergraduate women of color in STEM, Espinosa (2011) found that factors such as joining STEM-related student organizations and interacting with peers to discuss course content helped undergraduate women of color to persist. Particularly, those women of color who engaged frequently with peers who had similar STEM foci and goals typically persisted (Espinosa, 2011). A similar result was found in Gasman et al.'s (2017) study on Black male STEM students at an HBCU. The researchers noted that the networks students built with other STEM-focused peers allowed them to discuss difficult course material, share ideas, and hold one another accountable in ways that led to their persistence toward a STEM degree (Gasman et al., 2017).

Black Community College Students and the Transfer Adjustment Process

Although there is not a great deal of literature that looks specifically at the experiences of Black community college students post-transfer, the literature that does examine this population points to similar factors that can lead to the success of Black

transfer students. These factors include easily accessible and approachable faculty, supportive peer networks, supportive academic and social experiences, and various student engagement opportunities (Dounebaine, 2020; Flowers, 2006; Gates, 2019; Jackson et al., 2013; Jackson-Smith, 2016; Strayhorn, 2015). While there are indeed similarities in the factors that impact the success of community college transfer students and non-transfer students, there are also several distinctions in the information and resources transfer students utilize that help facilitate their success at the 4-year institution (Jain et al., 2011, 2016; Ogilvie & Knight, 2019; Walker & Okpala, 2017). For example, student organizations that help transfer students get acclimated to the 4-year campus, communities of practice with other transfer students in STEM disciplines, and faculty who do not negatively stigmatize transfer students are considered instrumental facilitators of transfer student success (Laanan et al., 2010; Ogilvie & Knight, 2019; Qaqish, 2018; Qaqish et al., 2020).

In discussing the experiences of community college students post-transfer, it is important to address the concept of transfer shock and previous literature on how transfer shock factors into the post-transfer experience of community college students. “Transfer shock” (Hill, 1965) describes the feeling that transfer students, particularly community college transfer students, are likely to have once they experience a decline in their grade point averages (GPA) at the 4-year level. Typically, GPAs drop within the first or even second semester after transfer to a 4-year institution. Given that Hill (1965) noted the GPA decline for transfer students occurred regardless of students’ prior academic performance at the community college level, the drop in their GPA is presumed to be a result of the initial “shock” of moving from one institution to another. For STEM transfer students, in particular, declines in their GPAs post-transfer are not only more likely to occur, but are also more likely to increase their chances of departure from the STEM field or their institutions (Cejda, 1997; Lockwood et al., 2013; Shayestehpour, 2020; Smith & Van Aken, 2020). Additional research examining transfer shock has found that the quicker transfer students are able to bring up their GPAs, the more likely they are to persist and to achieve at similar levels to their native student counterparts (Glass & Harrington, 2002; Hills, 1965; Ivins et al., 2017; Shayestehpour, 2020; Thurmond, 2007). Since Hill’s (1965) conceptualization of transfer shock, many scholars have expanded the list of contributing factors to transfer shock to include both academic and social factors, such as age, marital status, and financial aid availability (Ivins et al., 2017; Rhine et al., 2000). Just as transfer scholars have built on the concept of transfer shock, many researchers have also resisted this idea, indicating that scholars should instead examine transfer student capital and factors such as grading practices when considering the retention of community college transfer students (Ivins et al., 2017; Laanan et al., 2010; Lukszo & Hayes, 2020; Moser, 2014; Nickens, 1972).

Essentially, the transfer adjustment process creates differing concerns for community college transfer students as well as differential experiences they have to navigate specifically related to their transfer identity (Laanan, 2001, 2007). The literature confirms that community college transfer students are concerned with issues such as adequate one-on-one time with faculty, adequate academic advising, and overall academic and social integration at the 4-year institution (Jackson et al., 2013; Townsend & Wilson, 2006). At the community college level, students benefit from small class

sizes as well as increased opportunities to connect with their faculty both inside and outside of the classroom (Deil-Amen, 2011; Laanan et al., 2010). In moving from the community college setting to the university setting, community college transfer students encounter stark contrasts of large classroom sizes and less individual face time with faculty (Laanan et al., 2010; Lester et al., 2013; Moser, 2014). Given some of these academic structural differences between the 2-year and the 4-year environments, the learning experiences of community college transfer students are not only impacted by learning in a new academic environment but are also impacted by the expectation that they navigate and operate under a new academic system to which they are not accustomed (Laanan et al., 2010; Nickens, 1972). Additionally, several variables directly relate to successful vertical transfer of community college students, including academic preparation at the high school level, race, socioeconomic status, student enrollment status, as well as non-academic obligations such as jobs, marriage, and children (Wang, 2012). Students who complete more coursework at the community college, specifically those who earned an associate's degree, have also been found to be more successful at the baccalaureate degree-granting institution (Smith & Van Aken, 2020).

To this point, our literature review has focused on the educational and student factors impacting transfer. However, campus climate factors are also critical to transfer student persistence. When discussing transfer receptive cultures, Jain et al. (2011) outline five items—two pre-transfer institution items related to students' community college experiences and three post-transfer institution items—that are critical in establishing upward transfer from the community college to the 4-year institution. These items include: (1) high institutional prioritization of transfer student accessibility, retention, and graduation, (2) transfer student outreach and resource offerings that align with the transfer mission of the community college, (3) adequate financial and academic support that meets the unique needs of transfer students, (4) acknowledgement of transfer students' lived experiences, intersectional identities, and the importance of their community and familial backgrounds, and (5) framework development aimed at assessing and improving transfer receptive initiatives as well as generating additional research on transfer students (Jain et al., 2011). In particular, the last two post-transfer items at the 4-year institution are especially relevant to this study. The backgrounds, identities, and experiences of transfer students must be acknowledged to facilitate their success post-transfer. Experiences in which higher education stakeholders such as faculty and staff have stigmatized, underestimated, or dismissed the knowledge and skill engineering transfer students bring with them have been found to negatively impact the adjustment and success of these undergraduates (Ogilvie & Knight, 2019). As such, more needs to be done by stakeholders to validate the contributions that transfer students make to both academic and social campus spaces. This validation contributes to the psychological factors affecting Black engineering transfer student persistence by affirming students' STEM identity, transfer identity, their self-efficacy within the classroom, and their overall goal orientation. Indeed, research has found that student motivation is directly influenced by institutional culture (Smith & Van Aken, 2020).

In examining this study's focus population, we seek to expand on the transfer student literature base as suggested by Jain et al., (2011, 2016). Although literature on

transfer students and transfer adjustment continues to expand, there is a dearth of research that aims to understand the experiences of Black engineering community college students, particularly their experiences post-transfer (McPhail, 2015). This paper aims to address this gap in the literature base.

Methods

This study was guided by the following research question: *How do Black engineering community college transfer students describe their academic experiences at a predominately White 4-year institution?* Data were drawn from a three-year study funded by NSF, which explores factors that lead to transfer, persistence, and graduation (with a 4-year degree) in engineering for African diasporic students in a large urban setting. The majority of Black engineering transfer students previously attended one of two community colleges, the first of which is located in a county in which over 60% of the population identifies as Black or African American; in the second county, 18% of the population identifies as Black or African American. Both counties also are home to large school districts and are also home to a considerable number of first and second-generation American families from West and East African countries.

Our team employed qualitative methods, focusing on semi-structured interviews and focus groups as the primary sources of data collection. Interviews and small focus groups are valuable to the research process because they allow students to make meaning of their experiences (Creswell, 1994). Interviews and focus groups also provide researchers with the opportunity to collect rich, in-depth narratives and allow researchers the flexibility to seek clarification throughout the data collection process (Bogdan & Biklen, 1992). In addition to interviews and focus groups, our team also collected demographic questionnaires from each student participant.

This study focuses on the experiences of 11 student participants. All of the participants transferred from a community college and were currently enrolled in the College of Engineering at a predominantly White 4-year institution—referred to here as State University—at the time of the interview. The majority of the participants (7) reported their gender as male and the remaining (4) identified their gender as women. The Race and ethnicity identification of students were reported primarily across two categories African and/or Black African and African American and/or Black American. However, there was one student who identified as mixed race from Canada. The country of origin varied considerably with 4 participants from the United States, 3 from Nigeria, and one participant from each of the 4 remaining countries Canada, Ethiopia, Togo and Zimbabwe. The engineering majors that students identified reflect a range of academic interests (e.g., aerospace, bioengineering, chemical, civil, mechanical). See “Appendix 1” for details for each participant across these categories.

As a research team we were intentional in our efforts to reach a diverse community of Black transfer students. As these students were all currently enrolled at the 4-year institution at the time of the interview, we worked closely with State University’s Registrar’s Office to identify eligible participants. Specifically, we requested

an email listserv of community college transfer students who identified as Black and who were enrolled in the College of Engineering. To protect the anonymity of enrolled students, the Registrar provided a single email listserv address that we used in order to advertise our research study. Students were invited to participate via email. We then utilized our demographic survey to ensure that students met our eligibility criteria.

Interviews and focus groups were conducted between fall 2018 and fall 2019. The interview and focus group protocols were informed by the research question guiding this study, the conceptual framework, and relevant literature (see “Appendix 2” for interview and focus group protocols). Example interview questions include: What are some differences in the academic experience at your community college as compared to [4-year school]; What have your interactions been with faculty and staff within [the College of Engineering] and on campus in general? Interviews ranged in time from 30 to 90 min and were audio-recorded with the consent of our participants. Members of our research team engaged in analytic memoing to reflect on the overall themes of each interview and focus group. Audio recordings were transcribed using Verbalink.com and shared with participants for member checking (Glesne, 2011) to allow each participant to amend their narrative to ensure their story is authentically represented.

Data from this study were coded in Dedoose using both inductive and deductive coding techniques (Saldaña & Omasta, 2016). The team began with a set of pre-established codes that were developed based on the conceptual framework; we then generated additional codes based on our data analysis. Each transcript was coded by at least two members of our research team and all coding discrepancies were reviewed carefully by the team and resolved through a discussion among the sub-team members. Analytic memoing continued through the coding process to allow for research team members to continually reflect on the data collection process. The use of analytic memoing and member checking is essential to the data collection and analysis process to ensure trustworthiness and credibility of the data (Glesne, 2011; Saldaña & Omasta, 2016).

Positionality

According to Jones et al. (2014), “*Positionality* describes the relationship between the researcher and his or her participants and the researcher and his or her topic” (p. 26). Beginning at the moment we crafted our initial research question and throughout data collection and analysis, it has been important for our research team to acknowledge our positionality. Both the primary and secondary author for this paper have experience working as practitioners supporting transfer students. The primary author currently serves as the program director for transfer student advising and admissions, supporting students interested in transferring to a 4-year engineering college. The secondary author of this paper was employed for over a decade as a recruitment director and coordinator in an engineering college based within a large, 4-year public university on the East Coast; part of his tenure included outreach as part of an engineering program for underrepresented student groups. Given

this experience, these authors share a scholar-practitioner lens that informs their overall understanding of this work. The other authors on this paper collectively have experience researching higher education and STEM education, have served in administrative positions in higher education addressing student needs broadly, and currently study and engage in issues of race, equity and diversity. In particular, the doctoral student on this paper has an undergraduate STEM background (having studied biopsychology, cognition, and neuroscience) and has a professional background in incoming college student transition and success, including serving as a facilitator and coordinator for a STEM program for incoming first-year students (a program she also participated in during her time at her undergraduate institution). Additionally, her research agenda focuses on the target racial and ethnic populations represented in this study: Black immigrant and Black American students. Together, our experiences inform how we engage with this work and shape our insight and understanding of how Black engineering transfer students navigate systemic inequities throughout the transfer process and beyond.

Findings

Findings from this study are organized around three themes: heuristic learning, a lack of institutional knowledge (which is examined under the theme of “You’ve Never seen a Turbine: You Don’t Know What You Don’t Know”), and the challenge of navigating the “intensity” of the 4-year school.

Heuristic Learning

An obvious aspect of campus adjustment is in the physical environment. The size and scope of the 4-year campus—including physical space, larger numbers of individuals, and range of services and opportunities—often call for students to re-learn new ways of operating, navigating the campus, and interacting with faculty. Aspects of heuristic knowledge are reflected in the comments of Douglas, who talks about how he was adjusting his approach to the 4-year campus and how it influences his academic engagement. He notes:

... I had to take whole new different approaches to studying, to, I guess, interacting with people. I felt like, because that community college was so much smaller than [State University], like actual square footage-wise. I feel like people felt closer because it was smaller. I think sometimes at the community college I would see the same person like four times in one day, because the campus is that small.

Here, Douglas realizes that the 4-year campus context is requiring something very different than his community college. He recognizes that getting to know the campus, becoming familiar with the people and geography of the campus, would require an adjustment in how he operates if he was going to be successful in this

new environment. Similarly, Homa reflects on the size of the classroom and how this shaped important elements of interaction with people, especially teachers.

You're on your own sometimes, you know, unless you have the right support system. ...you have to go out of your way to look for support. Over there [community college], you know, the teachers, it's a small classroom, so teachers are, you know, more comfortable, like, you're more comfortable asking teachers over there, yeah.

Talking about the extent of the differences in practices, Homa went on to observe,

...the exams are different, too. Like, over here [State University], the exams are shorter, but the amount of difficulty is much harder. Over there [community college], it's just more questions, but there's...it's easy to tackle. You know, these questions that you're familiar with, you know? It's just like automatic. But over here, you have to take time and think, double, like, think about it. That's in terms of assessments.

We learn from Homa that what was once "familiar" is now unfamiliar and, thus, learning the new context becomes important. How the work unfolds as well as the shift in mastery and learning are no longer automatic, and this adds to the intensity of the adjustment process. However, as Homa observes, "you have to take time and think, double, like, think about it." This process contributes to the labor that is required, using more time to think and double check what they know and understand to make the adjustment.

Not surprisingly, participants express more comfort interacting with teachers in a smaller environment. However, it is not simply the size of the institution that shapes the perceptions of interactions with teachers and the intensity of the learning; it is also how teachers behave and the perceptions that students have of them. At State University, students felt teachers simply had less time and that the responsibility for navigating the shift in learning was on them, with less help from the faculty. Aman shared:

I feel like the amount of work you have to do by yourself is a lot compared to the amount of work you have to do by yourself at a community college. The [four-year] professors are just going to give you indications about what to study and where you can get the information. Or they just give you, they just skim the material. But the devil is in the details always, so you have to go there and work hard.

Ultimately, adjustment to the intensity of the 4-year school occurs in very personal and distinct ways for every student. Depending on the systems of support that students find on a 4-year campus, they are able to successfully adjust more quickly and to reduce the amount of stress they undergo during the adjustment process. We had students who were more aware than their peers about how to navigate and use the support available at the 4-year campus. One of the participants, Debbie, provides an excellent example of having confidence and understanding of how to advocate on her own behalf.

Here [State University] it's very different because even when you're very good in a class, you still have to go talk to a professor and say, this is what I'm interested in... My two-year college actually trained me to have that interaction with professors. [At State University] it's like if you didn't have that interaction prior, you wouldn't be able to approach a professor and then the professor might not be able to link you up with opportunities that they have. Professors here don't typically just come to you and be like, "Oh, I heard of this scholarship or this program or this internship."

Debbie understood the importance of letting the professor know her expectations. As clear by her comments, she was taught early at the 2-year (community college) campus to prepare for this process of advocating. As she notes, "my 2-year campus actually trained me." This preparation process is key to navigating the transition to the 4-year campus successfully. We certainly know that not every student will have these experiences; therefore, it becomes even more important that intentional efforts be made to look for the signs that students need help. These moments of engagement can make all the difference, as illustrated by the example of Debbie, who received timely feedback in an informal interaction with a professor at the 4-year school.

The professor, I think she was going home, and she probably left something in class and came back. She saw me and she was like, "Oh, hi [Debbie], you're still here." I'm like, "Yeah." She was like, "You look worried. What's up?" I was like, "I don't think chemical engineering is for me. I want to change." At that point, [the] Professor, I feel like she was really key.... she was like, "Debbie, you're doing okay. You're doing good in class. If you're complaining it's tough, it's probably tough for other students too."Professors that can tell you you're doing okay, at this rate you're doing good, just keep studying. She just told me things that I really needed to hear, so I was like, "Okay, maybe I'm not doing as bad as I think." Over time, I figure, "Okay, no worries. It's okay to not have all A's as long as I'm doing great still."

This example reminds us of how important informal interactions are between a professor and a student. Unfortunately, this is not always the case, and the interactions with professors can feel rushed and impersonal. For example, Douglas explains:

I thought maybe I could go to the professor's office hours, learn something. And the professor just did not... I felt like when I went to that professor here for that class, the professor was trying to sum up everything really fast so that he could get me out. And I guess because he had other people in that class as well that had different questions. So, he was like on the book, "Who was here first? Okay, you're gonna come here. What question do you have? Okay, just do this, and that's how it's done. All right, go." But there's no actual explanation. If I had more questions, I couldn't ask it.

As faculty establish strategies to work with students, they may believe that they are setting up equitable and useful processes to work with students (i.e., sorting students into groups based on what they need to learn) only to miss the fact that these very processes can feel impersonal and rushed to some students. Being aware of different

student needs is what matters and understanding that some students may still need one-on-one time is critical. Eventually, over time and with the right levels of support, students begin to develop academic mastery, they settle into a place where they have less stress, and they begin to feel stronger and more confident in their abilities.

“You’ve Never Seen a Turbine”: You Don’t Know What You Don’t Know

During their first semester at State University, several students spoke about the challenges they encountered as a result of “not knowing” certain things about the 4-year campus. While students all connected this lack of knowledge to their academic experiences, there were variations within their narratives. For some, the gap in information was specific to the academic culture of the 4-year institution (i.e., a lack of institutional knowledge). For other students, confusion arose because they did not have institutional knowledge of the academic department or—at times—the field of engineering.

Institutional Knowledge

Evie’s observations reflect what many students say about the first year of the transfer process, “The first year it was obvious that I was a transfer student, because I didn’t know a lot of things or a lot of people.” Many students agreed that they felt “like a transfer” simply because they did not know certain things about the institution. Here, Evie shares how challenging it was for her to adjust to the university’s grading system:

Another thing that made it harder was like the whole plus/minus system. So, usually, I just try to aim to get a 90 percent in most of my classes – which is not good – but as long as I have 90 – A – I didn’t really mind. But, now I couldn’t like aim to get a 90 and think I’m going to get an A. I’ll probably get an A minus which drops my GPA. So, I mean that plus minus system was one of the things too.

State University provides students with weighted GPAs based on whether they earn an A, A–, B+, B, etc. This grading system differs from the community colleges within the state (where grades are awarded as simply A, B, C, D, F) and can often come as a surprise to many newly admitted transfer students. The new grading method alters not only their understanding of their grades but also their study habits—as exhibited by Evie. Aman echoed Evie’s comments by sharing that many students were not accustomed to the university’s academic policies and practices. While talking about teaching assistants and the overall grading policy, Aman shares:

A lot of people are not accustomed to that type of approach, especially transferring from community college. Especially, the first semester is always going to be the hardest and I struggled – frankly speaking – I struggled with my first exams. And honestly, I’m a hard-working student... You have to step up your game and work even more harder.

Homa also highlights the adjustment process of working with a teaching assistant (or TA): “We didn’t have TAs in community college, so you had to, you know, force yourself to go to the teacher’s office.” Several students lamented that “not knowing” important academic information was a major barrier that they needed to overcome. In addition to grading and teaching policies, students also spoke about specific campus resources and websites. For example, Leila explains:

I felt very overwhelmed when I transferred here. Everything is bigger and different. Some of the challenges that I had – [in] my first week, I didn’t even know how to access [the learning management system], so, [laughs] yeah, so that was something I had to figure out.

Departmental Knowledge

The examples listed above speak to large-scale institutional challenges that students face when navigating a new campus. However, many of our students also spoke more specifically about information gaps within their department and classroom environments. For example, both Paul and Douglas describe instances where their courses were made more difficult because faculty held certain assumptions about what all students “should know” upon enrolling in their courses.

When describing his experience within the classroom, Douglas focuses on his first programming course at the 4-year institution. In the quote below, Douglas refers to the language taught in the course “C” as a means of describing the course:

[During my first semester], I was taking intermediate programming, a C course. And, I mean, I was confident I could take the course. And I decided, at least for the first semester, I think I only took 12 credits. So, I decided to pace myself. I knew that it was gonna be a change, and it was gonna be different. But, I took that intermediate C programming course, and I thought because, “Oh, yeah, I went through [community college] and I did five languages at one time at the beginner level. So, I can definitely handle this intermediate course of one language.” Then, on the first day of class, the professor is like, “Oh, I don’t recognize a lot of you guys from my beginner course. We’re gonna have an exam next week going over everything in the beginner course.”

Despite his confidence in his prior coursework, preconceived notions from the professor led Douglas to believe that he was unprepared for the exam. The language from the professor (e.g., “I don’t recognize a lot of you guys from my beginner course”) assumes that students who did not take the specific course offered at the 4-year school are unprepared to move into the higher-level curriculum. This assumption discounts the relevant education that transfer students acquire at their prior institutions. As a result, Douglas, who indicated that he “was confident [he] could take the course” felt that he was lacking in important contextual knowledge.

Paul similarly seemed to lack contextual knowledge that could have helped him during his first semester at State University:

I took a class where a professor recycled his exams. And students who had been here already knew that, so they were already prepared with past exams. And me and my friends, we didn't know that, and we didn't have the exams to practice [...] So, it's sort of disadvantages [us] in the sense that I didn't know all the ins and outs of the school, just because I missed the first two years.

Much of the information students lacked upon transferring was not specific to their academic preparation. Rather, they described heuristic knowledge that is only gained over time based on an individual's experience within a specific context.

Engineering Knowledge

Finally, both Debbie and Mira describe instances where professors made assumptions regarding what students should know about the field of engineering. Debbie, who was born in Nigeria, explains that she was in a class where the instructor spoke about Legos (the interlocking plastic toy brand). "It's just different," she laments, "I didn't grow up with Legos. I'm like 'What are Legos?'" Debbie also describes additional classroom experiences where professors assumed prior knowledge:

I remember one of the classes I took here and [the professor was] talking about turbines and compressors. [...] I'm not even seeing what a turbine is. I remember I asked a question one time, and someone was like, "You've never seen a turbine?" I haven't seen a turbine. People are like, "What? You've never?" Sometimes I ask a question and it's like, "You don't know what this is?" "You didn't grow up with all this?" It's just different. I really have to do a lot of catching up.

Debbie did not grow up in the United States context and, as such, does not have the same experiences as her peers. As a result, she felt this constant need to "catch up." For students like Debbie, who were born outside of the U.S., this need to "catch up" creates a dual challenge, as these students must work not only to catch up with their academics but also to learn cultural nuances that are specific to the U.S. experience.

Mira also struggled to make connections in the classroom. Though, for Mira, the struggle appeared primarily because she saw very few classroom examples connecting the theoretical to the practical:

The way some of the classes are structured, I wish they were slightly more practical. For example, my [Product Engineering] class – we sit in lecture. We learn about the product evolution process. It makes sense because the product evolution is common sense, but there are still nuggets that you should learn in some places. At the end of the last class, [the professor] does a little case study. "Look at this wheelchair that was designed." It was really cool. I learned pretty much everything you just said in that one example. So, I wish a lot of the classes were a bit more like that, more case studies.

Navigating the “Intensity” of the 4-Year School

Embedded within the heuristic learning process that occurs when the participants in our study engaged with the new campus seemed to be a level of academic intensity. As students dealt with the changes in the academic culture, work expectations, and practices at the community college versus the 4-year school, they appeared keenly aware of the need to adjust to this intensity. The expressions of academic intensity were illustrated in a number of ways. A representative example is reflected in the sentiments shared by Aman, who talked about the first-semester adjustments and how academic expectations shift.

You have to step up your game and work even...harder. The intensity is different. I feel once you get used to that level of intensity, you will be more effective. But the first semester is always going to be the hardest.

The intensity that Aman is adjusting to reflects not only the transition to the institution but also the culture of the work environment within the 4-year campus, which requires him to “step up his game” even as he identifies as a hard worker. Aman’s comments suggest that he is adjusting to the shift in the amount of effort his studying is requiring and is developing stronger work habits to meet the new demand and culture of the 4-year environment.

Similarly, talking about her initial adjustment, Debbie shares how challenging the early stages are in the transition to the 4-year institution.

I remember the first summer when I came here, the first class I took, I was struggling. My idea of struggling is it wasn’t looking like I was going to get an A. It was different for me because I transferred with a 4.0 and...I was probably going to get a B plus or an A minus. It was so strange. I remember one time I was so close to crying. I was like, “Why am I not getting As on these assignments?”

Yet again, grades are an important part of the student transition. While students describe the plus/minus system as relating to institutional policy, here, grades are illustrated as an important metric for how students determine if they are succeeding in their transition. The reality is that adjustments are continually being made throughout the process, and, as students transfer and begin to take advanced courses in their major, they may not always earn As. Thus, they are likely to experience more fluctuation in their grades. Aman notes the challenges of taking more advanced courses:

Everything is building up on the previous classes so if you haven’t mastered the material in the previous classes, you would not be able to be effective on the advanced classes. Not only that you have to study the material in the classes you are taking now but you have to go back and review. And understand the material from the classes you have taken. On top of that, the exam hours are so short. You have sometimes an hour. Sometimes, you have an hour and 15 minutes, so you have to pace yourself. Learn how to pace yourself. Do that in the time limit.

The coursework continues to be a source of struggle and difficult transition for students, especially in dealing with the intensity of courses. The intense shift in the learning process and expectations shapes a good part of the academic transition. The fact that subject matter in the major is now building on what was learned previously means that students really must study more effectively for current classes while also turning to notes to re-learn previous materials in this new context. Adding to these classroom adjustments in intensity of learning is the need to gain heuristic knowledge and understanding of the new environment. While not directly related to academic success, learning the campus can have a secondary impact on academic achievement.

Discussion

The salience of being a transfer student was especially powerful as it related to what participants did—or did not—know or do prior to enrolling at State University. Transferring to the 4-year campus had a number of implications for the participants, including adjusting to academic norms and expectations of the new campus as well as the engineering program. These findings suggest that transfer students needed to be better socialized into the new campus norms and academic culture. Even in cases where opportunities may have been provided for students to learn about State University and its engineering college, they may have been unaware of these programs and, thus, may have had perceptions that they did not exist. Unfortunately, this reflects challenges that previous studies have raised as undergraduates move through the transfer adjustment process (Laanan, 2001, 2007). Moreover, most salient among our findings is that the participants seemed to be navigating this process on their own, without the intervention of the 4-year institution. This idea of self-navigation for engineering and other STEM transfer students has already been articulated by Wang (2021) in the formal transfer process, but our work extends this idea to the time after the process ends and as students begin their tenure at the 4-year university. That is, not only does the notion of self-navigation emerge in the *transfer* process, but it also seems to be evident in the *adjustment* process post-transfer.

Respondents' comments underscore the relevance of individuals on campus who can play a major role in helping transfer students become acclimated to the 4-year engineering and overall university environment. However, whereas prior studies highlight the importance of both faculty (Laanan, 2001) as well as advisors and student organizations (Ogilvie & Knight, 2020; Qaqish, 2018; Qaqish et al., 2020), findings from our study suggest that respondents had varied experiences with faculty including some that made them feel connected. Faculty seemed to make certain assumptions of the knowledge that the students brought with them to the classroom, and non-transfer undergraduates who had been with the university had heuristic and other forms of knowledge that the transfer population did not possess. On the other hand, there were faculty who informally checked in and provided affirming feedback that alleviated immediate stress for students. Seymour et al. (2019) have previously written about the challenges that minoritized first-year STEM students face when adjusting to engineering courses from under-resourced high schools, but fewer

articles have addressed the gap in knowledge that minoritized *transfer* students encounter. This work once again illuminates the need for more research around the unique experiences of minoritized transfer students, particularly those in intense majors like engineering. Our results further underscore our attention to institutional academic factors that can impact Black engineering transfer students' persistence, and points to the university (not the student) as critical in defining much of their post-transfer experiences.

Our findings also reinforce the significance of faculty as gatekeepers and influencers of the culture within the 4-year engineering college environment. The incident involving Douglas' programming professor who made assumptions about his enrollees' prior knowledge speaks to a perennial challenge around rigor and elitism. Indeed, engineering education scholarship has critiqued engineering curricula for its overemphasis on academic rigor at the expense of marginalizing students in under-resourced communities (Riley, 2014). Riley (2017) adds that "rigor accomplishes dirty deeds...disciplining, demarcating boundaries... demonstrat[es] white male heterosexual privilege...[and] reproduces inequality" (Riley, 2017, p. 249). Students of color from many urban and lower-income communities may, therefore, be adversely affected by curricula that focus too much on high standards of rigor and that fail to take their unique contexts into account. In a similar way, the notion of "intensity" with shorter and more difficult exams may simply be another way that engineering is presented as a more rigorous and selective field. Framing engineering as intense, rigorous, elite, or selective is fundamentally associated with the way that 4-year engineering schools—particularly those associated with research-intensive universities—may present STEM majors in general (Seymour et al., 2019). These intense testing strategies may miss the ultimate goal of helping students master the subject matter in engineering. Indeed, schools that present STEM in this way often feature courses that have "content overload, incoherent presentation...with material pitched too high and inappropriately abstract, [and] a focus on rote learning" (Seymour et al., 2019, p. vii). The marginalization that transfer students face in largely white, baccalaureate degree-granting institutions places an added burden in a discipline that is already fraught with its own exclusivity problems (Jain et al., 2016). Students such as those in our study therefore face both discipline-related and transfer-related issues that persist in many engineering programs. By contrast, scholars have not described community colleges instruction in these ways, perhaps because community colleges usually hire faculty whose primary role is to teach.

Moreover, the overall size of State University and the size of the classes on its campus were starkly different from what participants like Douglas and Homa were accustomed to at their community colleges. For Homa in particular, the smaller campus and classroom sizes at his community college made him "more comfortable," which reflects Laanan's (2001) work and our own conceptual framework. Additionally, the smaller or more accessible nature of Debbie's community college made it appear easier to ask professors about internship and co-curricular activities, than at State University. These findings reinforce previous scholarship that suggests the strong impact that dedicated teaching faculty at community colleges can have (Haberler & Levin, 2014), which differ from often unwelcoming classroom environments in baccalaureate engineering programs (Seymour et al., 2019). Considering

the differences in ways State University engineering faculty managed their classes and participants' prior learning experiences in community colleges, the transfer students may have been "trained"—as Debbie said—to expect more positive campus experiences. Thus, rather than associate their academic challenges with *individual* shortcomings, our findings add to the body of work that redirects the responsibility for these challenges on 4-year *institutions* that have unintentionally created barriers to success (Seymour et al., 2019). Indeed, these findings reify the importance of institutional culture on engineering transfer student outcomes (Smith & Van Aken, 2020). Our implications below suggest ways in which 4-year institutions can foster cultures that are more conducive to Black engineering transfer student success.

Implications

The findings from this study offer insights and implications for 4-year engineering and other campus stakeholders, including those in urban community college environments. In this section, we outline a number of these implications, situating our perspective first within the context of the classroom, and then expanding outward to a more global view of the 4-year environment. We include several recommendations that suggest a reimagining of the 4-year engineering environment that reflects some promising practices from community colleges. By creating more consistency between what happens within community colleges and 4-year schools, transfer students are less apt to experience the type of difficulties in adjustment that we describe above.

First, when contrasting community colleges' commitment to teaching (Haberler & Levin, 2014) and schools like State University's prioritization of research as a research-intensive university, there is an opportunity to draw from community college faculty promising practices. Smaller, more accessible classes in which professors are encouraged and incentivized to really engage with undergraduates is one element that students benefited from in their community colleges, but lacked once they transferred to State University. At the same time the research-intensive nature of schools like State University has allowed it to develop a center for teaching advancement, which ideally should help professors to develop better instructional practices. Thus, engineering professors at 4-year schools can also draw from centers like these—as well as promising practices from community colleges—to implement instructional methods like culturally-responsive pedagogy. This can be especially helpful for Black transfer students.

Second, rather than assume that transfer students will easily adapt to the 4-year environment, community colleges and 4-year engineering programs should communicate with each other to ease the learning curve required to adjust. For example, if community colleges offer longer exam periods and fewer homework assignments than their 4-year counterparts, faculty and advisors at both institutional levels should inform undergraduates of such systemic changes by offering *transfer success* workshops before and/or after the transition occurs. These workshops can also focus on technical skills that engineering students may need to know after transferring, such as Matlab or other programming languages. This reflects Weis' (2018)

recommendation for urban community colleges, in that it is “most important” that the first two years of community colleges “parallel...those in 4-year institutions.” Simultaneously, Weis (2018) reminds us that urban community colleges often serve socioeconomically under resourced learners, whose lives are juxtaposed between academia and the realities of difficult living environments. At the same time, our study reveals that urban community colleges serve not just students born in the US, but also students who have immigrated from other countries in hopes of better academic and professional lives. Thus, community colleges have and must continue to serve their immediate surroundings, and 4-year engineering programs must be conscious of the missions that community colleges are responsible for upholding. Expecting, for example, community colleges to completely adapt their teaching methods to reflect those of baccalaureate engineering programs, with no attention to the challenges that Weis (2018) describes, may be insensitive to the needs of these learners. Care should be taken to attend to the needs of these diverse collegians, while at the same time preparing them as much as possible for 4-year campus environments.

While community colleges consider ways of adapting their programs, baccalaureate engineering colleges might consider adapting their assignments to mirror those of community colleges, perhaps by extending the time for exams or reducing the number of questions required. This adaptation can help underscore the notion that 4-year engineering schools are less focused on rigor and intensity, and more focused on ensuring that students demonstrate mastery of technical content. These and other recommendations imply that faculty and advisors at community colleges and 4-year schools can and should develop more consistency between what students experience in the classroom at each institutional level. Similarly, senior administrators and faculty at 4-year engineering programs—particularly those at research-intensive schools—need to be encouraged to reframe engineering as a less exclusive field for only those who can manage its intensity. One means for effecting change may be annual or semi-annual meetings of faculty and advisors, in which community colleges and 4-year schools share promising practices with each other for working with undergraduates. This can be especially useful for 4-year predominately White schools that historically have not educated as diverse a population of learners as their community college counterparts.

Conclusion

Engineering colleges, particularly within the context of 4-year research-intensive predominantly White institutions, historically have a high rate of attrition due—in part—to an often-unwelcoming environment (Seymour et al., 2019). Yet, even for those who remain within engineering, they often lament the very same challenges that cause many of their peers to leave (Seymour et al., 2019). Interestingly, engineering transfer students at 4-year institutions have retention rates that are on par with their first time in college (FTIC) counterparts, but indeed, challenges remain. For Black students, some of these challenges in engineering have typically been framed along racial lines, with some undergraduates encountering racism or

Table 1 Participant data

Pseudonym	Gender	Year of birth	Race; ethnicity ^a	Country of origin	Major
Aman	Man	1990	African; Ethiopian	Ethiopia	Electrical Engineering
Paul	Man	–	Black; Shona, American, African	Zimbabwe	Aerospace Engineering
Evie	Woman	1999	Black; Nigerian	Nigeria	Bioengineering
Mike J	Man	1998	Black; African American	United States	Mechanical Engineering
Will	Man	1997	Black American; African	United States	Chemical Engineering
Debbie	Woman	1994	African; Yoruba	Nigeria	Chemical Engineering
Homa	Man	1997	African American; Sudanese	United States	Electrical Engineering
Mira	Woman	1998	Black/African; Nigerian	Nigeria	Mechanical Engineering
Jake	Man	1991	Black; Black	United States	Civil Engineering
Leila	Woman	1989	African; West African	Togo	Bioengineering
Douglas	Man	1997	Mixed Race; Tanzanian	Canada	Electrical Engineering

^aThe racial and ethnic identifiers in the table were selected by the participants. The researchers did not assign these identifiers

additional forms of “othering.” For Black engineering *transfers*, our data reveals that transfer status may be another way that students feel othered. To provide greater support for Black engineering transfers, 4-year schools must embrace and recognize them holistically, recognizing that their experiences and pathways likely differ from those of their FTIC colleagues. Just as community colleges have done and continue to do, 4-year engineering schools have an opportunity to support populations that are truly reflective of the communities in which they are based.

Appendix 1

See Table 1.

Appendix 2: Interview and Focus Group Protocols

Interview Protocol

Pre-college

1. What inspired your interest in science, math, or engineering?
2. Tell us a little about the science and mathematics courses that you took in school?

1. What kind of teaching did you experience in the classroom? (Hands on, lecture style, etc.)
2. How challenging (or easy) were the courses you took in school? Why?
3. What led you to decide to enroll in a community college? Did you know initially that you planned to transfer? If so, why? If not, why not?

Community College

1. Did you have any support systems at the community college? If so, what were they? If not, why not?
2. Were there people who influenced you while at the community college? If so, who were they? (Probe: Parents, extended family, peers, an employer, Institutional agents (e.g., faculty))
3. What was the most challenging aspect of your community college experience?
4. How knowledgeable were you about the transfer process, i.e., the process to transfer from community college to a 4-year institution? Why? How prepared did you feel to transfer given your knowledge about the process?
 1. What college resources and/or experiences were the most crucial for your preparation to enroll into an engineering program at a 4-year institution?
5. Were there any academic or social challenges as you prepared to transfer? If so, what were they?
 1. *If necessary*, [If they reference challenges] What steps were you taking to address those challenges?
 2. *If necessary*, What did you hear from your peers about the transfer process?

CONTINUE WITH THIS SECTION FOR THOSE STUDENTS WHO HAVE TRANSFERRED

4-Year School

1. Now that you are enrolled in the [engineering school at the 4-year institution], what has been working well for you and where are you experiencing challenges?
2. Now that you are enrolled at [4-year institution], do you think of yourself as a transfer student?
3. Since being on campus, have there been particular racially-charged incidents on and off campus that have impacted your experience?
4. What are your goals for the next few semesters at [4-year institution]? What do you hope to accomplish before you graduate?
5. What motivates you to study engineering? To what extent does your gender, race, transfer, cultural identity play into that motivation?
6. Tell us a little about the science and mathematics courses that you have taken at [4-year institution]?

1. Probe: What kind of teaching have you experienced in the classroom? (Virtual, hands on, lecture style, etc.)
2. Probe: How challenging (or easy) have the courses you have taken at [4-year institution] been? Why?
7. What are some differences in the academic experience at your community college as compared to [4-year institution]?
8. What kind of feedback have you received about your academic performance?
9. Have faculty or advisors or other campus staff given you any feedback that stands out to you?
10. What have your interactions been with faculty and staff within [engineering school at the 4-year institution] and on campus in general? Do you feel like you are a member of your department, the [engineering school at the 4-year institution], or [4-year institution]? If so, in what ways? If not, why not.

Focus Group Protocol

Pre-college

Student Factors

(Academic performance, Career capital, Engineering identity, Personal goals)

1. When you look back over your pre-college education, is there a memory or experience that stands out that prepared you to be an engineering student?
2. Can you describe the moment you knew you wanted to be an engineer?
3. Are there particular individuals who were influential in your preparation?
4. How did your pre-college courses prepare you for community college and 4-year school?

Community College

College Resources

(Course alignment with 4-year school, financial aid, Accessible faculty, Pre-Transfer Advising)

1. Are there particular teaching techniques that professors used to help you learn important engineering concepts?
2. Looking back, what information would you have liked to have had to prepare you for being an engineering student?
3. What has contributed most to your ability to be academically successful as an engineering student?
4. What resources have you had access to that have made you feel supported?
5. What do you feel provides you most in the way of campus support? What do you feel is missing from your experience in the way of support?

6. If you find that you are having trouble with a class or a professor, who do you turn to for support?
7. Since being on campus, have there been particular racially-charged incidents on campus (on and off campus) that have impacted your experience?
8. How satisfied are you with your advising experience? What has contributed to your feelings?
9. Who have you received career counseling advice from?

Student Factors

(Community college experiences, Career capital, Engineering identity)

1. Did you feel like an engineering student at the community college? Please share why or why not.
2. What was the most challenging aspect of the community college environment?
3. What was the most positive aspect of the community college environment?
4. How do you see your identity impacting your experience as an engineering student? Or does it at all?
 1. Possible identities to probe with: Engineering student, transfer student, student of color, gender, other salient backgrounds?
5. In what ways have you been active (were you active) and participate(d) in campus activities? Have/Did you joined any student organizations?
6. How confident do/did you feel in your ability to successfully graduate with a bachelor's degree in Engineering (while at the community college)?

Four-Year School

College Resources

(Bridge programs, Academic advising, Career counseling, Accessible faculty, Institutional commitment to students, Positive racial climate)

1. For those of you who are currently attending a 4-year institution, how have your experiences changed (if at all)?
 1. Probes: resources, campus support, professors, racially-charged incidents, advising experiences, career counseling, support from academic department

Student Factors

(Prior academic experiences in two & 4-year schools, STEM preparation, Self-confidence, Commitment to field)

1. For those who transferred, did your campus involvement at the 2-year differ from your involvement at the 4-year school?

2. For those who transferred, did your confidence in your ability to graduate with a B.S. in engineering at the 2-year differ from your level of confidence at the 4-year school?

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