

Exploring the Interpersonal Relationships of Black Men in Undergraduate Engineering Programs

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ABSTRACT

The dilemma of making education an equitable system, especially for minoritized groups, has persisted for centuries. While there have been efforts aimed at decreasing disparities, there is still more work that needs to be done. An often-overlooked population in science, technology, engineering, and math (STEM) is Black men—a group at the nexus of being a gender majority and racial minority. Thus, the purpose of this exploratory research study is to understand how Black men experience interpersonal relationships in undergraduate engineering programs. The overarching research question that guides this study is: *What are the qualitatively different aspects of interpersonal relationships experienced by Black men in undergraduate engineering programs?* Using Bronfenbrenner's Ecological Systems Theory as a lens and a quasi-phenomenography methodology to understand the variance of the students' relationships, I conducted 14 semi-structured interviews with students who identified as a Black man and were a second-year or higher in their undergraduate engineering program. By examining interpersonal relationships, I clarify the meaningfulness of relationships at one historically Black college and university (N=1) and two historically white institutions (N=13). A total of seven relationship types and ten different ways students described their relationships were identified in the data. Each of the ways students described their relationship was organized on the emergent domains of academic, emotional/mental, financial, professional, social, and spiritual. Students also mentioned five environmental influences that impacted their experiences in engineering. My results indicate that students find value in relationships with people who were relatable, people who could provide insight or knowledge, and people who showed a sense of care or concern for the student. Students also mentioned how environmental influences bear significance on their over experience in engineering. The present study lays the groundwork for holistically examining the interpersonal relationships of Black men in undergraduate engineering programs.

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GENERAL AUDIENCE ABSTRACT

For decades, Black men have experienced educational hardships from as early as first grade. While many researchers have identified areas to improve the educational experience for Black men, few have looked at the educational experience of Black men in science, technology, engineering, and math (STEM). My research adds to the current conversations surrounding Black men in undergraduate engineering programs by looking at how relationships impact their educational experiences. I conducted a research study with 14 Black men in undergraduate engineering programs at two historically white institutions (N=13) and one historically Black university (N=1). I asked Black men about the types of relationships they had and why those relationships were meaningful to them. I also asked the students if there were outside influences such as stereotypes held by society that might impact how they look at their relationships. The students primarily discussed relationships with their STEM peers and professors. Relationships that were more meaningful for students were with people who were relatable, people who could provide insight or knowledge, and people who showed a sense of care or concern for the student. Outside influences that impacted students' relationships were their academic major, the type of institution they attended, their gender, their race/ethnicity, and National events. These findings contribute in several ways to our understanding of the value of relationships and provide a basis for future research involving Black men in STEM.

Dedication

The door was closed so I knocked until my knuckles turned purple

The door was closed so I shouted until I lost my voice

The door was closed so I kicked until I broke my leg

The door was closed and one day the door opened

To those who had to give up on the door and those who are still waiting for the door to open

I will open the door for you

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Chapter 1

1 Introduction

“American education is not a neutral institution, but one that functions in the context of political, cultural, and social inequalities and plays a role in maintaining and legitimating those inequalities” (Rushing, 2001, p.32).

In U.S. rhetoric, education is often positioned as a “great equalizer”. In hopes of realizing this vision, notable education policy efforts—such as the 1890 Morrill Act, the 1954 *Brown v. Board of Education*, the 1965 Higher Education Act, and the 1980 Science and Technology Equal Opportunity Act—have attempted to decrease inequities that exist within the education system (Lichtenstein et al., 2014). However, cultural norms, values, and standard practices within institutions often run counter to these policy reformations. Higher education institutions have been accused of legitimizing and perpetuating systemic inequities, ultimately preventing forward progress towards equity in educational systems (Cheville, 2017; Leonardi et al., 2009).

Literature suggests that higher education is perfused with systemic inequities. However, contextualized problems relating to equity exist within each discipline. For instance, there have been significant efforts to broaden participation in STEM (science, technology, engineering, and mathematics) fields (Lucena, 2005; NSF, 2017), a collection of disciplines facing unique challenges related to diversity and inclusion. Such issues are evidenced by the continued overrepresentation of White men in engineering disciplines despite the growing number of ethnic and racial groups (e.g., African Americans, Hispanic Americans) in the U.S. (Lichtenstein et al., 2014; Yoder, 2017). While there has been growth in the number of non-White people and White women who choose to major in engineering (NCES, 2017a), much work remains to decrease systemic inequities.

1.1 Motivation

For my dissertation, I looked at one particular subgroup of engineering students: *Black men*. Focusing on Black men is important because education systems have historically been less receptive to and accommodating of the needs of Black men and boys (Cuyjet, 2006; Harvey, 2008; Moore & Owens, 2008). Regarding terminology, I am using *Black* as opposed to *African American* to encourage a broad

exploration of Black men in engineering as the term African American can designate a more restrictive identification. However, when reporting on previous literature, I will use the terminology used by the author(s).

Among the underrepresented groups in STEM, Black or African Americans have historically and consistently suffered from educational disparities that impact their STEM degree attainment (Charleston, 2012; Jackson, Charleston, George, & Gilbert, 2012). While several studies focus on the college experiences of Black or African American men and their low participation and representation in engineering, there needs to be more work that highlights the nuanced experiences of Black or African American men through their own voices. Young (2004) eloquently describes this need for research that is focused on talking *to* and talking *with* Black men. Research that is focused on talking *to* Black men helps to better understand the underrecognized complexity of the lives of Black men. Work that centers on talking *with* Black men is also critical to help us understand how Black men interpret the world around them and make sense of their opportunities and circumstances (Young, 2004). By talking *to* and *with* Black men, we can understand more about how Black men know and experience the world, which is even more needed in the field of engineering where they are often overlooked given their plight in society. Through my dissertation, I add to research that focuses on talking *to* and *with* Black men to understand how they experience interpersonal relationships in undergraduate engineering programs.

1.1.1 Dimensions of Race, Ethnicity, and Gender

In order to contextualize educational disparities experienced by Black students, it is essential to examine the role of race, ethnicity, and gender in educational environments. In the 1940s, Everett Hughes coined the term “*master status*” to refer to a particular characteristic of an individual that is prioritized over any other characteristic (Hughes, 1945). Despite the existence of many types of master statuses—such as gender, occupation, or age—, external forces largely shape how people view the master status of an individual. In the U.S., race is a master status that often supersedes other characteristics that may or may not be visible (Anderson, 2011). Race has been used to marginalize African Americans for hundreds of years and can be understood as a power system that derives its significance from historical, political, and social contexts (Dancy & Brown, 2012).

In addition to race, it is important to acknowledge the role that both ethnicity and gender play for Black people because there is no universal *Black experience*. Although an individual’s skin color may characterize them phenotypically as Black, it does not mean they share a common experience with other Black-skinned individuals (Alex-Assensoh, 2009; Assensoh, 2000; Guenther et al., 2011; Shaw-

Taylor & Tuch, 2007). Race and gender influence the experiences of Black students in the educational pipeline, and the societal and cultural aspects of racial and gendered experiences are intersecting, not additive (Crenshaw, 1989; Mandara, 2006; Saunders et al., 2004).

1.1.2 Higher Education and Black Men

While there are numerous studies on the educational trends of Black boys in K-12 education, studies on Black men seldom focus on college-aged students, i.e., those 18-24 years old (Harper, 2004). Moreover, most studies that do focus on college-aged Black men use a deficit model, with themes focused on maladjustment, struggle, social deviancy, and disengagement (Ferguson, 2000; Harris III et al., 2011; Isom, 2007; Lasane et al., 2000; Poulson-Bryant, 2005). This scholarship, in turn, influences how U.S. media, academic researchers, and college administration view (Brown, 2011; Harper & Davis III, 2012) and how institutions interact and engage with Black men (Harper & Quaye, 2007).

Black men and boys face unique barriers in accessing and persisting in institutions of higher education (Chavous et al., 2003; Howard, 2003). Such barriers are significant because unequal educational outcomes can lead to other consequences, such as economic and emotional tolls, decreased levels of psychological safety, and intergenerational mobility throughout one's life. Black men and boys experience poor educational outcomes when compared to other demographic groups (Levin et al., 2007). From 1976 to 2006, the percentage of Black men enrolled at higher education institutions slowly increased from 4.3 to 4.5% (U.S. Department of Education, 2010). Educational disparities for Black men persist beyond the door of higher education; Black men also have higher attrition rates (Saenz & Ponjuan, 2011). While in college, fewer than one third of Black men earn bachelor's degrees within six years, which is the lowest graduation rate in the U.S. among men and women of all racial groups (Harper, 2012). In addition, while post-baccalaureate degree attainment for other groups has increased rapidly, rates for Black men remain lower in comparison. From 1977 – 2007, the percentage of Black men with post-baccalaureate degree attainment increased by 109%, compared to a 242% increase for Latino men, 425% increase for Asian American men, and 253% increase for Black women (Harper & Davis III, 2012).

Educational inequities for Black men in higher education emerge, at least in part, from inequities in K-12 school systems. In 2008, only 47% of Black male high school students graduated with their cohort of peers (Education, 2010). In K-12 school settings, Black men face barriers associated with learning disabilities and school suspensions (Abdullah, 2018; Jung & Poole, 2006). For example, African American boys are overrepresented in disability categories (Artiles et al., 2002; Ferri & Connor, 2005;

Gurian & Stevens, 2005; Losen & Orfield, 2002). Black boys are two times as likely to be labeled as “learning disabled,” and seven times more likely to be diagnosed with attention deficit disorder (ADD) or attention deficit hyperactivity disorder (ADHD) than girls (Abdullah, 2018). Research has also show that the increase of suspensions, incarceration, and unemployment of African American males is correlated with race and gender (Gregory et al., 2010; Losen et al., 2015; Nance, 2016; Wolf & Kupchik, 2017). Jung & Poole (2006) posit that the disparity between suspensions for African Americans and White students is significantly linked to race, and that for African American boys it is due to the intersection of gender and race.

Next, I concentrate the conversation on Black men in higher education on the specific context of undergraduate engineering programs.

1.1.3 Black Men in Undergraduate Engineering Programs

Black students are one of the least represented racial/ethnic groups in engineering. In 2017, Black students accounted for 4.5% of undergraduate engineering enrollment, with 4.1% of bachelor’s degrees awarded in engineering, despite making up 13.4% of the U.S. population (Bureau, 2018; Yoder, 2017). Regarding bachelor’s degrees awarded, Black or African Americans show increasing trends from the 1980s to the early 2000s; however, their percentages have now stagnated (Education, 2016; Yoder, 2017).

Engineering programs, where interpersonal relationships are essential for persistence, are challenging environments for Black men to navigate (Martin-Dunlop & Johnson, 2014; Palmer et al., 2011). Given the barriers that Black men face in their undergraduate engineering programs, several researchers have highlighted the various forms of support that Black men leverage to persist. Examples include family support, adequate college preparation, and proper coping strategies (Hendricks, 2015; Moore III et al., 2003; Yohannes-Reda, 2011). Nonetheless, subtle reminders of the racial hierarchy on college campuses (e.g., racial stereotypes and microaggressions from society, the institution, instructors, and peers) can influence how African American engineering students experience and respond to their college experiences (Mcgee & Martin, 2011).

Recognizing the impact of interpersonal relationships on the experiences of Black men in engineering, I will now further the conversation on the interpersonal relationships of Black men.

1.1.4 Importance of Interpersonal Relationships for Black Men in Engineering

An interpersonal relationship refers to an acquaintance, association, or connection between two or more people. Interpersonal relationships are essential for students' navigation of college, including phases of entering college, navigating college, or leaving college (Evans et al., 2010). Relationships are especially important during significant transitions in the life of a student as they can influence learning (Bowles, 2008) and the transition to adulthood (Jager, 2011). Examples of college-specific interpersonal relationships include those between students and their peers, faculty members, and other college personnel (Evans et al., 2010; Pascarella & Terenzini, 2005). The types of relationships that students engage in can be classified according to their sources, such as: family units (Bowles, 2016; Howard, Nicholson, & Chesnut, 2019; Toldson, 2008; Wadsworth & Santiago, 2008), a network of friends or peers (Bemak et al., 2005; Bonner & Bailey, 2006; Demetriou et al., 2019; Mayer, 2008; Stewart, 2007), teachers or instructors (Baker, 2006; Barber & Torney-Purta, 2008; Ewing & Taylor, 2009; Gasman & Anderson-Thompkins, 2003; Palmer & Gasmna, 2008), and other sources, such as fraternities or role models (Mondisa & McComb, 2015; Trenor, Grant, & Archer, 2010). Ultimately, a student's college experience is impacted by the various people they interact with through their personal networks.

For Black men, interpersonal relationships impact experiences in and navigation of educational environments. For example, Hotchkins (2016) found that social and extracurricular relationships can act as a protective barrier to lessen the effect of microaggressions experienced by African American males. Given the importance of interpersonal relationships in students' educational experiences and the marginalization of Black men in engineering, my work examines the interpersonal relationships experienced by Black men in undergraduate engineering programs.

Next, I describe the purpose and research questions of my study. I introduce relevant terminology for the study as well as provide a brief overview of my theoretical framework.

1.2 Purpose and Research Questions

The purpose of this exploratory research study is to understand how Black men experience interpersonal relationships in undergraduate engineering programs. The overarching research question that guides this study is: *What are the qualitatively different aspects of interpersonal relationships experienced by Black men in undergraduate engineering programs?* The sub-research questions are:

RQ1: What are the types of relationships Black men utilize in their undergraduate engineering programs?

- RQ2: How do Black men perceive interpersonal relationships in their undergraduate engineering programs?
- RQ3: What kind of variation exists across institutional experiences?
- RQ4: How do environmental influences impact the interpersonal relationships of Black men in undergraduate engineering programs?

I answered these questions using a quasi-phenomenography methodology. I chose this methodology because phenomenography allows the researcher to qualitatively map the different ways people experience, conceptualize, perceive, and understand various aspects of the phenomena and the world around them (Marton, 1986). This approach allowed me to better understand the phenomenon, i.e., how Black men experience interpersonal relationships in engineering. Traditionally, a phenomenography does not use theory when it comes to interpreting results; however, I used theory (discussed below) to assist with mapping the various interpersonal relationships as well as their impacts on Black men. Through semi-structured interviews, I explored the differences in students' experiences and further understood the dynamics of the relationships of Black men in undergraduate engineering programs.

1.2.1 Definition of Terms

Throughout this document, I will consistently refer to the terms below. Each of the terms will be used based on the article cited.

- *African* – African refers to a person who is of African descent and was born in Africa.
- *African American* — African American is defined as a person who is of African descent and was born and raised in the United States.
- *Black*— Black is often defined as a person's race or skin color. The term is sometimes used synonymously with African American.
- *Ethnicity* – Ethnicity refers to a group of people who share a common identity-based culture, language, and/or ancestry that is often based on migration or colonization (Cornell & Hartmann, 2007).
- *Interpersonal Relationship* – Social and/or emotional interaction between two or more individuals
- *Race* – Race refers to the self-identification with one or more social groups (Bureau, 2017). It is generally about the origin of people. Race in the U.S. can be viewed as a social construct that evolves over time that has been shaped by reported data from federal agencies

(Council, 2004). The U.S. Office of Management and Budget defines five major racial categories: American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian and other Pacific Islander, and White (Council, 2004). Accordingly, the racial categories are social-political constructs and should not be interpreted as scientific or anthropological (Affairs, 1997).

1.3 Theoretical Foundation

I used *Bronfenbrenner's Ecological Systems Theory* as a lens to view and understand the different relationship types of Black men in undergraduate engineering programs. Ecology is the study of relationships of living things with their environment and each other (Shelton, 2018). An ecological framework is unique in that it takes into consideration individual differences in holistic student development (Patton et al., 2016). Bronfenbrenner used the word ecology to emphasize the embedded and holistic nature of human development (Hayes et al., 2017). Bronfenbrenner's ecological model attempts to understand the influence of context-specific person-environment interactions that influence an individual's development (Bronfenbrenner, 1993). In essence, the theory is composed of two main ideas: 1) personal experiences cannot be disconnected from the settings in which they occur; and 2) individuals are shaped by their social contexts. Ecological systems theory posits that developmental changes occur through relationships between an individual and the ecological levels of their environment (Bronfenbrenner, 1979, 1989, 1993). Overall, this theory alludes that, "a person exists in a system of relationships, roles, activities, and settings all interconnected" (Shelton, 2018).

Bronfenbrenner's work emphasizes the following four factors for understanding student development over time: process, person, context, and time—hereafter referred to as PPCT. *Process* refers to the interactions between the individual and the environment (Bronfenbrenner, 1993). *Person* includes the characteristics or attributes that are likely to shape an individual's course of development (Bronfenbrenner, 1993; Patton et al., 2016). *Context* is composed of four levels that influence, and are influenced by, an individual (Bronfenbrenner, 1989). And lastly, *time* represents the change of an individual's ecology over time (Renn & Arnold, 2003). Each of the PPCT components interact with each other to create a student's environment (Patton et al., 2016).

1.3.1 Application of Bronfenbrenner's Ecological Systems Theory

Bronfenbrenner's theory is particularly useful in studying how Black men experience interpersonal relationships at their undergraduate institution because it heavily emphasizes how a variety of factors—

such as the evolution of time, the environment, and relationships with others—impacts a person’s development. Given the stress on time, the environment, and relationships, I primarily used the context component as it explores each of these factors. More specifically, I used Bronfenbrenner’s theory to help me map the participant responses. This analysis provided a systems-level analysis of the relationships Black men engaged with at their institution.

The context component of Bronfenbrenner’s Ecological Systems Theory (see Figure 1) details each of the five systems: microsystem, mesosystem, exosystem, macrosystem, and chronosystem. The microsystem and mesosystem are where interpersonal relations and interactions between people occur (Hayes et al., 2017). The microsystem includes significant relationships (e.g., parents, teachers, mentors, peers, and associates) who are most likely to influence the values of an individual (Bronfenbrenner, 2005a) while the mesosystem encompasses the exchanges between the people in the microsystem (Bronfenbrenner, 2005b). Hayes et al. (2017) argues that Bronfenbrenner’s theory looks beyond the development of an individual by considering other factors such as the context of the environment and societal factors.

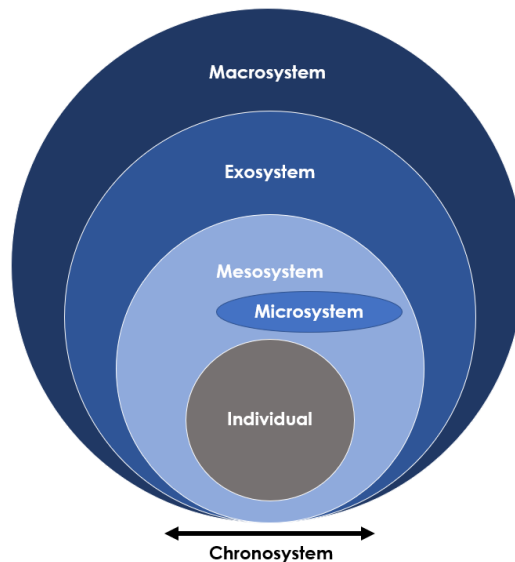


Figure 1 - Adapted visual of the context portion of PPCT

1.4 Overview of Research Design

To explore how Black men experience interpersonal relationships in undergraduate engineering programs, I conducted a quasi phenomenography. In a phenomenography, the aim is to explore the

variation within a group instead of a singular experience (Marton, 1981). Phenomenographic research attempts to reveal the complexity of educational settings and situations in order to generate significant and useful inferences (Trigwell, 2000). A quasi phenomenography allowed me to use theory to help explore the role of the environment on the interpersonal relationships of Black men.

A phenomenographical study consists of two expected outcome classifications, referred to as categories of description and outcome space. *Categories of description* refers to the individual responses or interpretations that members of a larger group experience during a phenomenon (Akerlind, 2005b; Turner, 2015). The categories of description are organized into logical, structural relationships from less comprehensive to more comprehensive, otherwise known as an outcome space (Akerlind, 2005b). The *outcome space* provides a holistic way of understanding how the participants experience a phenomena despite the variation of experiences by the participants (Akerlind, 2005b). To assist with the interpretation of the outcome space, I employed a quasi-phenomenography aspect, which included incorporating Bronfenbrenner's Ecological Systems Theory in the data analysis process.

For data collection, I worked with gatekeepers from three universities to recruit participants. I chose each institution based on the accessibility to potential participants via gatekeepers and their ability to identify Black men from a variety of undergraduate engineering programs. I conducted semi-structured interviews with 14 participants. During the interview, the participants and I co-created a figure to understand which relationship types were meaningful which also served as a form of member checking. The interviews were transcribed and followed a very iterative process.

1.4.1 Significance of the Study

My results show what types of relationships are experienced by Black men in undergraduate engineering programs. In addition to an overview of the different types of relationships that Black men experience, emphasis was given to the positive, negative, and neutral aspects of these relationships to further understand their roles. These findings advance our understanding of interpersonal relationships experienced by Black men in undergraduate engineering programs and provide a basis for future work.

First, my study is focused on Black men in undergraduate engineering programs. While several researchers have analyzed Black men in undergraduate engineering programs (Calhoun, 2014; Cross & Parette, 2015; Hayes, 2014; Moore III et al., 2003, 2004; Yohannes-Reda, 2011), my research expands current literature by understanding the various aspects of an interpersonal relationship. Specifically, the present study states who is involved in these relationships, how these relationships impact Black men, and why these relationships are impactful. By employing phenomenography in conjunction with

Bronfenbrenner's Ecological Systems Theory, my dissertation provides a novel approach to holistically exploring interpersonal relationships.

Secondly, this work provides a deeper insight into the role and culture of institutional contexts (e.g., Historically Black Colleges and Universities [HBCUs], Historically White Institutions [HWIs], Predominately White Institutions [PWIs]) for Black men in engineering. These empirical findings meet the demand for more qualitative research that describes the experience of Black men on university campuses (Harper et al., 2019; Harper, 2009; Kimbrough & Harper, 2006; Moore, 2003; Palmer et al., 2010). The identification of challenges specific to Black men can serve as the foundation for further research and actions that will increase Black men's likelihood for success in engineering programs.

Lastly, the analysis of interpersonal relationships undertaken here extends our knowledge of student retention and persistence for Black men (Kim & Sax, 2009; Museus et al., 2011; Pascarella & Terenzini, 2005). A deeper level of understanding and attention is given to the perceptions of relationships. The variety of relationships that exist as well as how a relationship might differ will provide areas to improve to create more inclusive environments for Black men (Eagan et al., 2012; Fries-Britt & White-Lewis, 2020; Suarez-Balcazar et al., 2003; Vogt, 2008).

1.5 Summary

Studies on Black men in engineering have primarily focused on their reasons for attrition, such as a weak educational background and the impact of negative stereotypes on their success. However, few researchers have extended beyond this deficit approach or examined how relationships other than role models and mentors are utilized by Black men in engineering. In order to address these literature gaps, my study explores how Black men experience interpersonal relationships in undergraduate engineering programs. Using a quasi-phenomenological approach with Bronfenbrenner's ecological systems theory, I illuminate the complexity of interpersonal relationships for Black men in undergraduate engineering programs. My dissertation generates novel insight into the various ways that Black men in undergraduate engineering programs not only utilize relationships, but provide an understanding of the roles these relationships have for Black men in their progression through engineering.

Chapter 2

2 Literature Review

In Chapter 1, I provided an overview of my research study. In this chapter, I review the literature regarding Black men in engineering and interpersonal relationships. There is a scant amount of literature that focuses on the types of interpersonal relationships that are impactful to Black men in undergraduate engineering programs. The majority of research that discusses Black men in engineering focuses on role models and mentors as examples of interpersonal relationships. This chapter highlights gaps in the literature and challenges to understanding the interpersonal relationships of Black men in undergraduate engineering programs. I begin by providing an overview of Bronfenbrenner's Ecological Systems Theory before going into each of the systems of the theory. As I discuss each system, I will also explore relevant literature pertaining to Black men in engineering.

2.1 Bronfenbrenner's Ecological Systems Theory

Urie Bronfenbrenner was a developmental psychologist who had a strong interest in the roles of family support and early childhood education. He was heavily involved in public policy and supported the idea that it takes the support and involvement of the entire society to successfully raise a child (Hayes et al., 2017). In 1964, Bronfenbrenner and Edward Zigler were appointed by the Office of Economic Opportunity under President Lyndon B. Johnson to establish a project that would assist disadvantaged preschool children (Hayes et al., 2017). This project was later announced as Head Start—a federally funded program that aimed to increase the success of students and families from low-income backgrounds (Tregaskis, 2015). As co-founder of Head Start, Bronfenbrenner created a program that would be flexible with the dynamic interplay of interactions that families from impoverished backgrounds might face (Tregaskis, 2015) as well as focus on the interactive instead of additive effects of family and peer influences (Renn & Arnold, 2003). In the 1970s, Bronfenbrenner ideas regarding student development began to take shape into his ecological systems theory.

Bronfenbrenner's Ecological Systems Theory is largely based off of the notion of an ecosystem. An ecosystem perspective considers interactions as a means to view how students engage with the system, each other, and other networks (Cheville, 2017). In addition, an ecosystem perspective encourages the

researcher to understand the ways students interact with each other as well as their environment (Lord et al., 2019). According to Bronfenbrenner,

the ecology of human development involves the scientific study of the progressive, mutual accommodation throughout the life course, between an active, growing human being and the changing properties of the immediate settings in which the developing person lives, as this process is affected by relations between these settings, and by the larger contexts in which the settings are embedded (Bronfenbrenner, 1989, p.188).

Before Bronfenbrenner's theory was ultimately established as an ecosystem, his work went through three iterations. The first iteration focused on the role of context in student development; the second iteration focused on recognizing the active role of the student; and the third, and final, phase emphasized the process-person-context-time (Hayes et al., 2017). Phase 3 is discussed further below.

2.1.1 Process-Person-Context-Time

Process-person-context-time (PPCT) is a model that is used to help explain a person's ecosystem and understand the course of human development (Bronfenbrenner, 2005b). Process, sometimes referred to as a proximal process, is the dynamic relationship between the person and their environment (Bronfenbrenner, 2005b). Process includes the ongoing reciprocal interactions between the person and the people, objects, and symbols in a microsystem (Jaeger, 2016). Person is comprised of one's biological, cognitive, emotional, and behavioral characteristics (Bronfenbrenner, 2005b). Context encompasses the environment of the four connected systems (Bronfenbrenner, 2005a). Time is understood as multiple dimensions of temporality (or a state of existing in time) that can be broken down into the micro, meso, and macro levels (Bronfenbrenner & Morris, 1998). My study primarily focuses on context of the PPCT model because it allows me the flexibility to explore the multiple dimensions of the interpersonal relationships experienced by Black men as well as understand the role of the environmental context. Context is explained in more detail below.

2.1.1.1 Context

There are four levels of context that influence and are influenced by an individual, creating a person's ecology: microsystem, mesosystem, exosystem, and macrosystem (Bronfenbrenner, 1993; Renn & Arnold, 2003). The microsystem refers to parents, teachers, friends, or other people in one's inner circle as well as the immediate setting that includes the person (Bailey, 2017). The family is the most familiar microsystem for an individual (Hayes et al., 2017). Interpersonal relations are also found in

the microsystem. The mesosystem refers to lateral connections and communications between a person's microsystem (Hayes et al., 2017). The mesosystem is the intersection of two or more microsystems, which could be a student's school microsystem (e.g., instructors, janitors, peers, etc.) and their home microsystem (family members, extended family members) (Jaeger, 2016). For example, a child's parent (home microsystem) could speak at their school on Career Day (school microsystem). An exosystem refers to people who are more distant and indirectly involved in a person's development, while the macrosystem is the extant cultural and economic conditions of the society that affect an individual. The microsystem, mesosystem, exosystem, and macrosystem comprise a person's dynamic ecosystem and regularly influence human development.

2.2 Application of Bronfenbrenner's Ecological Systems Theory

Researchers have applied Bronfenbrenner's ecology model in a variety of domains. Prior studies have primarily used this theory to examine campus environments, identity, academic advising, mental health, and the home environment of various groups of people. The theory has also been used to study Black men. My study adds to how Bronfenbrenner's ecology model is currently used by applying it to a lesser explored domain, the interpersonal relationships of Black men in undergraduate engineering programs. Of the various components of Bronfenbrenner's theory, I used the various systems within context (i.e., microsystem, mesosystem, exosystem, macrosystem, chronosystem) to understand how Black men experience interpersonal relationships in undergraduate engineering programs.

Microsystems, mesosystems, exosystems, and macrosystems are nested dynamic structures and networks of interactions that create an individual's ecology. Figure 2 below provides a visual representation of the five systems. Table 1 further explains each of the systems in further detail and includes an engineering education specific example of what could possibly fall under each system.

In the subsequent sections, I summarize examples of literature that used Bronfenbrenner to study areas related to campus environments, student identity, academic advising, mental health, and the home environment.

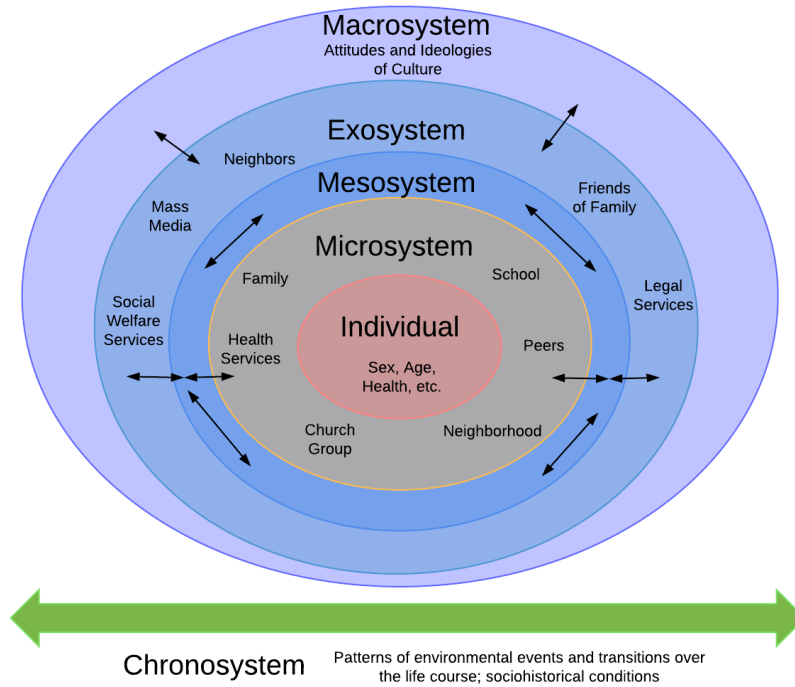


Figure 2 - Context Systems

Table 1 - Exploration of Bronfenbrenner's Systems

System	Definition	Engineering-related examples
Microsystem	<p>Activities, roles, and interpersonal relations experienced by the developing person in a given setting within a particular physical and material characteristic.</p> <p>Interaction of the people with the immediate social and physical environment</p> <p>“pattern of activities, roles, and interpersonal relations experienced by the developing persons in a given face-to-face setting with particular physical, social, and symbolic features that invite, permit, or inhibit engagement in sustained, progressively more complex interaction with, and activity in, the immediate environment.” (Bronfenbrenner, 2005b)</p>	<p>Home, family, school settings</p> <p>Calculus class</p> <p>Peer group, community group, church, recreation centers</p>
Mesosystem	<p>Interactions between various microsystems in a person’s life.</p>	<p>Relationships with people on and off campus</p>

System	Definition	Engineering-related examples
	<p>Network of interpersonal relationships that overlap across a variety of settings.</p> <p>“...linkages and processes taking place between two or more settings containing the developing person. Special attention is focused on the synergistic effects created by the interaction of developmentally instigative or inhibitory features and processes present in each setting.” (Bronfenbrenner, 2005b)</p>	
Exosystem	<p>Distal influences</p> <p>A setting that influences the development of an individual although the individual isn't directly in the setting.</p>	<p>Federal government – financial aid (work study, anxiety, stress)</p> <p>Educational policy, curriculum design</p> <p>Student's parent feels stressed at their job and the student is affected by the parent's stress</p>
Macrosystem	<p>Larger societal institutions that lay the social and historical context</p> <p>“overarching pattern of micro- meso- and exosystems characteristic of a given culture, subculture, or other extended social structure, with particular reference to the developmentally instigative belief systems, resources, hazards, lifestyles, opportunity structures, life course options and patterns of social interchange that are embedded in such overarching systems” (Bronfenbrenner, 2005b)</p>	<p>Government, media, political philosophy</p> <p>Meritocratic notions, cultural understandings of race and gender</p> <p>Societal values, cultural views, expectations, and values</p>
Chronosystem	<p>Time</p> <p>Sequence of events over time</p> <p>“The individual's own developmental life course is seen as embedded in and powerfully shaped by conditions and events occurring during the historical period through which the person lives.” (Bronfenbrenner, 2005b)</p>	<p>National and global events that characterize the era, i.e., millennials, economic and cultural trends</p> <p>Time from the individual's perspective as well as historical time</p> <p>Transition from high school to college</p>

Note: Table created from (Bronfenbrenner, 1979, 1989, 1993, 1994, 2005b; Bronfenbrenner & Evans, 2000; Hayes et al., 2017; Jaeger, 2016; Patton et al., 2016)

2.2.1 Previous Theory Applications

Ecological models have been suggested for student affairs educators to understand how to shape campus environments to promote optimal growth and development for diverse student populations (Jessup-Anger, 2012). For example, Peterson (2014) used Bronfenbrenner's theory as a conceptual framework to understand residential colleges. These researchers used a quantitative, cross-sectional hierarchical linear modeling approach to understand the personal and environmental characteristics of a person's desire of life-long learning. Renn (2003) used Bronfenbrenner's theory to understand the development of White racial consciousness for White students at a Historically Black College. These researchers used Bronfenbrenner's theory to contextualize the intersections of race, gender, and the environment through in-depth interviews and observations.

A plethora of researchers have also used Bronfenbrenner's theory to study identity. Guardia & Evans (2008) mapped the interactions of mixed-race students within and between the environments using Bronfenbrenner's PPCT Model to explore the influence of postsecondary environments on multiracial identity. They used open-ended interviews, a focus group, and written response exercises to collect data from participants at three universities. Guardia & Evans (2008) used Bronfenbrenner's Ecological Systems Theory to understand how membership in a Latino Greek fraternity at a Hispanic Serving Institution encouraged members' ethnic identity development. They used a phenomenological approach in conjunction with semi-structured interviews and a focus group with seven participants of the Latino fraternity.

Some researchers have used Bronfenbrenner as a lens to understand the various interactions that exist during academic advising (Stebbleton, 2011; Zhang, 2018). Stebbleton (2011) looked at the academic advising of international students at a Texas community college to understand how their experiences were shaped by an individual's backgrounds and environmental influences. Through semi-structured, open-ended interviews with academic advisors and students, the researchers found factors in each subsystem that influenced an international students' experiences in advising and academic success. Langhinrichsen-Rohling et al. (2011) used Bronfenbrenner's theory to understand how immigrant college students interact with their environment including exchanges with academic advisors which impacts their student development, success, and retention. They used published studies on immigrant college students to create an illustrated model that can be used for academic advising.

Related to the topic of mental health, Schwebel & Brezausek (2007) looked at four of Bronfenbrenner's ecological levels to see how they are associated with an increased or decreased risk for suicidal ideation of active-duty US air force members. Using survey data of over 52,000 active-duty

members, it was found that there should be multiple levels of influence to address suicide prevention. Lastly, pre-college studies have used Bronfenbrenner's theory to identify relations between the home and out-of-home child care environments and the risk for injury. Bailey (2017) used the microsystem and mesosystem aspect of Bronfenbrenner's ecological model to understand the role of the environment on a child's development of over 800 children in a longitudinal investigative study.

2.2.2 Applications with Black Men

Researchers have also used Bronfenbrenner's theory to understand African American men. For instance, Bush & Bush (2013) looked at why African American men leave or avoid STEM majors. Using a dataset of 14 interviews of African American males who left STEM majors or avoided majoring in STEM, the researcher looked at factors that push students away from majoring in STEM and factors that pull them towards non-STEM majors. Bronfenbrenner's theory was used to help code interview responses under each of the contexts in order to understand how racism, stratification, and inequality affects African American male academic outcomes.

Though not selected as my theoretical lens, it is important to also note that African American Male Theory (AAMT) has been used to look at Black men. Figure 3 below is a diagram of the AAMT model, which builds on Bronfenbrenner's ecological theory. Bush and Bush created AAMT as a means to theorize the experiences of African American men and boys (Bush & Bush, 2013). Composed of six tenets, AAMT uses Bronfenbrenner's ecological theory along with African philosophy to explicitly undermine oppression (Bush & Bush, 2018). The six tenets of AAMT are:

1. The individual and collective experiences, behaviors, outcomes, events, phenomena, and trajectory of African American boys and men's lives are best analyzed using an ecological systems approach
2. There is something unique about being male and of African descent
3. There is a continuity and continuation of African culture, consciousness, and biology that influence the experiences of African American boys and men
4. African American boys and men are resilient and resistant
5. Race and racism coupled with classism and sexism have a profound impact on every aspect of the lives of African American boys and men
6. The focus and purpose of study and programs concerning African American boys and men should be the pursuit of social justice

Each of the six tenets collectively strives to achieve social justice for African American boys and men. AAMT was considered as a possible theory to use instead of Bronfenbrenner’s model. AAMT was designed to challenge current deficit narratives of African American men and boys. According to the authors, while there are non-deficit frameworks and approaches, they are still deficient. AAMT encourages researchers to re-examine current deficit and non-deficit approaches (Bush & Bush, 2018).

Although AAMT uses Bronfenbrenner’s five systems, AAMT differs in three ways. First, AAMT divides the microsystem into an inner and outer microsystem. The inner microsystem is composed of an individual’s biology, personality, perceptions, and beliefs while the outer microsystem includes the family, peers, neighborhood, and school environments. Secondly, the mesosystem includes linkages between the inner microsystem, outer microsystem, and an additional system called a subsystem. Third, the subsystem is comprised of matters relating to the supernatural and spirit, collective will, collective unconscious, and archetypes. Each of the three additions to Bronfenbrenner’s original model allows AAMT to be elastic in nature to capture the outcomes, behaviors, and experiences of African American men and boys (Bush & Bush, 2018). The subsystem considers the studies that have suggested that spirituality is important for African American men and boys (Bronfenbrenner, 2005b).

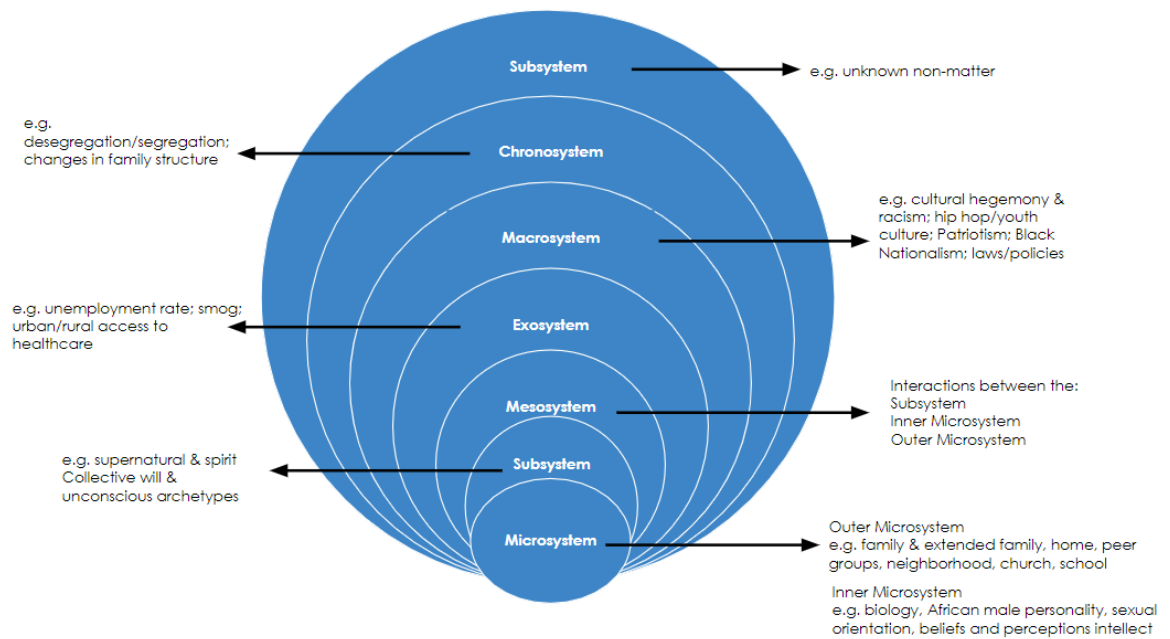


Figure 3 - African American Male Theory (AAMT) Model

My biggest reservation of using AAMT as a starting point instead of Bronfenbrenner was because it would introduce more bias into the study. When conducting a phenomenography, the researcher should try to limit outside literature when it comes to analyzing the results. Outside literature can disrupt the integrity of the participant's responses and encourage an analysis that is fueled by prior literature which may or may not be applicable to the experiences of a participant. On similar lines, I did not include AAMT as the underpinnings of AAMT are themes related to social justice, anti-racism, and an emphasis on men and boys of African descent. Using this theory would introduce bias by assuming study participants had each of these influences. Furthermore, because my study is focused on Black men in engineering at different institutions, I wanted to remain open to all possible areas of exploration. Overall, AAMT implies certain aspects of the Black men experience that might not be salient for all Black men, and it is for these reasons that I used Bronfenbrenner's Ecological Theory instead.

The next section is divided into four parts: (1) Interpersonal relationships (2) Black men in society; (3) Black men in education; and (4) Black men in engineering. Each part begins with a brief overview of the Bronfenbrenner's systems that are germane to each part before relevant literature is discussed.

2.3 Interpersonal Relationships (Microsystem and Mesosystem)

Interpersonal relationships are found in both the microsystem and mesosystem. The microsystem includes aspects of the environment that directly or indirectly impact and/or influence the daily life of a person (Bronfenbrenner, 2005b). This system can also include social, physical, and symbolic elements of a person's environment via the pattern and roles of their interpersonal relationships (Bronfenbrenner, 2005b; Hayes et al., 2017). The microsystem includes people who have a high importance to the individual, which could be ties to their family, school, home, neighborhood, and/or classroom (Bronfenbrenner, 2005b). The mesosystem includes the interactions that individuals have between microsystems: in sum, it is a system of microsystems (Bronfenbrenner, 2005b). The mesosystem normally refers to the linkages between two or more spheres, such as home and school (Swenson et al., 2008). In the section that follows, I discuss interpersonal relationships and elaborate on four types of interpersonal relationships that can be found in the micro- and mesosystem before concluding with a summary.

2.3.1 Interpersonal Relationships

Throughout existing literature, researchers have discussed different types of relationships that are important when it comes to the student experience. For example, for students who are transitioning

from high school to college, it is ideal to have close high school friendships during the first few weeks of college; however, there are more benefits to having a close relationship with a new college friend (Kerckhoff, 1986). While family and peer relationships can influence the values, opinions, attitudes, and skills relevant to the formal educational process (Baker, 2006; Ewing & Taylor, 2009), other types of relationships can also impact a student's experience. As discussed earlier, I expand on four types of relationships: (1) teachers, (2) family, (3) peers and (4) others.

2.3.1.1 Teachers

Within education, instructors, at all grade levels, play a massive role based on the relationships they form with their students. Several research studies posit the importance of teacher-student relationships in the development of a child. Research related to the teacher-student relationship has shown associations between the quality of the relationship in regard to closeness, conflict, and dependency of the teacher and student as it relates to the students' early school adjustment (Mcgrath & Bergen, 2015; Rudasill et al., 2010). From early education to secondary, research has found similar cases of how society, specifically instructor perceptions, impact an instructor's engagement and relationships with their students, specifically male students (Baker, 2006; Birch & Ladd, 1997; Pianta, 1999). Overall, teacher-student relationships with high degrees of trust are associated with positive school adjustment, and academic outcomes and those with low degrees of trust are associated with low school adjustment, academic outcomes, and more teacher-student conflicts (Masten & Coatsworth, 1998; Wadsworth & Santiago, 2008).

2.3.1.2 Family

Relationships with family members, especially parents, plays a vital role for typical and extreme challenges experienced by children (Wadsworth & Santiago, 2008). For example, Bowles (2016) suggest that families in poverty can instill resiliency in their children and assist to break cycles of family economic stresses. In addition, relationships with parents and siblings have been found to be most beneficial for an adolescents' social support (Howard, Nicholson, & Chesnut, 2019). Parents also play an important when it comes to student success in college (Toldson, 2008). For Black males, parents' expectations and involvement has demonstrated a positive statistical relationship with academic success (Adams & Blieszner, 1995; Newcomb & Bagwell, 1995; K. H. Rubin et al., 1998). Taliaferro & DeCuir-Gunby (2008) further explored the impact of parental involvement on the academic mobility of African American students. The authors found that many African American parents of low- and high-achieving

Black students were unaware of their child's exclusion from advanced placement courses and how they could advocate for their child to be included in those courses.

2.3.1.3 Peers

Peers play a vital relationship for children, adolescents, and adults (Astin, 1993; Chickering & Reisser, 1993). In the context of school, peer relationships can influence student development and satisfaction with an institution (Kerckhoff, 1986). Peer relationships can also affect cognitive and social skills as well as academic motivation (Bonner & Bailey, 2006; Harper, 2006; Palmer & Gasmna, 2008; Strayhorn, 2008). Research suggests that African American college men who have supportive peer relationships have higher levels of satisfaction and academic success (Bemak et al., 2005; Hallinan & Williams, 1990; Mayer, 2008; Stewart, 2007; Toldson, 2008). Positive peer interactions have been associated with high levels of academic achievement and college aspirations for Black males (Gasman, 2011). African American men in STEM fields tend to have best peer relationships, which at HBCUs are easily accessible due to the large amount of African American men that attend these schools (Trenor et al., 2010).

2.3.1.4 Other Relationships

Other types of relationships that are important include those with romantic partners, members of organizations, and role models. For example, membership in a Black Greek-lettered organization has been shown to provide their members with emotional support for academic achievement and persistence in engineering (Mondisa & McComb, 2015; Seymour & Hewitt, 1997). Some research has further looked into the value of relationships and has emphasized the importance of having a role model, especially when it pertains to being successful in engineering and STEM (Griffith, 2010; Lichtenstein et al., 2014; Shaw & Barbuti, 2010). In addition, a lack of seeing a role model that looks like oneself has been shown to impact the ability to persist in engineering (Hurtado et al., 2010; Lewis, 2003) especially for American Indians, African Americans, and Hispanic/Latino students (Hayes et al., 2017). In order to further understand the impact of interpersonal relationships within the microsystem and mesosystem, I turn to the next level of Bronfenbrenner's Ecological Systems Theory, the exosystem.

2.4 Black Men in Education (Exosystem)

When discussing the exosystem, I focus on Black men in both higher education and engineering education. The exosystem includes items that have a lesser influence or indirectly affect the person.

Examples of such items could be conditions that influence the wellbeing of the adults in a student's life, such as a parents' workplace and educational policy (Brown & Hurst, 2004; Saenz & Ponjuan, 2011). Although students are not directly involved at this level, they may feel positive, negative, or neutral impacts. In order to further understand the exosystem, I focus on policy within higher education as well as HBCUs and PWIs. I provide applicable literature that pertains to Black men and their educational attainment in each of these areas.

2.4.1 Higher Education and Policy

Compared to their female counterparts, African American men and boys trail when it comes to college access and degree attainment (NCES, 2000); this disparity is evident as early as elementary school. By third grade, Black boys are 1-1.5 years behind Black girls in their reading and writing abilities (NCES, 2006); and by grades 4-8, they are twice as likely to be held back a grade level Neal (2006). There are even more disadvantages when comparing Black and White people. In an extensive study on the skill gaps between Blacks and Whites, Coleman (1966) concludes that it is unlikely that there will be skill parity with regard to educational attainment of Blacks and Whites over the next several generations. The educational attainment of African American males is connected to the hardships they face in society (Obama, 2007).

In regard to policy, Black men have been a topic of concern for quite some time. In 2007, the Joint Economic Committee of the United States House and Senate submitted a record that discussed the status of African American men by saying:

The data reveals that more than half of all African-American boys in some cities do not finish high school, and half of all Black men in their 20s are jobless. The unemployment rate for young African American men is over twice the rate for other groups of men. One study a few years ago found more Black men in prison than enrolled in college... Despite these gains, however, there remains a growing disparity, particularly concerning African-American men, with respect to educational achievement and labor force participation...The crisis of the Black male is our crisis whether we are Black or White, male or female...The failure of government policies to recognize Black men as husbands, fathers, sons and role models cannot be tolerated any longer. We need new policies that deal with the breakdown of families, close the educational achievement gap, promote high-wage employment, and reduce racial discrimination... (Noguera, 2003)

As shown above, the educational and workforce plight of Black men and boys is a Nation-wide concern. There needs to be a larger emphasis on closing the gaps that exist between Black men and other groups, such as educational achievement and labor force participation.

Despite the vast amount of social pressures and obstacles mentioned above, Black men can navigate institutional structures (Toldson et al., 2009); however, they can be difficult for Black men to successfully navigate. For example, in 1940, 1.42% of Black men had a college degree compared to 5.8% of White men; and by 2007, the number of Black men with a college degree increased to 15% while White men increased to 31% (Berhan et al., 2018; M. Bonous-Hammarth & Boatsman, 1996; Chen et al., 2014a; Outcalt & Skewes-Cox, 2002). While the increase is smaller for Black men than White men, progress was still made. As such, Black men have often sought a variety of institutional environments to assist with their educational journey. Two specific institutional environments that I discuss are HBCUs and PWIs. Each of these institutional environments warrant a needed conversation as research on these environments has shown a variety of differences and my study includes participants from both of these environments.

2.4.2 HBCUs & PWIs

Institution type is regularly found to influence Black men's experience in higher education. Several studies have focused on understanding the experiences of Black STEM students, comparing students at Historically Black Colleges and Universities (HBCUs) and Predominately White Institution (PWIs) or Historically White Institutions (HWIs) (Berhan et al., 2018; Bonus-Hammarth & Boatsman, 1996; Chen et al., 2014; Outcalt & Skewes-Cox, 2002). Bonus-Hammarth & Boatsman (1996) conducted a comparative study of factors that affect the social and academic well-being of African American students in engineering at a PWI and HBCU, specifically a student's sense of belonging to an institution and profession, engineering identity, Black identity, and support mechanisms of NSBE members and non-NSBE members. It was found that there is a need for PWIs to have culturally inclusive environments and organizations like NSBE to help African American students alleviate feelings of alienation.

Chen et al. (2014) conducted an extensive study of African American students at HBCUs and PWIs. Looking at the results of African American students on a freshmen survey, it was found that African American students reported lower levels of satisfaction at PWIs than HBCUs. The level of satisfaction of African Americans at HBCUs was higher than any ethnic group at PWIs. Overall, the results suggest that the campus environment is related to higher levels of satisfaction especially for African American students.

Outcalt & Skewes-Cox (2002) examined the level of student engagement and satisfaction of African American students at HBCUs and PWIs. Using a National Survey of Student Engagement, Chen et al. (2014) found that of 3,287 African Americans at 26 HBCUs and 126 PWIs of similar Carnegie institutional classification, a supportive campus environment is the most significant factor for student satisfaction. These researchers also found that African Americans who attended HBCUs with a higher perceived level of academic challenge were more satisfied students.

In a comparative study of the involvement, interactions, and satisfaction of African Americans at HBCUs and HWIs, African Americans at HBCUs had higher levels of academic involvement, such as engaging in tutoring other students (Brown et al., 2004; Brown et al., 2005; Von Robertson & Chaney, 2017). However, fewer students at HBCUs participated in intramural sports, belonged to racial and cultural organizations, and took ethnic course studies. The authors posited that the decreased level of engagement in such activities at HBCUs was because African American students felt that the climate was more supportive and there was a decreased need to engage in such activities. In regard to satisfaction, African American students at HBCUs were more satisfied with the racial/ethnic diversity of their faculty and the sense of community than African American students at PWIs. However, African American students at HBCUs were less satisfied of the student services available, such as financial aid, career placement, and community service opportunities. Overall, it was found that HBCUs provided more satisfaction for the interpersonal environments of African American students.

Moving from individual studies to larger themes, overall research shows that the experiences of Black students at PWIs seem to be less favorable than those at HBCUs. Researchers have found that Black men's experiences at HWIs include higher occurrences and perceptions of racism, racial microaggressions, and devaluation of the African American experience by faculty and the university Harper, (2009). This distinction is further exemplified by Harper (2009)'s phrase, *niggering*. Niggering involves the, "reinforcement of racist stereotypes that stigmatize them [Black men] as dumb jocks, Black male criminals from the local community who do not belong on campus, affirmative action beneficiaries who were undeserving of admission, and at-risk students who all emerge from low income families and urban ghettos" (p. 261). According to Strayhorn (2009; 2011), African American men at PWIs often experience niggering and similar encounters. Thus, in order to further understand the unwelcoming environment created in engineering (Education, 2007), I move into another area in the exosystem, Black men in engineering.

2.5 Black Men in Engineering (Exosystem)

In this section, I continue the conversation about Black men in higher education by focusing on Black men in STEM with an emphasis on engineering. I begin by numerically illuminating the field of engineering before diving into some of the criticisms of the culture of engineering. The remaining portion of this section discusses literature about the experiences of Black men in engineering.

According to the National Center for Educational Statistics, 24% of underrepresented minorities earn STEM degrees within six years, compared to 40% of White students (Riegle-Crumb et al., 2019). However, the low degree attainment is not solely due to a lack of interest in the field. As of 2010, 65.3% of Black students who initially showed interest in pursuing a STEM degree did not graduate with a STEM bachelor’s degree placing the Black student STEM retention rate at about 34% on a national scale (Adelman, 1999; Bonous-Hammarth, 2000). Table 2 below shows the percentage of Black or African American engineering bachelors, masters, and doctoral degrees and the percentage of Black or African American faculty. As shown in Table 2, Black students are exposed to a small percentage of Black or African Americans at various levels from undergraduate to graduate and even as faculty within engineering. Thus, the culture of engineering impacts the engineering experiences of Black men that extends beyond inadequate pre-college preparation (Anderson, 2011).

Table 2 - Percentage of Degrees of Black or African American Engineering Students and Black or African American Faculty adapted from (Yoder, 2017)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Bachelor’s Degrees	4.7%	4.6%	4.5%	4.2%	4.2%	4.3%	3.5%	4.0%	3.9%	4.1%
Master’s Degrees	4.6%	4.8%	4.7%	5.1%	4.9%	4.7%	4.7%	4.4%	4.7%	4.7%
Doctoral Degrees	3.2%	3.8%	4.4%	3.5%	4.1%	4.1%	3.6%	3.2%	4.4%	3.8%
Faculty	2.5%	2.5%	2.5%	2.5%	2.7%	2.6%	2.5%	2.5%	2.3%	3.1%

Black men are widely approached with a deficit model, and often have to prove themselves to be law-abiding and trustworthy (Maton et al., 2011). Black men tend to have to prove themselves to be academically equal to their peers while being a victim to the effects of discrimination and prejudice at

the individual and systemic levels (Mcgee & Martin, 2011). This reality is particularly evident in engineering, where Black students are often in a heightened state of awareness of how their racial identities are undervalued and constantly under attack (Leslie et al., 1998; Seymour & Hewitt, 1997; Treisman, 1992).

2.5.1 Engineering Culture

Engineering consistently receives criticism for how it educates students and the culture it produces. Conventional approaches in engineering are “survival of the fittest” and “weeding out the weak” mentalities (Armstrong & Thompson, 2003; Leslie et al., 1998; Seymour & Hewitt, 1997; Suresh, 2006; Treisman, 1992; Weston et al., 2019). These mentalities encourage a perspective where a student’s success is solely dependent on their skills, placing minimal responsibility on the institutional for fostering a student’s success (Tonso, 2006). Each of these mentalities further places engineering as a field with unspoken hierarchies (Leonardi et al., 2009). An engineering identity is created from the campus environment and is often passed on from faculty to senior engineering students all the way to first-year students (Alsubaie, 2015). An example of how an engineering identity can be passed on to others is the notion of a hidden curriculum. Hidden curriculum refers to the premise that there are unspoken, implicit behaviors, procedures, and norms that exist in an educational setting that are often unknown to students (Jerald, 2006), yet indirectly conveyed in the words and actions of people in society (Villanueva et al., 2018). Within engineering, the hidden curriculum is even more critical to understand for underrepresented populations as it influences the degree of engineering persistence (Education, 2016).

In addition, engineering culture is not the same across institutional contexts. The majority of STEM education research published on HBCUs tends to highlight positive implications of attending an HBCU, such as higher GPA and overall positive experience. On average, HBCUs produce 27% of African American students with bachelor’s degrees in STEM (Brown, Morning, & Watkins, 2004). Below I discuss the results of an in-depth individual study.

Brown, Morning, & Watkins (2005) conducted an extensive study of African American undergraduate engineering students in ABET-accredited engineering programs in the U.S on their perceptions of campus climate factors in determining how it influenced their academic performance and experience. Using a quantitative and qualitative survey instrument, the researchers surveyed students who attended four conferences either sponsored or supported by the National Society of Black Engineers (NSBE). They found that students rated their perceptions of their campus climate mostly

positive, with only 30% reporting a negative perception regarding racism and discrimination. However, the authors attribute this low percentage due to the high percentage of respondents from HBCUs (25%) who do not as often experience this in their undergraduate experience. The authors report that more students at PWIs experienced racism and discrimination in their college environment than those who attended HBCUs. Building off of the study, Brown et al. (2005) studied the relationships between student perceptions of the campus climate factors, the graduation rate at their institution, and the academic selectivity categories of those institutions of the students described above. Gasman (2011) found that African American engineering students that attend HBCUs have a more positive view of their college experience as well as higher GPAs and lower perceptions of racism and discrimination than African American engineering students at other institutions PWIs. Climate variables were the least favorable at PWIs, although PWIs had higher graduation rates than HBCUs. The authors suggest that non-academic factors, such as financial aid, impacted the graduation rate for students at HBCUs. For Black men at HBCUs, there tend to be many efforts focused on bringing them up to college-level courses as many of their precollege educations did not prepare them for college (Borum & Walker, 2012; Burrell, 2015; Burrelli & Rapoport, 2008; Fleming et al., 2013; Lewis et al., 2011; Lundy-Wagner, 2013; Outcalt & Skewes-Cox, 2002; Owens et al., 2012).

Although literature has shown the success of Black students in STEM fields at HBCUs (National Academies of Science, Engineering, 2019), few published studies address or acknowledge the additional contextual differences associated with and among HBCUs and HWIs, such as available resources. For example, although the principal mission of HBCUs is to educate Black Americans, there are more nuances among HBCUs. HBCUs can differ in terms of the income, enrollment intensity, and academic preparation of their students (National Academies of Science, Engineering, 2019). It follows then that standard institutional accountability metrics often fail to consider contextual factors that are important at minority serving institutions such as HBCUs. Examples of contextual factors that are often overlooked include: students' financial circumstances, life stage, work and family commitments, enrollment intensity, and resources (Gasman, 2011).

A large proportion of published research pertains specifically to Black women than Black men (Lundy-Wagner & Gasman, 2011). This trend also appears when it comes to the number of STEM bachelor degrees awarded. For example, in 2008, 93,860 STEM bachelor's degrees were awarded to Black women, while 48,716 degrees were awarded to Black men (Kimbrough & Harper, 2006). With that said, there is a sense of urgency for faculty and administrators at HBCUs to improve the overall experience for African American men (Hayes et al., 2017).

Lastly, I move toward the outermost edges of Bronfenbrenner's Ecological Systems Theory, the macrosystem and chronosystem to analyze Black men in society.

2.6 Black Men in Society (Chronosystem and Macrosystem)

To understand Black men in society, I turn to the chronosystem and macrosystem. The chronosystem encompasses a sociohistorical time frame that impacts the growth and development of a person (Bronfenbrenner, 2005b). A chronosystem can be specific or a series of life experiences or events (Bronfenbrenner, 2005b). The macrosystem includes items related to culture, subcultures, and the associated belief systems and lifestyles (Bronfenbrenner, 2005b). The macrosystem can be seen as a societal blueprint which includes a person's "...belief systems, resources, hazards, lifestyles, opportunity structures, life course options, and patterns of social interchange..." (Hayes et al., 2017). This level is the most removed from a person; however, items that take place in the macrosystem can still significantly influence their lives (BLM, 2019). The chronosystem and macrosystem will be discussed in regard to race. In order to address the chronosystem, I will discuss two events that impacted society. For the macrosystem, I will elaborate on cultural views and expectations of Black men.

2.6.1 Chronosystem

While there is a plethora of events that could be discussed in the chronosystem, I will limit my discussion to two events that were salient at the time of data collection: the development of a national movement and the emergence of a global pandemic. A national movement that has impacted society, especially for Black men, is *Black Lives Matter*. The movement began in 2013 with the hashtag #BlackLivesMatter in response to the acquittal of George Zimmerman in the shooting of Trayvon Martin in 2012 (BLM, 2019). Black Lives Matter is an ideology and political intervention aimed at helping Black people live in a world where they are systematically and intentionally targeted (Gander, 2019). In the U.S., Black men are 2.5 times more likely to be killed than White men by police (AJMC, 2021). Since the shooting of Trayvon Martin, there have been numerous shootings, including:

Michael Brown – 18 years old, shot to death August 2014

Eric Garner – 44 years old, chokehold to death July 2014

Tamir Rice – 12 years old, shot to death November 2014

Walter Scott – 50 years old, shot to death April 2015

Alton Sterling – 37 years old, shot to death July 2016

BLM and the reality of being more likely to be shot by a police officer (or otherwise armed civilian) can impact the development and possible interpersonal relationships of Black men in undergraduate engineering programs. Black men can be more hesitant and cautious when it comes to interacting with people of different backgrounds than their own.

Another event in the chronosystem is the pandemic of the coronavirus disease 2019 (CoVID-19). On January 21, 2020, the Center for Disease Control (CDC) confirmed the first case of CoVID-19 in the United States and on March 11, 2020 the World Health Organization declared CoVID-19 a pandemic (AJMC, 2021; Browning et al., 2021; Son et al., 2020; Wang et al., 2020; Zhai & Du, 2020). CoVID-19 brought about several negative impacts—such as increased anxiety, stress, and depressive thoughts—and will likely have long-term effects on students' health, education, and lifestyle (Hooper et al., 2020; Lederer et al., 2021). CoVID-19 has also shown more negative disparities for people from low-income backgrounds and for people of color especially Black, Latinx, and Pacific Islander populations (Anderson, 2015). Both of these events are examples of what one could find in the chronosystem. These events take place over time and have the ability to influence the development of a person.

Next, I discuss the macrosystem as the final system within Bronfenbrenner's Ecological Systems Theory.

2.6.2 Macrosystem

In the U.S., the antecedents of slavery have solidified the negative connotation and master status of the Black race (Cuyjet, 1997; Steele & Aronson, 1995). Under this notion, society's perceptions of Black men and boys have negative implications, where Black men tend to be viewed as less intelligent, less sociable, and more threatening. In addition to influencing how others view Black men, these perspectives also influence how Black men view their own intelligence and aspirations (Hrabowski & Maton, 2009; Majors & Billson, 1992). For example, research has suggested that Black men may believe and start to embody the stereotypes associated with Black men as aggressive, hypersexual, and criminals (Agenda, 2011).

Cultural views and expectations of Black men are largely fueled by society. Society creates and fuels the biases and stigmas against Black men. Of the various mediums, media representations have been shown to have the greatest impact on public perceptions and attitudes toward others (Clawson & Trice, 2000; Entman & Rojecki, 2007; Hooks, 2004a, 2004b; Noguera, 2008; Tucker, 2007). Consequently, stereotypes about Black men—e.g., violent, untrustworthy, anti-intellectual, hypersexual, absent fathers, unemployed, and positively talented in sports and music (Sue et al., 2008)—tend to start in

elementary school and follow Black men even after they are accomplished professionals (Blum, 2002; Fredrickson, 2002; Zack, 2002). Black people have been socially constructed as culturally and biologically inferior to White people and this notion continues to persist (Asante et al., 2016).

In the next section, I dive into the cultural views of Black men by exploring how society doesn't treat all Black men the exact same and there are nuances regarding the various ethno-racial categories of Black people.

2.6.3 Ethno-Racial Categories

It is important to acknowledge that there are several ethno-racial categories within the larger category of Black, such as African Americans, African or Black immigrants, and Afro Latinos. Africans and African Americans have historically had common struggles, such as gaining independence from colonizers. However, the shared experiences do not necessarily translate to a shared and mutual identification as Black people (Lao-Montes, 2007). Thus, in order to begin to understand the complexity of what it means to be Black, one must acknowledge some of the different ethnic identities that exist. In the next section, I draw attention to some of the different ethno-racial categories and scholarship pertaining to each group.

2.6.3.1 African Americans

African American generally refers to the category of Black people who are from North America, particularly the United States (Gans, 2005). Gans (2005) suggests that although other people of color are able to improve their status in the U.S., African Americans are largely unable to improve their economic and social status. As more non-White immigrant groups came to the U.S., their skin was socially whitened and they were able to move up economically and socially although their skin color never changed colors. Gans (2005) refers to this as African American exceptionalism. While other groups are able to experience social whitening and acceptance, African Americans are forced to stay in their low racial status. Despite any upward movement of African Americans to the middle class, they still experience harsher discrimination and segregation than non-White immigrants in middle class. Reasons presented for why African Americans experience exceptionalism is due to racism, fear of dark-skinned people, "Negroid" features, the mentality that because the majority of African Americans are poor they commit more crimes, and the continuous impacts of slavery (IPUMS, 2018).

2.6.3.2 Immigrants of Black Descent

The majority of Black immigrants come from Jamaica, Haiti, Nigeria, Ethiopia, Trinidad and Tobago, Ghana, Kenya, and Somalia (Faola & Roberts, 2008; Olupona & Gemignani, 2007) and tend to move into areas with established social networks (Alex-Assensoh, 2009). For example, several Ghanaians and Nigerians tend to live in Atlanta and D.C. metropolitan areas while Ethiopian and Somalians tend to live in the Minneapolis-St. Paul metropolitan areas (Alex-Assensoh, 2009; Asante et al., 2016).

A common narrative provides a unified experience of Black immigrants and U.S. native-born African Americans. However, the experiences of Black immigrants tend to be overshadowed and assumed to be synonymous with African Americans (Benson, 2006). African and Caribbean immigrants are generally classified as Black in the United States even though they experience marginalization as immigrants and Blacks (Shaw-Taylor & Tuch, 2007). In addition, several studies have alluded to the notion of role distancing of Black immigrants to other groups. Role distancing refers to when African immigrants separate themselves from stereotypes typically associated with African Americans as a way to assert their differences from African Americans. Role distancing tends to be a consistent process of, “negotiating social situations as the Other Black people in America” (Guenther et al., 2011).

Black immigrants often lean on their ethnic identity over their racial identity to maintain ethnic solidarity and increase their chances of upward mobility. Assensoh (2000) looked at how Eastern African immigrants experienced racial inequality and “negotiated and mobilized National origin, immigration status, gender, ethnicity, and religion separate from African Americans.” Compared to African Americans in the U.S., African immigrants have often had less reason to feel inferior (or oppressed) due to their race because in their culture Black people are the majority. However once in the U.S., African immigrants are positioned with a new sense of their Black identity that is rooted in the structural and systematic racism of the U.S.

2.6.3.3 Africans

African refers to a person who is of African descent and was born in Africa. The relationship between African Americans and Africans can be viewed as a pendulum that swings from conflict to cooperation, dependent on the time, historical-political context, economic context, and cultural norms (Asante et al., 2016). African Americans and Africans have different ways that they are positioned and negotiate within the existing structures of Blackness and Whiteness (Guenther et al., 2011). Several researchers discuss how, compared to African Americans, African immigrants often identify no reason to feel inferior in their culture because Black people are the majority in their home countries (Alex-

Assensoh, 2009). Compared to African Americans, African immigrants have a multitude of experiences with variations in ethnicity and to their country of origin instead of a general shared experience of racial oppression. Voluntary African immigration has introduced numerous ethnic groups that have a variety of languages, cultures, worldviews, and racial/ethnic experiences, which often notably differs from each other as well as African Americans (Alex-Assensoh, 2009). Alex-Assensoh (2009) aimed to look at the various dimensions of ethnic diversity specifically for African students. African immigrants tend to see themselves in their national or ethnic identity instead of adopting the U.S. society-imposed identity of African American or Black. Compared to African Americans, in the 1990s and 2000s, African immigrants tended to have higher educational attainment, household incomes, and rates of employment and compared to African Americans, African immigrants tend to have higher educational attainment and rates of employment (Asante et al., 2016).

Langmia & Durham (2007) looked at how African and African international students negotiate their Black racial identities in the United States. The study looked at African students who moved to the United States as international students and are currently permanent residents or naturalized U.S. citizens. The authors found that Black migrants use multiple strategies to negotiate their Black subjectivity. African students have to constantly negotiate their Black identity from their country of origin to the United States. African students who come to the U.S. have to disprove the common image of Africa while African American students gravitate toward their experiences of struggle and resistance of being in White America.

Although Africans and African Americans are presumed to have are the same race, it cannot be assumed that they have adequate cross-cultural communication. In a study, Lao-Montes (2007) analyzed the difference between African and African American undergraduate students at HBCUs. Emergent themes from the study included: intragroup stereotypical perspectives of the “other”; cross-cultural communicative tension; and a yearning for the presence, maintenance, and perpetuation of improved intercultural dialogue. African Americans categorized Africans from a biased standpoint from the subjective portrayal of sub-Saharan Africa in mainstream American media. In addition, there was hostility and ethnocentrism toward African students. Essentially, both groups of students have biased perceptions towards each other that are shaped by global discourses and the U.S. construction of African American culture.

2.6.3.4 Afro-Latinos

Lastly, it is important to acknowledge the Afro-Latino population. Afro-Latinos or Afro-Latinidad is an ethno-racial category that refers to lived experiences of people of African descent in Latino/America (Lao-Montes, 2007). In addition to lived experiences, Afro-Latinidad can also include their histories, cultures, social movements, social locations, and memories (Lao-Montes, 2007). Afro-Latinos share a connection between Africanity and Latinidad. Afro suggests the national denominations that have been used on the southern side of the American hemisphere since early 20th Century (Lao-Montes, 2007). Although Afro-Latinos are not generally included in discussions of the African Diaspora, literature often posits the unique trans-diasporic nature that Afro-Latinos have (Rivera, 2011) and even a triple consciousness of being racially Black, nationally American, and ethnically Latino (Library, 2020). For example, Arturo Schomburg was a Puerto Rican and Black male who was infamous during the Harlem Renaissance. He founded the Negro Society for Historical Research and was President of the American Negro Academy (Monforti & Sanchez, 2010; Newby & Dowling, 2008).

Compared to other groups, Afro-Latinos tend to have their Latino identities questioned by non-Black Latinos. Even though both groups have similar linguistics, the Black skin color of Afro-Latinos tends to portray them as outsiders to non-Black Latinos (Rodriguez, 2014). This phenomenon is especially seen in large cities, such as Miami and New York, where society has created an acceptance of only a specific image of an Afro-Latino (Logan, 2003; Nicholson et al., 2005). Research has shown that Afro-Latinos who identify as Black compared to other racial/ethnic groups tend to have lower rates than those who identify as another group. In the 2000 Census, Afro-Latinos had lower educational attainment, higher racial segregation, and higher poverty rates compared to those who identify as Latino, White, and other races (Agenda, 2011).

Overall material, historical, cultural, and political forces shape and constrict societal views on Black men (Du Bois, 1903). Moreover, Black men have to exist and navigate in society with a double consciousness where they view themselves through their own perspective as well as the perspective of the dominant group (Fanon, 1996). Some researchers have even extended this notion by stating that being Black is denied of one's subjective sensations and being subjected to stories about being Black that are told and imposed by White people (Asante, Sekimoto, & Brown, 2016; Cuyjet, 2006; Fries-Britt, 1998; Fries-Britt & Turner, 2001; Harper, 2004, 2005, 2006; Hotchkins, 2016). Also, research often highlights Black men as a monolithic population without addressing the various dimensions that exist among the population (Gilroy, 1993; Lao-Montes, 2007). Thus, there is an ongoing transnational cultural

construction where historical narratives, politics, and self-identifications are contested and negotiated (Levin et al., 2007).

2.7 Summary

In Chapter 2, I identified an extensive amount of literature that pertains to the experiences of Black men in the United States. Using Bronfenbrenner's Theory as an outline, I drew attention to multiple themes highlighted in literature that pertain to Black men. I defined the various types of literature on interpersonal relationships before going into Black Men in engineering, education, and society. Engineering is a field that has proven to be difficult for students to navigate especially underrepresented minorities. While the experiences of women and people of color have been extensively explored, there has not been as much attention focused on Black men who lie at the intersection of a gender majority and racial minority in engineering. Thus, I add to the scant amount of research that is focused on Black men as engineering majors by expanding on the types of interpersonal relationships that are deemed as important by Black men themselves. In doing so, I contribute to literature that advances the depth of knowledge about the interpersonal relationships of Black men in undergraduate engineering programs. Although this review on Black men is not exhaustive, this chapter provides a glimpse into literature on Black men and why it is the economic interest of society to invest more in the education of Black males (Bowden, 2000). The collection of individual data, detailing the personal experiences of each Black man involved in the study, generates significant and useful insights on the importance and prevalence of relationship-building as a success factor in undergraduate engineering programs.

Chapter 3

3 Methods

3.1 Introduction

The purpose of my study is to understand how Black men experience interpersonal relationships in undergraduate engineering programs. As a reminder, my overarching research question is: *What are the qualitatively different aspects of interpersonal relationships experienced by Black men in undergraduate engineering programs?* I will address this overarching question by answering the following sub-questions:

- RQ1: What are the types of relationships Black men utilize in their undergraduate engineering programs?
- RQ2: How do Black men perceive interpersonal relationships in their undergraduate engineering programs?
- RQ3: What kind of variation exists across institutional experiences?
- RQ4: How do environmental influences impact the interpersonal relationships of Black men in undergraduate engineering programs?

To answer these questions, I conducted semi-structured interviews with 14 Black men currently enrolled in undergraduate engineering programs to explore how they experience interpersonal relationships. To examine the influence of context, I recruited participants from Historically Black College and Universities (HBCUs) and Predominantly White Institutions (PWIs) in the Southeastern region of the country.

In this chapter, I discuss my exploratory research design aimed at understanding how Black men experience interpersonal relationships in undergraduate engineering programs. According to Creswell (2003) and King & Brooks (2017), it is imperative that researchers explicitly communicate the purpose of their study, connecting it to all areas of the research process, from initial conception of the study to interpretation of the results. In the sections that follow, I further describe my purpose and strategies for my study. I begin by addressing my positionality before going into a brief summary of my interpretivism worldview. Next, I explain my rationale for choosing a quasi phenomenography as a methodology and provide a summary of prior phenomenography applications. I then provide my research study design

and highlight my data collection and analysis. Lastly, I expound upon the measures of quality and limitations.

3.2 Positionality

Before conducting any research, one should consider their philosophical stance (or positionality) because it has implications regarding data collection and data analysis (Huff, 2008). One's positionality shapes how our problem and research questions are formed, how assumptions are explored, and how outside parties interpret the research study (Milner, 2007). To address my positionality, I am using Milner's (2007) racial and cultural awareness framework. Milner's framework is composed of four characteristics: (1) researching the self, (2) researching the self in relation to others, (3) engaged reflection and representation, and (4) shifting from self to system. Compared to other practices that encourage the researcher to detach from their racial and cultural positionality, Milner's framework pushes researchers to explore the multi-faceted levels of their own racial and cultural consciousness. In doing so, the researcher will be able to work through the seen, unseen, and unforeseen possibilities and dangers of their research inquiry (*Intersectionality*, 2020). The following section is an account of my positionality as a researcher using Milner's (2007) racial and cultural awareness framework. Following the discussion of my positionality, I describe my worldview.

3.2.1 Researching Myself

Milner (2007) provides a list of questions to engage my consciousness of the known (seen), unknown (unseen), and unanticipated (unforeseen) risks of my research inquiry. What follows is my response to Milner's (2007) question, *how do I negotiate and balance my racial and cultural selves in society and in my research?*

Through attending two PWIs, I have become increasingly aware of my racial and cultural identity. As a young (i.e., under the age of 30) Black woman with natural (i.e., Afro-textured) hair, I constantly have to balance and negotiate my racial and cultural selves in environments where I am hyper visible. Aware of how I am perceived and the implicit biases that exist about my race and culture, I determine how much of my authentic self is allowed in particular settings. My racial awareness has subsequently resulted in a critical nature, often displayed through conversations in subtle ways. For example, I am unafraid to probe a colleague about their perspective on a specific race-related stance. Nevertheless, I am also cognizant of the privilege that I outwardly display to others as a person who has been able to pursue higher education. In research, I consistently question if I am accurately representing the groups

who are studied as well as those who are discussed or used as a comparison group in my research. I want to ensure that when discussing various groups, the verbiage does not encourage an “oppression Olympics” dynamic. Oppression Olympics refers to when two or more groups, typically marginalized groups, try to prove themselves as the more oppressed group (Milner, 2007). An example of the oppression Olympics dynamic would be two groups arguing about the relative severity of the Holocaust and American slavery. In research, I try to avoid vilifying one group with the hopes of victimizing another group. In the context of my dissertation, I made sure to probe my participants when they mentioned elements of their engineering experience that impacted their race/ethnicity.

3.2.2 Researching Myself in Relation to Others

Milner (2007) urges researchers to reflect about their relationships with their intended research population. An example of researching the self in relation to others include considering issues of power, such as the power distance with studying a particular population (Milner, 2007). Below, I present my response to Milner’s (2007) question, *what are and have been some social, political, historical, and contextual nuances and realities that have shaped my research participants’ racial and cultural ways or systems of knowing both past and present?*

Admittedly, it is true that while I am a Black woman and might have similar experiences to Black men, I am in no way an expert on everything that Black men may experience. Furthermore, even though I am proposing to study engineers based off of their race, I cannot overlook the role of ethnicity. I briefly discussed the role of race, gender, and ethnicity in Chapter 1 and conducted a more thorough evaluation of these characteristics in Chapter 2. Initially, I leaned on my own social, political, historical, and contextual experiences as a Black woman to write these texts. I assumed that events such as Black Lives Matter and the Presidential election of a Black man, as well as the impact of the ever-present effects of systemic racism, influence the experiences of Black men in engineering. I also assumed that Black men regularly experience the impacts of being a gender majority and racial minority, the latter of which are often negative in nature in engineering. I was only able to confirm or deny the impact of such events for Black men once I conducted interviews with my research participants. Nevertheless, I made sure to delineate from my Black woman perspective so that I would not overshadow what current research says about Black men.

3.2.3 Engaging Reflection and Representation

The third characteristic of Milner's framework focuses on the representation and shared perspectives of the research participants. The researcher's voice does not overshadow the voice of the researched and the voice of the researched does not overshadow the researcher's voice. Also, narrative and counter-narratives are equally represented and one experience is not overshadowed for preference (Bowden, 2000; Marton, 1986). To prevent any overshadowing, I repeatedly analyzed the entire interview transcripts to ensure the voices of my research participants were correctly interpreted. In addition, my research methodology (phenomenography) instilled the notion of understanding the differences of participant's experiences (Orgill, 2012; Ornek, 2008). In phenomenography research, the researcher attempts to be neutral to their own ideas of the participants to bring about awareness and reflection of the participants of the study (NCSEE, 2017a).

3.2.4 Shifting from Myself to the System

Lastly, Milner (2007) encourages researchers to consider the broader systems that exist—including historical, political, social, economic, policy, institutional, systemic, and collective issues. The following is the response to the question, *what does the research literature reveal about the community and people under study?*

Research literature indicates several viewpoints of the community (engineering) and people (Black men) on which my study focuses. In regard to the engineering community, literature often highlights the nuanced experiences of people of color and White women compared to the dominant group, White men. In engineering, Black men often experience higher rates of workforce discrimination, although they have some of the lowest numbers in the workforce as well as degree attainment (Creswell, 2003). Research on Black men is often portrayed in a deficit role regarding their starting capital, resources, and opportunities for advancement. However, engineering is often positioned to cultivate economic potential especially for persons of color and women.

In Chapter 2, I expounded upon both engineering and Black men in further detail. Having discussed my positionality, I now advance the conversation by discussing my worldview.

3.2.5 Worldview

A worldview refers to a researcher's orientation to their own research as well as the world, and it is often shaped by a researcher's discipline area and past research experiences (Case & Light, 2011; King & Brooks, 2017). For this research study, I brought an interpretivism worldview perspective. Researchers

with an interpretivism perspective examine how the social world is experienced and understood in light of a person's subjective experiences (Creswell, 2009; Hammersley, 2013). Interpretivists gain a deeper perception of the phenomenon by seeking to discern the diverse and complex ways of seeing and understanding the world while avoiding any bias (Koro-ljungberg & Douglas, 2008).

A researcher's worldview should align with their methodology. In alignment with interpretivism, I worked with Black men to understand their experiences with interpersonal relationships. My research methodology, phenomenography, encourages the researcher to actively listen to the participant to understand their experience and not impose one's beliefs on the participants. Interpretivism encourages the researcher and participants to be partners with the hopes of understanding and deconstructing a phenomenon (Case & Light, 2011; Koro-ljungberg & Douglas, 2008). This inductive approach allows for the emergence of insights during data collection as well as data analysis (Case & Light, 2011). Interpretivism generally involves purposeful sampling in order to produce generalizability (Lincoln & Guba, 1985), allowing the reader to determine transferability to contexts of their choosing (Clough & Nutborwn, 2002). In alignment with interpretivism, I used purposeful sampling to understand the interpersonal relationship experiences of Black men.

This section has reviewed key aspects of my positionality via Milner's (2007) racial and cultural awareness framework and an exploration of interpretivism. In the next section, I present my research methodology and plans for conducting my research study.

3.3 Research Design

I explore my methodological approach, which includes an overview of why I used a quasi phenomenography for this study, the purpose of phenomenography research, and various applications of the methodology. Methodology refers to the theoretical justification for methods used in a study (Case & Light, 2011). It is imperative to explicitly address methodology because doing so encourages researchers to broaden the set of research questions they address (Cibangu & Hepworth, 2016).

I used an emerging methodology, phenomenography, to understand the interpersonal relationships of Black men. Although other emerging methodologies exist (e.g., ethnography, narrative analysis), phenomenography was selected because it enabled me to expand upon individual experiences to explore the variance that exists instead of reducing individual experiences to a single essence, which is commonly found in phenomenology studies (Case & Light, 2011). A quasi phenomenography research approach was utilized to best capture and understand the phenomenon of interpersonal relationships perceived by Black men in undergraduate engineering programs. Data analysis included traditional

phenomenographic methods as well as other methods described later. Phenomenography allows the interpersonal relationship experiences described by Black men to be at forefront of the research. Furthermore, my decision to leverage phenomenography aligns with my interpretivism worldview. Studies that follow an interpretivism viewpoint are generally inductive in nature, allowing insights to emerge throughout data collection and analysis (Akerlind, 2005a; Larsson & Holmström, 2007; Marton, 1986).

3.3.1 Phenomenography

Phenomenography was developed in the 1970s as an empirical research approach by Ference Marton and colleagues (Larsson & Holmström, 2007; Ornek, 2008; Trigwell, 2000). Phenomenography is constructed by how people view, experience, understand, or conceive a phenomenon (Marton, 1988). A phenomenon is the unit of description in a study that can be experienced or conceptualized by a subject (Ornek, 2008; Trigwell, 2000). The focus in this methodology is how a person experiences and understands the given phenomenon (Marton, 1988), which for my study is how Black men experience interpersonal relationships as undergraduate engineering students.

Phenomenography explains the relations or experiences between subjects and the world around them (Bowden, 2005; Marton, 1986). The researcher attempts to understand the differences in experiences and explore the relationships between the subject and the phenomenon (Booth, 1997; Marton, 1986). The experience is built on how the phenomenon is distinguished from its context and how the phenomenon and its parts are related to each other as described by subjects (Marton, 1986). For my study, the experience is built on how interpersonal relationships are distinguished from Black men at PWIs and HBCUs and how the interpersonal relationships described by Black men are related to institutional context. The results of a phenomenography capture the perceptions or categories of description described by subjects and the relationships among the categories of descriptions (Larsson & Holmström, 2007). The categories of description are based on how the interviewed subjects described their ways of understanding with the researcher (Marton & Booth, 1997). While the categories of description are mutually exclusive, the researcher will usually report categories of description in a hierarchical manner (Bowden, 2005).

Figure 4 further explains the relations that exists between the researcher, the subjects, and the phenomenon. Accordingly, there is a unique symbiotic series of relations between the researcher, the subjects, and the phenomenon (Alsop & Tompsett, 2006; Carstensen & Bernhard, 2009; Kilinc & Aydin, 2013; Pang & Marton, 2003; Polat, 2013; Reid, 2001; Rose et al., 2005; Tan & Prosser, 2004; Trigwell &

Prosser, 2009; Wiles, 2017). The researcher has a connection with the subjects in a study and the phenomenon that is being studied. The subjects have a connection with the researcher and the phenomenon and the phenomenon has a connection between the researcher and the subjects. Each of these relations influence each other while the researcher directly influences the object of study on the relations between the subjects and phenomenon.

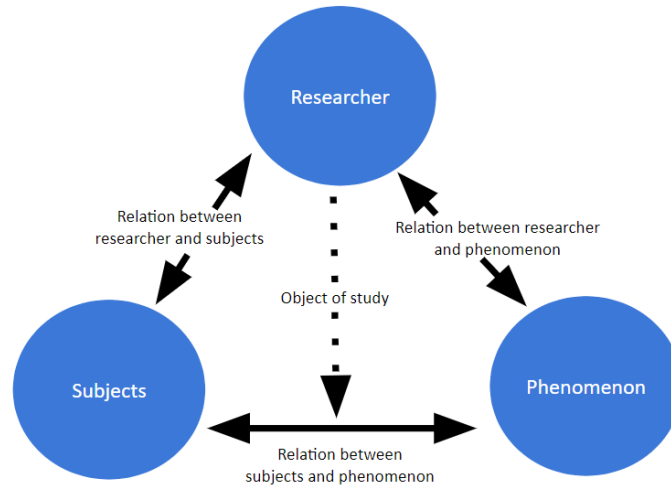


Figure 4 - Phenomenographic relationality adapted from (Bowden, 2005)

Regarding phenomenography research, the next section will discuss previous applications of phenomenography.

3.3.2 Applications of Phenomenography Studies

As a whole, phenomenographic research has been primarily applied in studies focused on higher education, where researchers have used the methodology to further understand teaching practices and approaches as well as how students learn (Tight, 2016). Phenomenography has also been used to understand ways to improve teaching and learning (Marton, 1986; Orgill, 2012), where its application has focused on three major areas: (1) approaches to learning; (2) understandings of academic content; and (3) understanding of experienced phenomena (Ryan, 2000).

Outside of higher education, phenomenography has been used in a variety of fields, such as tourism (Lamb et al., 2011), business (Anderberg et al., 2008), linguistics (Barnard et al., 1999; Holmstrom et al., 2003; Sjostrom & Dahlgren, 2002), and healthcare (Sjostrom & Dahlgren, 2002). There has also been an extensive use of phenomenography in nursing research. The field of nursing has used the methodology

to understand the different states, experiences, and needs of patients (Andersson et al., 2015; Degen, 2010) as well as nurses (Barry & Ward, 2017; Brammer, 2006) and nursing students (Bruce et al., 2004; Bucks & Oakes, 2011; Fila, 2017; Magana et al., 2012; Smith, 2015; Stamouli, 2007).

While there have been various applications of phenomenography, my study adds to the existing scholarship by applying the methodology to engineering education Bowden (2000). To ensure alignment as well as embed validity and reliability within the study, I followed Marton (1986) to conduct a phenomenography research study. In the following sections, I describe my research plan, including data collection and analysis. I also discuss my methods for interpretation.

3.4 Data Collection

My primary method of data collection was a semi-structured interview as it allows for unanticipated responses (Green, 2005). I conducted semi-structured interviews with Black men in undergraduate engineering programs at two PWIs and one HBCU. I recruited participants virtually through gatekeepers at the institutions and snowball sampling. Participants were selected if they 1) identified as a Black man and 2) were at least in the second year of their undergraduate engineering program. In the subsequent sections, I discuss site selection, participant recruitment and selection, and how everything relates back to the study purpose.

3.4.1 Sampling Frame

I recruited students from HBCUs and PWIs. Given my specific focus on Black men in engineering, it was necessary to include more than one HBCU and PWI to have a larger population to recruit from and subsequently a larger representative population of Black men in undergraduate engineering programs. Institutions were selected based on the premise that the contexts were similar enough to categorize in the same outcome space.

3.4.2 Initial Participant Recruitment

Given that the purpose of the study is to understand how Black men experience interpersonal relationships at HBCUs and PWIs, I used purposive sampling along with snowball sampling to select students for this study. Purposive sampling aligns with phenomenographic methods in that it aims to include a mixture of participants who are representative of the intended population (Patton, 1990). Snowball sampling (or chain sampling) is the process of locating qualified participants and asking them

for other potential participants to include in a research study (Marton, 1989). Snowball sampling further increased the amount of variation given that I solicited from a small population.

As a result of the varying nature of undergraduate engineering programs, Black men who had completed at least their first-year of engineering were targeted. Some engineering programs require first-year students to take general engineering courses before allowing them to take major specific courses during their second year. However other schools require students to take major specific courses as first-year students. While first-year students can provide valuable information, because the purpose of this research is to understand the interpersonal relationships that are formed, it could be too early in the academic journey of a first-year student to capture the extensive nature of their engineering program. Thus, I purposively selected students who were at least in their second year of engineering with the hopes of maximizing the varying types of interpersonal relationships in which a participant might engage. As explained in Chapter 2, this selection could potentially include students with a range of ethnicities (e.g., Nigerian, Haitian, Jamaican, etc.) despite their shared race.

Given the global pandemic that was ongoing at the time, students were only recruited virtually. Emails were sent to gatekeepers, various administration and faculty members at their respected institutions and leaders of diversity-specific student organizations to advertise the study. A copy of the initial recruitment email and flyer that was sent to gatekeepers to forward to students is included in Appendix A, B, and C. The recruitment email and the recruitment flyer included a link to a survey questionnaire to determine eligibility (see Appendix D). The recruitment email and flyer also advertised a \$25 Amazon gift card for participation. This process resulted in 40 responses of students from one HBCU and two PWIs (PWI 1 & PWI 2).

3.4.3 Participant Selection

Given that phenomenography emphasizes the differences that exist in a human experience (Case & Light, 2011; Trigwell, 2000), it is essential to maximize the variation between the selected participants to ensure a sample is representative of the experience or phenomenon being studied (Orgill, 2012). For my study, I obtained maximum variation by restricting my study to those who identified as Black men and were at least in their second-year of their undergraduate engineering program. Among the 40 survey responses I received, 10 did not fit the selection criteria as they were first-year engineering students. Invitation emails, see Appendix E, were sent to the remaining 30 students. One student declined to participate in the interview. Fifteen students did not respond to the

invitation, after being emailed a second time. Through this process, I was able to interview a total of 14 participants for my research study.

3.5 Participant Summaries

A total of 14 participants engaged in my research study. A curtailed background of each of the participants is included below based on their results from the pre-screening survey. Due to CoVID, I was unable to conduct all of the interviews in the same environment, which led to participants choosing an environment of their choice. Each participant, except the HBCU participant, completed the remote interview from institutional housing area (i.e., dorm room, dorm study room, etc.). The HBCU participant conducted their interview from their mother's apartment.

3.5.1 Alanson

Alanson is a fifth year, in-state, engineering student at PWI 1. Both of his parents graduated from a four-year college/institution. He has participated in a living -learning community, an internship, a student chapter of a professional society focused on underrepresented groups, out-of-class student design project, a student chapter of a discipline-specific professional society, a STEM-related honor society, undergraduate research, and a formal mentoring program. For the out-of-class student design project and STEM-related honor society, he was able to meet and interact with peers from other STEM majors. Alanson was able to meet several peers who were engineers and non-engineers in a living learning community who helped him academically and get a perspective outside of engineering. In the formal mentoring program and student chapter of a professional society focused on underrepresented groups, Alanson was able to interact with others who looked like him and were able to provide advice especially when it came to adjusting to being an underrepresented racial group. Without his interpersonal relationships, Alanson believes his experience in engineering would be more lonely and more difficult to be a successful engineer.

3.5.2 Bryce

Bryce is a fourth year, in-state, engineering student at PWI 2. He identifies as a first-generation Ghanaian whom both parents graduated from a four-year college/institution. He was born in the United States after his parents immigrated from Ghana, West Africa. Bryce has participated in an internship, a student chapter of a professional society focused on underrepresented groups, volunteer/outreach programs, undergraduate research, and a formal mentoring program. Bryce was able to participate in an

internship experience that was intended to create a pipeline for underrepresented students, so he was surrounded by people who looked like him during the experience. For him, his undergraduate research experience was a research experience for undergraduates where he got to interact with individuals from institutions across the U.S. and he was paired with a faculty member who was gracious with him as he did not know a lot about how to do research. In Bryce's formal mentoring program, he was able to be surrounded by like-minded individuals who helped him go through various personal and academic events. Relationships for Bryce were very influential to experience because he would be more confused as to where to get help from. Bryce's older brother majored in engineering at the same institution as Bryce and was able to provide more help to him than he noticed from other peers.

3.5.3 Cholin

Cholin is a third year, in-state, engineering student at PWI 1. Both of Cholin's parents graduated from a four-year college/institution. He is a military brat who has participated in an internship, living-learning community, STEM-club or student chapter of a professional society focused on underrepresented groups, volunteering/outreach programs, and a formal mentoring program. He describes his experience in engineering as "turbulent" when it comes to advancing in his academic coursework. COVID helped create more positive interactions with his professors while also creating negative experiences as well. Cholin mentioned having a hard time adjusting to the norms and culture of engineering and he often engaged with activities and peers outside of engineering that more aligned with his hobbies and interests in film and television. He enjoyed being in a living-learning community and was involved in a formal mentoring program through the living-learning community. Cholin believes that his interpersonal relationships helped develop his personal self-confidence and maturity and without his relationships he would be more engineering centric.

3.5.4 Clayton

Clayton is a third year, in-state, engineering student from PWI 2. He has one parent that has a master's degree and another parent who has a graduate/professional degree. Clayton has participated in an outreach program and out-of-class student design competitions. For the outreach program and out-of-class student design competition he was able to interact and become friends with people who are other engineering majors. Without his relationships, Clayton's experience would have been more stressful especially since his major required a lot of group work.

3.5.5 Daniel

Daniel is a second-year, out-of-state, engineering student at PWI 1. One of his parents graduated from a four-year college/institution and his other parent attended some college. Daniel is a military who participated in a living learning community, student chapter of a professional society focused on underrepresented groups, volunteering/outreach programs, formal mentoring program, an out-of-class student design project/competition, and a STEM club or student chapter of a discipline-specific professional society. Daniel describes his engineering experience as difficult given his engineering major however, he interacts with peers in his major and other STEM fields who help give him support. He was involved in a living-learning community and after being a mentee he became a mentor in the mentoring program. He often leaned on upperclassmen who shared his major in a student chapter of a professional society focused on underrepresented groups to gain assistance with coursework from picking professors to getting help with homework. Without his relationships, Daniel believes he wouldn't be as dedicated to his schoolwork and wouldn't have role models in his life to know what to do when things come up or resources to ask if he doesn't know what to do.

3.5.6 Marvin

Marvin is a second-year, in-state, engineering student at PWI 1. Both of his parents earned a master's degree or higher. He is the first person from his family who is born in the United States and his parents are from two African countries. Marvin participated in a living-learning community and volunteering/outreach programs. His involvement in the living-learning community helped him form relationships with other STEM peers and his interactions at the animal shelter served as a stress reliever for him. Without involvement in these relationships, Marvin states that without his interpersonal relationships he would be more closed off because his relationships have helped him learn to trust and ask for help—academically and emotionally/mentally—from others.

3.5.7 Matthew

Matthew is a fourth-year, in-state, engineering major from PWI 1. One of his parents earned a graduate professional degree and one parent earned a two-year degree or certificate. Matthew has participated in a living-learning community, volunteering/outreach programs, an internship, a formal mentoring program, and a student chapter of a professional society focused on underrepresented groups. He enjoys interactions in his living learning community, especially with his RA as they are the same major and have similar religious backgrounds. Within the volunteering/outreach programs,

internship, and mentoring program, Matthew has been able to interact and find relatability with people from a variety of backgrounds. In the student chapter of a professional society focused on underrepresented groups, Matthew was able to form a close bond with some of the upperclassmen in the organization however due to CoVID he was not able to gain closure with them graduating. Matthew posits that his relationships were a positive distraction and helped take the edge off because if he only associated with those in engineering he would metaphorically explode. For Matthew, engineering can be degrading and can beat you down and so relationships and support groups help your soul from being crushed.

3.5.8 Ryaan

Ryaan is a second-year, in-state, engineering student at PWI 1. Both of his parents are from African countries who graduated from high school. Ryaan is a first-generational student and has been involved: living-learning community, a non-STEM social fraternity, and volunteer/outreach programs. Ryaan's involvement in a living learning community helped keep him on track when it came to his academic coursework; however, he soon had to create a new group of peers. Although Ryaan is a member of a non-STEM social fraternity, he has found a group of engineering majors within the fraternity who are able to provide academic guidance to him. Without his interpersonal relationships, Ryaan states that he would have been more lost especially when it came to adjusting to the academic workload of high school to college.

3.5.9 Shannon

Shannon is a third year, in-state, engineering student at an HBCU. One of his parents has a master's degree and one parent and his other parent has some college. He has participated in part-time employment, an internship, student chapter of a professional society focused on underrepresented groups, STEM related honor society, undergraduate research, student chapter of a discipline-specific professional society, out-of-class student design competition. Shannon's part-time employment helped him enjoy a hobby while providing practical applications of his engineering major. During the internship he experienced a learning curve initially and had an uncomfortable experience with his supervisor. Shannon likes holding a leadership position of a student chapter of a discipline-specific professional society and the out-of-class student design competition because he is able to showcase his leadership and problem-solving skills when it comes to any problems that arise. Relationships for Shannon have helped keep him in college and feel a stronger sense of his self-worth to society that he matters.

3.5.10 Sherrard

Sherrard is a fourth-year out-of-state engineering student at PWI 2. He identifies as Haitian and both of his parents have a master's degree. Sherrard has participated in a work study, lab work, living learning community, student chapter of a professional society focused on underrepresented groups, undergraduate research, formal mentoring program, out-of-class student design project, and volunteer/outreach programs. Sherrard's participation in a student chapter of a professional society focused on underrepresented groups helped gain him leadership experiences and opportunities to interact with industry recruiters. The work study position was beneficial to Sherrard as he was able to gain research experience while getting paid for his work. For Sherrard, his formal mentoring program gave him a person to regularly interact who assisted him professionally. Relationships for Sherrard provided a major sense of support because after being on academic probation he needed the structure to help get him back on track to graduate.

3.5.11 Sloan

Sloan is a fourth-year, in-state, engineering student at PWI 2. He identifies as Ghanaian and grew up in Ghana most of his life. Both of Sloan's parents graduated from high school. Sloan has participated volunteering/outreach programs, undergraduate research, student chapter of a professional society focused on underrepresented groups, work study, and an informal mentoring program. Sloan has been able to form relationships at his institution and across the U.S. given the research he was able to do in his research program. He views his involvement with a student chapter of a professional society focused on underrepresented groups because he is able to promote diversity on a higher level. In his work study and informal mentoring, Sloan is able to have someone who cares about him beyond his academics and into his emotional/mental well-being. For Sloan, his relationships were extremely valuable as he felt that he had no concept of what college would be in the U.S.

3.5.12 Travis

Travis is a second-year, out-of-state, engineering student at PWI 1. Both of his parents have Master's degrees. He has participated in a STEM club, formal mentoring program, and an out-of-class student design project/competition. The STEM club and out-of-class student design project has helped Travis to form relationships with other peers who enjoy similar activities in a fun, enjoyable way. Within the formal mentoring program, he was able to find academic relatability. If Travis did not have these

relationship types, he believes he would not have had the opportunity to meet so many people of different backgrounds than his own.

3.5.13 William

William is a third-year, in-state, engineering student at PWI 1. He is a transfer student from another PWI institution. One of his parents graduated from a four-year college/institution and his other parent has a master's degree. He's participated in a living-learning community, a student chapter of a professional society focused on underrepresented groups, a non-STEM social fraternity, volunteering/outreach programs, and undergraduate research. William's involvement in the living learning community and his STEM peers helped his transition from his prior institution as he felt intimidated at first coming to PWI 1 to major in engineering. He is involved in a student chapter of a professional society focused on underrepresented groups. Several of his peers from high school also attend PWI 1 so he leaned on several of his high school peers during his academic journey. The graduate students and professors whom he's met while conducting undergraduate research have helped him to work with big names in technology and engineering. For William, his relationships helped create a strong academic network which was very helpful as a transfer student.

3.5.14 Zachary

Zachary is a third year, in-state engineering student from PWI 2. One of his parents graduated from a four-year institution/college and his other parent has a master's degree. He has participated in an internship, living learning community, student chapter of a professional society focused on underrepresented groups, STEM related fraternity, non-STEM related social fraternity, volunteer/outreach programs, undergraduate research, formal mentoring, and an out-of-class student design competition. Although Zachary's internship was shortened and moved to online because of CoVID, he learned that not everything he learns in school is useful yet having an engineering background makes it easier to have academic conversations with people. In a student chapter of a professional society focused on underrepresented groups, Zachary was able to bond with a group of people that look like him and understand his story among an institution where nobody looks like him. Zachary's involvement in a non-STEM related social fraternity was impacted by his desire to be a member of the same fraternity as his father and to have someone look out for you wherever you go. If Zachary was not involved in his relationships, he believes he wouldn't be pushed to think outside of his boundaries as an engineer and he would feel more lost in engineering as the only Black kid in his classes.

3.6 Semi-structured Interviews

Once participants were selected, I collected data using semi-structured interviews. The purpose of semi-structured interviews in a phenomenography is to have the participant reflect about their experiences so that the interviewer and participant have a mutual understanding of the meanings (Akerlind, 2005a). Semi-structured interviews allowed me to have the flexibility to guide the participant to discuss the phenomenon. Phenomenographic interviews explore how the participant thinks about and experiences the phenomenon and moves from “what” questions to also include “why” questions (Larsson & Holmström, 2007). “What” questions explain the subject’s focus and “why” or “how” describes how the meaning is created (Bowden, 2000). These types of questions encourage the participant to reflect on what they said, further explain their understanding, and reveal their way of understanding a phenomenon (Barnard et al., 1999). The interview should reveal the beliefs, values, feelings, reality, and experience of the phenomenon (Orgill, 2012). Thus, during interviews, emphasis was placed on the beliefs of their reality instead of the “correctness” of their responses (Bowden, 2000).

In phenomenography research, the process of interviewing begins by designing diagnostic interview questions that reveal the various ways of understanding the phenomenon within a specific context (Ornek, 2008). Participants are probed by the researcher with several follow up questions in order to reduce the number of incorrect interpretations of what is being asked of them (Turner, 2015). Once the participant begins openly discussing the phenomenon, the interview becomes open-ended and non-directive (Orgill, 2012). Sample interview questions include:

- *Can you tell me about some of the relationships that you have at [institution name]?*
- *What is the quality and nature of the relationships you choose to engage with?*
- *What is the quality and nature of the relationships you choose not to engage with?*

Examples of follow up and probing questions include:

- *Could you explain that further?*
- *Why was that important to you?*
- *What do you mean? I am not clear.*

I conducted one semi-structured interview with each participant that was open and deep. By *open* I am referring to the notion that while there was a list of questions to be discussed with the participants, I had to follow the lineage of the participant (Orgill, 2012). By *deep* I am referring to the idea that I had an exhaustive line of reasoning with the participant (Larsson & Holmström, 2007). I encouraged participants to give concrete examples to avoid any assumptions that I could make (Bowden, 2005)

which facilitates the exposure of as many viewpoints as possible without influencing the participant (Marton, 1986). The interview covered a brief life story of the student, details of the various relationships that they have during their undergraduate journey, summarize the students' reflection of the value of the relationship, and an exploration on how the students' understood how their race, gender, institution type, and major impacted their experience in engineering. Because I kept the questions as open-ended as possible, participants had the flexibility to choose the dimensions of the questions they wish to answer, which further reveals the degree of relevance to an individual (Akerlind, 2005a). Nevertheless, I was very intentional with the design of my interview protocol so that I would be able to explore various dimensions of how a student perceived an interpersonal relationship without disrupting the flow of the interview. By allowing the interview to be conversational yet purposeful, I, at times used follow up questions to help guide a conversation, in case it went off topic, back to answer my research questions. The follow up questions not only helped me to understand the very essence of what the interpersonal relationship was to the participant but also encouraged an environment for the participant to feel open to talk about their relationships whether positive, negative, or neutral. To have a greater understanding of an interpersonal relationship, I asked follow up questions such as, "Is there a specific experience you remember interacting with []?" or "Can you tell me a story that summarizes your relationship with []?" In addition to asking follow up questions, I provided feedback to the participants that I was actively listening during the interviews by using the names of the relationships and/or descriptions of the relationships mentioned by the participants throughout the interview. For example, when a participant mentioned a peer's name, I occasionally mentioned the peer's name as a point of reference when other peers of similar backgrounds were mentioned.

Given that phenomenographic interviews are different from traditional qualitative interviews, it is encouraged to have practice conducting and analyzing a phenomenographic interview (Marton, 1986). Accordingly, I conducted a pilot study at one HBCU and one PWI to refine data collection procedures. Specifically, this pilot study ensured the interview protocol was exhaustive as well as provided familiarity with conducting a phenomenographic interview. The final interview protocol that I created for this study is included in Appendix F.

3.6.1 Co-constructed Student Figure

While conducting the semi-structured interviews, I had my participants create a figure to further explore their interpersonal relationships. While the participants were talking, I typed the names of the relationships they mentioned during the interview inside boxes, as shown in Appendix G. Participants

were instructed to click and drag the boxes based on the degree of impact the relationship had on their undergraduate engineering experience. The resulting figure was used to ensure the relationships mentioned by the participants were impactful to their engineering experience.

3.7 Data Analysis

In phenomenographic research, at a high-level, data analysis consists of sorting quotes into piles, examining borderline cases, creating criterion attributes for each group, and putting the attributes into categories (Marton, 1986). The particular analysis process in a phenomenography is imperative as it not only reveals the structural framework of the categories, but it helps make light of the participant's understandings (Marton, 1986). Phenomenography tends to follow two similar yet different ways to analyze interviews. The first method emphasizes the use of quotes (Bowden, 2000), while the second method accentuates using the entire transcript for analysis (Marton, 1986). While the process of data analysis might appear to be straightforward, it is a tedious, interactive, and iterative process of sorting and re-sorting data until unanimity is achieved (Marton, 1986).

According to Marton (1986), the first step of data analysis consists of a selection procedure based on criteria of relevance. The phenomenon is narrowed down and interpreted based on quotes from the interviews. Next, the quotes are interpreted and classified based on the context they are taken from. The next step of data analysis involves the shift from individual subjects to the meanings embedded within the quotes themselves (Marton, 1986). In this step, a quote has two meanings: (1) the meaning of the quote in the interview from which it was taken; and (2) the group of meanings to which it belongs. Thus, quotes are looked at from both the individual's experience it is taken from and as a group to understand the variation in the responses. Lastly, categories are formed from quotes, tested against the data and adjusted, retested, and readjusted until a consensus is made.

Although similar to Marton (1986)'s process of data analysis, Bowden (2000) describes an analysis process using the entire transcript. The focus in this process is on the participant's meaning in the entire transcript instead of focusing on a specific quote to group into categories. Thus, any utterance by a participant is taken in the context of the entire transcript (Green, 2005). Transcripts with similar meanings are grouped together and categories are formed with illustrative quotations from the transcripts (Bowden, 2000). Data analysis is also iterative; however, transcripts, instead of quotes, are used to group and re-group until a consensus is made.

While both approaches can be employed, I used a hybrid version of Smith (2015)'s analysis similar to (Daly et al., 2012). Because my participants discussed more than one relationship, I dissected

each transcript based on the relationship types they mentioned as well as the perceptions that the participants had pertaining to each relationship type. Each relationship was analyzed separately from the transcript it was taken from. Figure 5 below provides a visualization of the various steps I took during data analysis with an explicit answer each research question that was adapted from (Daly et al., 2012).

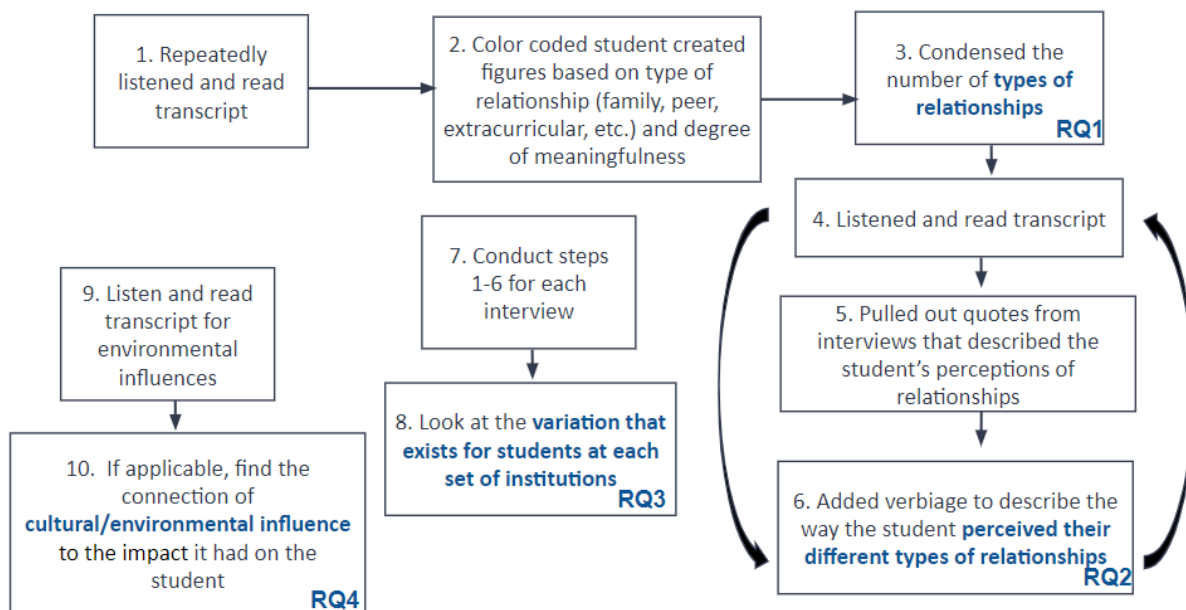


Figure 5 - Data Analysis Process and Research Questions

Data analysis consisted of an iterative process to create a distinct set of categories that captured the variation between the participants in the fewest categories possible (Akerlind, 2005b). Therefore, when it came to analyzing interview transcripts, each transcript was analyzed and interpreted within the context of the group of transcripts (Larsson & Holmström, 2007). As shown in Figure 5 above, the first step of data analysis was becoming familiarized with the transcript through listening and reading (Box 1). The next step involved using the student created figure to sort the various relationship types (Box 2). Then I condensed the number of relationship types (Box 3) and used this result to answer my first research question.

Next was a repetitive process, where the transcripts were re-listened and re-read (Box 4) and quotes were pulled out to describe the perceptions of the relationship types (Box 5). The quotes created themes or categories of description (Box 6), which answered my second research question. Categories of description refer to the different ways of understanding how the phenomenon can be understood (Ornek, 2008). When analyzing the data, I gave attention to similarities as well as differences between the interview responses in order to account for variance Akerlind (2005b). I followed Marton & Booth

(1997) conditions to look for categories of description. The first condition is that each category is a separate, distinct representation of the understanding the phenomenon. The second condition is that the categories are logically related and the last condition is that critical variations are represented by as few categories as possible. Turner (2015) posit each of the categories of description are layers of individual experiences which builds the argument that all of the participants are experiencing the same experience.

The process described above was repeated for each of the 14 interviews (Box 7). Then the categories of description were analyzed for variation by institution and was used to create a visual known as the outcome space (Box 8), which answered research question three. An outcome space is the set of empirically related categories of descriptions (Akerlind, 2005b). The outcome space is holistic in nature because it includes all of the ways of experiencing the phenomena as understood by the participants Marton & Booth (1997). Ihde (1977) and Sandbergh (1997) contest that the quality of the outcome space is based on three criteria:

1. Each category in the outcome space reveals a distinct way of understanding the phenomenon;
2. The categories are logically related, usually as a hierarchy of structurally inclusive relationships; and
3. Each of the outcomes are represented by as few categories as possible.

Lastly, the transcripts were re-listened and re-read (Box 9) and any quotes related to cultural or environmental influences were identified (Box 10). This last stage answers my fourth research question.

3.7.1 Use of Theory

In phenomenography studies, theory is not generally used. The researcher withholds theories and prejudices while interpreting data also known as phenomenological reduction (Daly et al., 2012). However, I used theory as an additional way visualize the various relationships described by the participants to understand the complexity of interpersonal relationships. As stated by Akerlind (2005a) “the value of using phenomenographic methods is the ability to create a landscape view that encompasses diverse perspectives that distinguish critical features of this landscape of awareness while simultaneously highlighting the relationship among these variations (such as moving from narrow to broad, external to internal, and surface to deep levels of awareness).” Given that underrepresented groups are more likely to have a broader understanding of a phenomenon than majority groups (Bowden, 2000), Bronfenbrenner’s Theory provided a holistic view of the various interpersonal relationships experienced by Black men in undergraduate engineering programs. Leaning on the idea

that categories of description will form from the interview transcripts, I used Bronfenbrenner's Theory four systems (microsystem, mesosystem, exosystem, and macrosystem) to explicitly map the interpersonal relationship experiences of Black men and further add to the outcome space.

3.8 Measures of Quality

As explained in the sections above, I explicitly aligned the purpose of the study to each of the steps within planning, data collection, analysis, and interpretation following (Bowden, 2000). In the sections below, I acknowledge the validity and reliability of this study.

3.8.1 Validity

In a phenomenography, validity is obtained through a very clear and transparent alignment of the purpose of the study as well as the research design (Akerlind, 2005b). Regarding the validity of the study, Bowden (2000) and Walsh (2000) recommend communicative validity and pragmatic validity. Communicative validity refers to if the study uses appropriate analysis methods and if the results accurately describe the data. Pragmatic validity refers to if the results are presented in a meaningful manner to the intended audience. To address communicative validity, I explicitly explained the methods that I used to employ to understand the interpersonal relationships of Black men and, in Chapter 4, explained how the results of the study accurately describe the data. For pragmatic validity, I presented the results in an appropriate manner. In contrast to some phenomenography studies, few studies use secondary researchers to compare categories of description to provide additional validity (Sandbergh, 1997). However, there has been pushback as additional researchers can change the un-biased construction and analysis of categories of description (Sandbergh, 1997). In addition, the use of member checking can also insert bias into the study as a participant can change their response which takes away from their interpretation of the original experience (Orgill, 2012). As stated above, the co-constructed student figure served as a form of member checking for my research study. Given that phenomenography encourages the use of a priori coding, coding where there is not an original framework or codebook, I refrained from reviewing literature regarding relationships during the data collection and analysis phases.

3.8.2 Reliability

In order to establish reliability, I followed Sandbergh (1997)'s notion of interpretative awareness. Interpretative awareness is when the researcher explicitly explains how they interpreted the data and

how they plan to critically look at their data to counteract prior assumptions or conceptions. With that being said, I have clearly identified the purpose of my research study along with a detailed research plan on how I achieved my results. The aim in a phenomenography is to not gauge accuracy but to understand the perceptions students hold (Ihde, 1977; Sandbergh, 1997). Thus, by adding Bronfenbrenner's Ecological Theory, I was able to more accurately understand the experiences of Black men in undergraduate engineering programs via a holistic approach.

I also used phenomenological reduction as a way to address reliability (Ihde, 1977). In phenomenological reduction, the researcher attempts to fully understand the experience by limiting the interference of prior biases and other conceptions of the experience. There are five steps to address phenomenological reduction: (1) the researcher is oriented to the phenomenon as and how it appears in the research process; (2) the researcher is oriented to describing what constitutes the experience instead of explaining why it appears as it does; (3) the researcher treats all aspects of the experience with the same level of importance; (4) the researcher looks at various interpretations of the experience until a consensus is made; and (5) the researcher look at what and how a person understands as their reality and ways of relating those conceptions to reality (Trigwell, 2000). By purposely embedding validity and reliability throughout my entire research design I add to the quality of my study.

3.9 Limitations

There are three main limitations of my research study. The first limitation pertains to the number of participants. While typical phenomenographies have a minimum of 15 participants, I was only able to interview 14 participants. Due to the global pandemic, I had to mostly rely on virtual means of solicitation which included solely rely on gatekeepers at institutions and snowball sampling as a means to secure prospective participants. Since I attended an PWI for the entirety of my academic journey, I may be considered an outsider for any HBCU students. To address this limitation, I leveraged a fully immersive research methodology, phenomenography which encouraged me to thoroughly question my research participants. In addition, I incentivized my research study by rewarding participants with a \$25 Amazon gift card with the hopes of encouraging more students to participate. Despite having fewer participants, I was able to capture an extreme level of depth with my participants and build an extensive level of rapport without knowing any of my participants prior to the interview.

The second limitation was the location of the interviews. Since I had to conduct the interviews over Zoom, the participants could be encouraged to only highlight certain relationships because their needs changed since CoVID and from having to finish the duration of their spring semester virtually. Only one

participant was not physically at their institution during the interview. Thus, participants might have a unique experience or perspective on which relationships were meaningful to them if they were no longer in the environment of the institution.

Another limitations of the study include the transferability of the results. It is important to note that, within a phenomenography, the research is not meant to be generalizable. A phenomenography aims to understand how a person's experience is impacted by the context the phenomena takes places (Akerlind, 2005a). Phenomenographies provide limited generalizability as they seek to understand the context-sensitive nature of a group of individual experiences instead of focusing on one individual's experience (Lord et al., 2019). Given that this study focused on a small sampling of institutions, there is a limited amount of external validity of the results to other institutions.

3.10 Summary

In summary, the purpose of this study is to understand how Black men experience interpersonal relationships in undergraduate engineering programs. In order to address the purpose, I used a quasi-phenomenography research design to understand the interpersonal relationships of Black men at two different institutional contexts—HBCU and PWIs. A quasi-phenomenography research design was appropriate as it allowed me to better understand the phenomenon, interpersonal relationships in undergraduate engineering programs. I acknowledged my positionality as a researcher and how my research is intertwined with my own race and culture. I outlined how I collected data through semi-structured interviews and used Bronfenbrenner's Ecological Systems Theory in tandem with conventional data analysis methods to further understand interpersonal relationships. Lastly, I discussed the measures of quality with this research plan.

Chapter 4

4 Results

In this chapter, I present the results from my quasi phenomenographic study. As a reminder, the purpose of this research study is to understand how Black men enrolled in undergraduate engineering programs experience interpersonal relationship. The research questions that I employed to address my purpose are:

RQ1: What are the types of relationships Black men utilize in undergraduate engineering programs?

RQ2: How do Black men perceive interpersonal relationships in their undergraduate engineering programs?

RQ3: What kind of variation exists across institutional experiences?

RQ4: How do environmental influences impact the interpersonal relationships of Black men in undergraduate engineering programs?

The aim of the research questions was two-fold. Firstly, I aimed to understand the types of interpersonal relationships that Black men engage (RQ1). Secondly, I aimed to understand the impact of those relationships (RQ2). In order to further understand the impact of the interpersonal relationships, RQ3 and RQ4 provide an additional lens to more holistically understand the impact of the relationships.

The answers to these questions are presented in the following sections. First, I provide a brief overview of the different relationship clusters that were found in the interviews and give specific examples of the various relationship types. Third, I explore the impact these relationships had on Black men through categories of description that were created from quotes from the participants. Next, I illustrate the relationship differences that existed for participants via outcome spaces. Lastly, I explain how environmental influences affected the interpersonal relationships for participants. To avoid confusion, for the remainder of this chapter, I will refer to the interviewed Black men in this research study as participants. Also, it is important to acknowledge that while I interviewed a total of 14 participants, 13 of the participants came from PWIs and one came from an HBCU. Thus, the HBCU participant is viewed as a counterexample and not a collective summary of the entire HBCU experience. When presenting the results, I include the data collected from each institution and, when applicable, state if data has been delineated by institution type.

4.1 Relationship Types

During my study, participants mentioned a variety of relationship types that impacted their undergraduate engineering experience. While the majority of the participants discussed relationships with people who are students and faculty/staff at their respective institution, some participants mentioned people outside of the institution, such as family members and high school peers. The images that were co-created during data collection helped identify which interpersonal relationships were impactful during the participant's undergraduate engineering journey.

Participants mentioned 25 specific relationship types during the interviews. I formed a total of seven relationship clusters from these relationship types: (1) non-STEM peers, (2) STEM peers, (3) housing peers, (4) industry personnel, (5) family, (6) institutional staff, and (7) other. A minimum of two similar relationship types formed a relationship cluster, and relationship types that could not be included in a detailed cluster were put into the cluster of Other. Though I took effort to create mutually exclusive relationship clusters, some relationship types could be viewed in multiple relationship clusters. More details regarding each of the relationship clusters is explained below.

4.1.1 Non-STEM Peers

Non-STEM peer relationships referred to relationships with peers that had a direct connection to the institution but did not anchor on the STEM context. Examples of Non-STEM peer relationships ranged from peers that a participant met through their social fraternity to participation in the band. Nine of the 14 participants referred to a non-STEM relationship.

4.1.2 STEM Peers

The STEM peer relationship cluster focused on relationships with peers who have a STEM influence meaning the peer is a STEM major at the participant's institution and/or the peer is involved in a STEM-focused club or organization. The category of STEM also included peers who participated in a STEM-based transition program. All of the participants described a STEM-based relationship with a peer.

4.1.3 Housing Peers

Housing peer relationships included relationships with a roommate or other peers within a living-learning community. It is important to note that some participants mentioned relationships within

a living-learning community, although they themselves were not members of that specific living-learning community. Six of the 14 participants mentioned an interpersonal relationship related to housing.

4.1.4 Industry personnel

Industry personnel included relationships that participants had with company recruiters and staff members at their internship. Company recruiters referred to interactions that the participants had during a career fair that had a lasting impact on the participant's experience in engineering. Seven of the participants mentioned the impact of the relationship with industry personnel.

4.1.5 Family

The family cluster was used for participants who mentioned a family member or someone who they viewed as a family member. The types of specific family members that was mentioned ranged from parents to siblings to cousins. Another relationship type that was included in the family was fictive kin. For example, the parent of a peer was included in this cluster because the participant stated that they viewed their peer's parent as an aunt. Of the 14 total participants, twelve of them mentioned a relationship within the family cluster.

4.1.6 Institutional Staff

Institutional staff includes relationships with professors, teacher assistants (TAs), academic advisors, major-specific academic advisors, academic success advisors, and diversity-focused engineering personnel. Including the personnel mentioned above, undergraduate research staff was also categorized under institutional staff. Similar to STEM peers, all of the participants mentioned an interpersonal relationship that was clustered as institutional staff.

4.1.7 Other

Lastly, other was grouped for interpersonal relationships that did not fit into the other six categories. Other relationships included those with peers and adults who were not directly within the structure of the institution. Examples of other relationships ranged from church peers to a formal or informal mentor. Eleven of the 14 participants revealed an "other" relationship.

4.1.8 Summary

Table 3 below gives an overview of the relationship clusters and the relationship types that comprise them. Situating these results into Bronfenbrenner’s Ecological Theory, the seven relationship clusters fall into the microsystem and macrosystem. The relationship clusters fall into these systems because they are relationships that have a high importance to the participant’s experience in engineering. In the next section, I go into detail about the impact of each of the relationship clusters for participants.

Table 3 - Overview of Relationship Clusters and Types

Relationship Cluster	Relationship Types
Non-STEM Peers	Band peers; Club sport peers; Fraternity; Non-major club peers; Non-STEM peers; Romantic partner
STEM Peers	Major club peers; Major peers; Other institution peers; STEM diversity club peers; STEM peers; Transition program peers
Housing Peers	Living-learning community peers; Roommate
Institutional staff	Academic advisors; Diversity-focused institutional personnel; Graduate students; Institutional staff; Professors; Teacher’s assistant; Undergraduate research staff
Industry personnel	Company recruiter; Internship personnel
Family	Family; Parent of peer
Other	Those people; Volunteer organization; Church peers; High school peers; Mentor

4.2 Experience Interpersonal Relationships (Categories of Description)

My second research question focuses on understanding the interpersonal relationships of Black men, specifically how do Black men perceive their interpersonal relationships. Following Marton & Booth (1997), the descriptions of these perceptions are called categories of description. From the 14 semi-structured interviews, I formed ten categories of description. Each category of description was created from adjectives that were used by participants to describe their relationship types. In order to further categorize the adjectives, they were all designated by a domain that they fell under: academic,

emotional/mental, financial, professional, social, or spiritual. Similar to the categories of description, each of the domains emerged from the interview transcripts of the participants.

I discuss each category of description by illustrating the adjectives that comprise each category of description. In alignment with Marton & Booth (1997), the categories of description are organized from least to most complex based on the number of domains that were found under each category of description. The categories of description that had fewer domains were viewed as least complex and those that had more domains were viewed as more complex. The ten categories of description, in order from least to most complex, are: 1) competitive, 2) solitary, 3) lighthearted, 4) venturesome, 5) uncivil, 6) indifferent, 7) coming of age, 8) relatable, 9) informed, and 10) embracing. When there were categories with the same number of domains, I organized the subset group of categories of description based on intricacy from least to greatest. Quotes were chosen from the 14 participants to further describe the categories of description as well as explain the range of interview responses. At the end of each category of description, I include a table that lists the adjectives associated with the category of description as well as the participants.

4.2.1 Competitive

Competitive was interpreted as the least complex category, only appearing in the academic domain. Competitive was used to describe participants who expressed how some of their interpersonal relationships had a feeling of contention or battling with each other academically. For the participants in the study, academic competition appeared with their family members, housing peers, and STEM peers. Only one adjective was included in the Competitive category of description and five participants stated experiences surrounding competition. Table 4 below highlights the specific relationship clusters that Competitive appeared as well as with which participants.

Table 4 - Overview of Competitive Category of Description

Domain	Adjective	Relationship Clusters	Participants
Academic	Competitive	Family; STEM peers; Housing peers	Matthew, Ryaan, Sherrard, Sloan, Zachary

Several participants highlighted a competitive nature with their STEM peers. Matthew had a heightened awareness of the competitive nature of his engineering peers when comparing them to his peers in humanity majors. He stated, *“It’s a palpable difference, engineers. I think they’re... very concrete and a little, on the competitive side whereas in other majors I’ve seen, they’re a little more abstract.”* Matthew views his STEM peers as more competitive than people in other majors. Similar to Matthew, Ryaan, Sloan, Sherrard, and Zachary all sensed a competitive nature from their STEM peers.

Participants also mentioned competition among their family members. Sherrard elaborated how his cultural heritage impacts the types of academic majors that both he and others who identify as Haitian might chose to major in:

My family is Haitian and it’s like really big and like I guess Haitian culture [is] like [to] pursue prestigious-like type jobs... If your child is Haitian or if you’re a senior sometimes you want to be an engineer... That’s...a good thing, like that’s kind of what they....expect...compared to my brother who majored in [engineering major] we sometimes have a family rivalry against each other. (Sherrard, Family)

For Sherrard, he felt that his relationship with his brother was competitive because they are both engineering majors and their cultural background encourages them to pursue esteemed occupations. When it comes to competition, participants only cited it within an academic domain.

4.2.2 Solitary

The Solitary category of description appeared in the academic and emotional/mental domains. Solitary is viewed when participants expressed a relationship felt lonesome or that the participant was all alone. Solitary appeared for STEM peers and other. Two adjectives, isolated and alone, were used to explain the category of description of Solitary for two participants. Table 5 below highlights the other nuances of this category of description.

Table 5 - Overview of Solitary Category of Description

Domain	Adjective	Relationship Clusters	Participants
Academic	Isolated	STEM peers; Other	Ryaan, Zachary
Emotional/Mental	Alone	STEM peers; Other	Ryaan, Zachary

Zachary and Ryaan were the only two participants who perceived two or more of their relationships as Solitary. Academically, Solitary appeared when a participant felt isolated in their interpersonal relationship and had few positive levels of academic interactions. Zachary explains his perceptions of isolation with a group project and his STEM peers. When looking at the demographic makeup of his group project peers, he realized he was unintentionally in a group with non-White classmates. Zachary alludes to feeling isolated from the rest of his White peers in the classroom:

We all kind of linked up because we were the minorities in the classroom...I'm the only Black [engineering major A]. There's one Lebanese and there [was a] Middle Eastern person who was in... [engineering major B]. One person that by Chinese descent and one... from India, so like we were like all the kind of group of minorities in the class. I don't know why we got put out together but that's what happened and the rest of the class and courses was predominantly white. So, I feel like we kind of found our way through together, even though like we kind of felt isolated. (Zachary, STEM peers)

Zachary expands upon this feeling of isolation and how he feels alone and that none of his STEM peers could understand or relate to him even outside of his group project:

I'm definitely... the only Black person...in your major or in your in your differential equations class. You definitely have...some kind of like push back inside your head that's like, do I really belong here. Is this where you know I'm meant to be? There's nobody else here that looks like me. There's nobody else that kind of understands my story. (Zachary, STEM peers)

In the quote above, Zachary adds to how feeling isolated impacts him emotionally and mentally and he feels alone. While Zachary discussed solitary feelings with his STEM peers, Ryaan discussed similar feelings with his high school peers. Ryaan felt isolated from his high school peers when it came to seeing the difference in their transition to college compared to his:

I kind of just stuck with them and like one of my closest friends I had a fall out with them...That kind of... let me to...start over and... it kind of broke the chain of... our group [that] was going to... get through like the academics together and we were going to lift each other up you know but like...through freshman year and stuff, it kind of gave us a fallout... it kind of like left me as an engineer, like all alone. (Ryaan, Other)

Ryaan mentioned how his high school peers began to distance themselves from him after seeing how he de-prioritized his academics compared to his high school peers. Both Ryaan and Zachary felt similar elements of Solitary. Even though both of the participants discussed their feelings of being alone academically, elements of their interview brought out the emotional/mental impacts as well.

4.2.3 Lighthearted

Lighthearted was found in the emotional/mental and social domains. In the Lighthearted category of description, participants described interpersonal relationships that instilled a carefree or relaxed perspective. Lighthearted appeared for the following relationship types: family, housing peers, institutional staff, industry personnel, STEM peers, Non-STEM peers, and other. Five adjectives were used to describe Lighthearted for 14 participants. In Table 6, a comprehensive list of the adjectives pertaining to the emotional/mental and social aspects of Lighthearted are presented.

Table 6 - Overview of Lighthearted Category of Description

Domain	Adjective	Relationship Clusters	Participants
Emotional/Mental	Relaxed	STEM peers; Non-STEM peers; Other	Bryce, Marvin, Matthew
Social	Easy-going	Family; Housing peers; Institutional staff; Industry personnel; STEM peers; Other; Non-STEM peers	Alanson, Cholin, Clayton, Daniel, Matthew, Sherrard, Travis
	Friendly	Family; Other; Institutional staff; Industry personnel; Housing peers; STEM peers; Non-STEM peers	Alanson, Bryce, Cholin, Clayton, Daniel, Marvin, Matthew, Ryaan, Sherrard, Shannon, Sloan, Travis, William, Zachary
	Fun	Institutional staff; Non-STEM peers; Housing peers; STEM peers; Other	Daniel, Marvin, Sherrard, Shannon, Travis, William
	Humorous	Institutional staff; Industry personnel; STEM peers; Housing; Non-STEM peers	Daniel, Marvin, Matthew, Travis

Emotionally and mentally, participants felt at ease and lower stress and anxiety levels. Some participants felt similar feelings of relaxation when engaging with their church peers, non-major club

peers, and STEM diversity club peers. For example, Marvin felt relaxed when interacting with animals at a volunteer organization. *“It was obviously for me a place when I’m most stressful. It was almost like stress relief and just having fun, and always, knowing somehow it’ll make you smile, no matter what.”* While Marvin felt lighthearted emotionally/mentally at a volunteer organization, several participants felt Lighthearted with their interpersonal relationships in social domains.

Socially, participants viewed an interpersonal relationship as Lighthearted when the participant felt that a person assists them by making them feel more comfortable, normally through a social setting or environment. Participants expressed feelings of laughter, fun, or humor such as what a person might enjoy when playing a sport with others. Marvin elaborated on the feeling of fun when playing basketball with his non-STEM peers:

At the time so awesome...I haven't played basketball...this year with CoVID... Basketball it was always fun because like we're all like super competitive and... during the game if my friends [were] losing, we'd all... sometimes talk to each other and get into each other's heads or something, make sure we can win...how... much fun we [had]... playing that game. (Marvin, Non-STEM peers)

For Marvin, playing basketball was a fun time to enjoy interacting with his friends. Although CoVID did put constraints on how he presently interacts with his non-STEM peers, Marvin continues to see basketball as an enjoyable piece of his interpersonal relationship. All of the participants had at least one relationship cluster that was socially Lighthearted. When it comes to Lighthearted, participants mentioned this through their emotional/mental and social domains.

4.2.4 Venturesome

Venturesome was found in the emotional/mental and social domains. Venturesome was surfaced when the participant viewed their relationship encouraged them to take a risk and try something new. Venturesome appeared in the following relationship clusters: family, housing peers, STEM peers, and other. One adjective, venturesome, was used to create this category of description and Venturesome was found for four participants. An overview of Venturesome is produce in Table 7 below.

Table 7 - Overview of Venturesome Category of Description

Domain	Adjective	Relationship Clusters	Participants
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Emotional/Mental	Venturesome	Housing peers; STEM peers	Daniel
Social		Other; Family; Housing peers; STEM peers	Cholin, Daniel, Ryaan, Travis

For the participants, Venturesome would often yield a positive outcome for their relationships. Emotionally and mentally, Venturesome appeared when the interpersonal relationship encouraged the participant to go outside of their normal comfort zone to interact with others, specifically their peers. Daniel explored deeper levels of his own personal self and have a greater understanding of his Black culture with his transition program peers:

Definitely helped me understand [and see], like who I am and in this sense of my culture because like in [state]. I like knew no one who was like the same, like anyone who is African American or Black. There was just... no one I knew. All [of] my friends were white, so... they were like kind of like [my] first... major friends ever actually from the same backgrounds as me so like they've...had a major effect on my life. You know, [peer 1] teach[es] me like African dances and [peer 2] like all this kind of art and stuff. (Daniel, STEM peers)

Daniel’s relationship with his transition program peers encouraged him to try new things related to Black culture such as African dances and understanding Black art.

Socially, Venturesome also encouraged participants to try something new. Ryaan elaborates on how he perceives his relationships with his club sports peers as engaging and how they encouraged him to meet other people and ultimately become friends:

It really like pushes you to be like, “hey, like let’s go grab lunch and stuff”... [Helps you] find a comfort level instead of going across like another person’s dorm and be like, “ hey, like, let’s do this” and I think rowing definitely helped me to break out into meeting some people that are like, kinda like me and like trying to become friends with them and stuff. (Ryaan, Other)

For Ryaan, being Venturesome with his club sports peers was a positive interaction as he was able to make friends with people who he might not have typically interacted with. Although there were only a few participants who ventured outside of their typical comfort zones to explore deeper levels of their own emotional/mental and social domains, their satisfaction after their exploration seemed appreciative.

4.2.5 Uncivil

Uncivil was found in the academic and social domains and used to mostly describe negative attributes that participants experienced in their interpersonal relationships. The relationship clusters that participants viewed as Uncivil were: institutional staff, STEM peers, family, industry personnel, housing peers, and other. Eight adjectives created this category of description for eight participants. Table 8 below showcases more details pertaining to Uncivil.

Table 8 - Overview of Uncivil Category of Description

Domain	Adjective	Relationship Cluster	Participants
Academic	Condescending	Institutional staff; STEM peers	Cholin, Clayton, Sloan
	Critical	Institutional staff; STEM peers	Cholin
	Demanding	Family	Ryaan
	Disinterested	Institutional staff	Ryaan, Zachary
Social	Inconsiderate	Institutional staff; Industry personnel; Housing peers; STEM peers; Other	Daniel, Shannon, Sloan, William
	Irritating	Housing peers; Other	William
	Judgmental	STEM peers	Cholin
	Discourteous	Institutional staff; Housing peers; STEM peers; Other	Daniel, Sloan, William

Overall, participants saw a variety of relationships as Uncivil. Academically, participants viewed relationships that belittled or made them feel less than as uncivil. Participants viewed some of their relationships with various institutional staff and STEM peers condescending or even critical. Cholin explains uncivility through a description of his interactions with his instructors:

I got into the class; it was like more or less a review of what we were doing the last semester, which I had not done too well with the class. So, I didn't understand a lot of material and then

going into it, I went into his office for the first class and he said, that... if I didn't know that stuff, I was going to fail the class... [and] he's like... how did you make it here, like, stuff like that.

(Cholin, Institutional staff)

In the quote above, Cholin expresses how his instructor was condescending and showed a superior or patronizing attitude towards him. Also, Cholin expresses how his instructor was disinterested and not willing to help Cholin understand the course material. Cholin elaborates on similar relationships he has with other instructors at his institution and how they are highly critical and openly express disapproval in front of his other classmates:

As soon as they notice that you weren't paying attention, as well as they want [you] to in class. They might call you out which makes you a bit scared to ask them a question, because then you're going to be like that was like the rematch you like oh, I cover[ed] that the first 10 minutes of class where were you? (Cholin, Institutional staff)

Cholin's negative perceptions of his interpersonal relationships with his professors has him further retreat when it comes to having more engaging interactions with other institutional staff members and even his STEM peers.

Participants also expressed feelings of uncivility with their family members. Ryaan felt that his relationship with his parents was demanding as they expected him to work extremely hard and meet very high standards:

They're always like pushing me. You know, it's just like the one thing about... African parents is like they always like want better for my whatever you do. Like I could be, Hey, you got 100% of those and they're just like is there extra credit like would you do, would you do it? Did you do anything else and stuff? And so they're always like wanting like more. (Ryaan, Family)

Although Ryaan knew his parents wanted better for me, he perceived his relationship demanding.

Socially, participants viewed social interactions that were irritating or discourteous as Uncivil. For example, Daniel discussed how his roommate was discourteous and showed a lack of consideration:

We didn't like talk that much. You know, even when we're in the same room it's more like we'd always just be on our computers with our headphones on...there was a frat party and [he] got really, really drunk and just the 2 frat guys drop[ped] them off in my dorm and I was like, I don't know how to do this and then I ended up, like I had to end up calling [institution] PD [police department] because he was like not responding... He had to go to hospital... and then when we got back the next day, he never really talked about it and I was like, are we going to talk about what happened yesterday, and he was, like, Nope. So, now..this is weird... That made the room

kind of awkward. And then on another occasion he came back really really drunk and I had called [institution] PD [police department] again and this ended up making me miss a call[ulus]. assignment because like I was working on it before he showed up and when he showed up, I was like, I gotta take care of this. And then the due date went by [and] I had to email the professor.
(Daniel, Housing peers)

In the quote above, Daniel explains how during two different experiences he had to handle an unpleasant situation with his roommate where he had to call the institution's police department. Daniel's perceptions of his roommate ultimately led him to finding alternative housing after this second encounter with his roommate.

Outside of family, peers, and institutional staff one participant, William, referred to interactions with a lump of people he called "other people":

Those types of people are going to downplay on like African Americans experience in the US or like say that systematic racism doesn't exist and it's and I admit that it's ironic for me... [Other people] sit back and say... you know, just, just work harder, you know, just, just do this and do that without looking at, like, what else these individuals have to deal with is selfish. It's tone deaf too... to see people talk about that is really irksome and oblivious to the people that you only got in here because you're Black. And there was one other reason I can't remember why they think systematic racism thing isn't real...But I mean like I worked really hard to get here. And I think it just kind of it's kind of like slap across the face to say how, you know, you couldn't have been here. (William, Others)

For William, "those types of people" represents a cluster of interpersonal relationships that he's felt annoyed or irksome particularly when it comes to a public or outward display of beliefs. In the interview, William vocalized how he felt wrongfully stereotyped by this group and often faced comments alluding that he must have been an athlete to gain admittance to his institution. For participants and their relationships, not all relationships were positive that impacted their undergraduate engineering experience.

4.2.6 Indifferent

Indifferent was found in the academic and social domains. Indifferent was appeared when a person in the relationship was very passive in their interactions. The relationship clusters Indifferent was found in: institutional staff, STEM peers, Non-STEM peers, and housing peers. Three adjectives formed

the category of Indifferent and eight participants had relationships that were Indifferent. Table 9 below provides further insight into indifferent and how it was experienced by the participants.

Table 9 - Overview of Indifferent Category of Description

Domain	Adjective	Relationship Cluster	Participants
<i>Academic</i>	Mundane	Institutional staff	Cholin, Zachary
	Nonchalant	Institutional staff; STEM peers; Non-STEM peers	Bryce, Clayton, Daniel, Shannon, Sloan, Ryaan
<i>Social</i>	Aloof	Housing peers	Ryaan

Participants perceived some their interpersonal relationships as un-eventful and very ordinary. Academically, Indifferent was used to describe an interpersonal relationship where the person was uninterested. Often, interpersonal relationships with institutional staff were mundane and nonchalant. For example, Zachary highlights the mundane interpersonal relationship with institutional staff.

“Professors have kind of been kind of two dimensional and the fact that they just spit information at you and expect you to just to regurgitate it out.” Zachary emphasizes how his relationship with his professor is lackluster and almost robotic. Similar to Zachary, Daniel describes his relationship with his engineering advisor and how he felt that they didn’t express any interest or enthusiasm towards him and his academic schedule. *“My...engineering advisor wasn't too helpful. I mean it was just like I say, “is the schedule fine yet?” Like, that's it.”* Through both of these examples, institutional staff stood out the most when it came to conveying an indifferent behavior towards the participant.

In addition to academics, participants viewed some of their social interpersonal relationships as Indifferent. Socially, a participant felt that their interpersonal relationship was aloof when they felt that the person would purposely distance themselves from interacting with them. Ryaan elaborates on this feeling further in the quote below:

The people aren't really like social at all... Like, I remember the first day of school like everybody's like all the people like will like open up... your doors so you can meet some people and stuff... and try to introduce yourself to others...Being new to college, I'm like, okay, I know my door is open, I

go around like trying to see people and it's just a lot of people like on their computers like gaming or just like they're locked the doors and stuff. (Ryaan, Housing peers)

For Ryaan, he had a higher expectation that his peers in his living-learning community would be more engaging and want to interact with him. However, he soon realized that he would have to find other ways to have engaging interpersonal relationships with peers. Participants who viewed an interpersonal relationship as Indifferent felt a lesser degree of negativity than Uncivil.

4.2.7 Coming of Age

Coming of age was found in the academic and social domains and represented a major shift in the perspective of the participant that was brought out from an interpersonal relationship. Participants perceived their interpersonal relationships as a realignment of their focus and greater self-awareness of their academics and, subsequently, their role. The relationship clusters that were came out from Coming of Age include: institutional staff, housing peers, STEM peers, industry personnel, and other. Two adjectives created the category coming of age across nine participants. More information regarding the category of coming of age is described in Table 10 below.

Table 10 – Overview of Coming of Age Category of Description

Domain	Adjective	Relationship Cluster	Participants
Academic	Awakening	Other; Institutional staff; Housing peers; STEM peers	Alanson, Ryaan, Sherrard, Zachary
	Conscientious	Industry personnel; Other; Institutional staff; Housing peers; STEM peers	Alanson, Cholin, Clayton, Matthew, Ryaan, Shannon, Sherrard, Zachary
Emotional/Mental	Awakening	Other; Institutional staff; Housing peers; STEM peers	Alanson, Daniel, Ryaan

Academically, the participant changes their current momentum when it comes to how they would generally approach their studies. Ryaan discussed one of his interpersonal relationships as conscientious regarding his academics with his living-learning community peers:

The one thing that like stuck... the most about them is whenever we go out to eat or anything like that they're [my peers are] always like, "oh, we're going back" and I'll just be like, "why", [my peers will say] "oh we have to do our assignment, you know like we make... we set time aside to do that."...So it's just like, time management stuff and I just needed to be like surrounded by like self-motivated people... I just realized that... those were.. like the people for me, you know... Sophomore year I definitely surrounded myself with people that aren't really like all about like the culture of... being in college and stuff but rather...we're here for a reason, or paying like money for this... (Ryaan, Housing peers)

Ryaan describes the change he felt after looking at how his living learning community peers were self-motivated.

An awakening emotionally and mentally was interpreted when the participant had a change from their prior perspective or outlook that had a deeper resonance for the participant. In the quote below, Ryaan describes his awakening when talking about his high school peers who attend the same institution as him:

Kind of gave us a fallout and I think it was a well needed, like break that I needed to have [because] cuz it kind of like left me as an engineer, like all alone and I sat there, and I had to realize, you know, I had all this time. I have all these resources and opportunities that I need to push myself and like get instead of, you know, sitting and waiting on why like I can be like one of the smart kids in class and stuff on how come I can't move on to like the material as fast as the other people and also like I just started, I was able to, like, look around for people that are like that are not going to sit back or are going to be at my pace, but people know like lift me up, you know...But I think that like now that like I kind of had an awakening to realize like the opportunity. I'm given like I think it definitely helped me to like kind of like switching on my own and like be focused on like not stopping the grind you know. (Ryaan, Other)

For Ryaan, the fallout with his high school peers helped him learn to grow take an active role not only in academics but how he views other areas of his life. There were only a handful of participants who described a coming of age where they had a transition that impacted them both academically as well as emotionally and mentally.

4.2.8 Relatable

Relatable was one of the few categories of description that emerged across multiple domains: academic, emotional/mental, professional, social, and spiritual. Relatable was viewed when the

participants shared similarities to a person. The relationship clusters that was found for Relatable include: family, STEM peers, housing peers, institutional staff, industry personnel and other. Three adjectives created the category of Relatable and Relatable appeared for all 14 participants. Table 11 highlights the various overlaps of multiple domains for similar relationship clusters and participants.

Table 11 - Overview of Relatable Category of Description

Domain	Adjective	Relationship Cluster	Participants
Academic	Relatable	Family; Other; STEM peers; Housing peers; Institutional staff	Alanson, Bryce, Clayton, Daniel, Matthew, Ryaan, Sherrard, Travis, Zachary
Emotional/Mental	Relatable	Family; Housing peers; STEM peers	Clayton, Ryaan, Sloan, William
	Empathetic	Family; STEM peers	Alanson, Daniel, William, Zachary
	Sympathetic	Other; Institutional staff; STEM peers	Bryce, Shannon, William
Professional	Relatable	Industry personnel; Other	Bryce, Matthew
Social	Relatable	Other; Institutional staff; Housing peers; STEM peers	Alanson, Bryce, Clayton, Cholin, Daniel, Matthew, Ryaan, Shannon, Sherrard, Sloan, William, Zachary
Spiritual	Relatable	Other; STEM peers	Alanson, Bryce, Matthew, Sloan

Participants showed several areas of feeling relatable from their academic to spiritual domains. Academically, relatable was viewed when a person was able to express common similarities of academic experiences. Daniel expressed feeling relatable towards his STEM peers:

We were in all...[in] the same classes but didn't know. So then, like, you find it by like talking about the professors and like this was crazy when that happened, and stuff like that. I was able to relate to him more. (Daniel, STEM peers)

Having a sense of relatability academically to his STEM peers helped Daniel feel more accepted and ultimately create stronger friendships with his peers. Participants felt similar perceptions of academic relatability to their STEM peers as well as their relationships with their fraternity brothers, high school peers, mentors, and church peers.

Emotionally and mentally, participants often felt that the person was able to understand them and what they were facing. Relatable sometimes appeared in interviews where participants described a person's ability to sympathize or empathize with them. In the quote below, William talks about one of his relationships with a STEM peer:

She was completely supportive of me and then in the wake of all of the protests of like George Florida and, of course, Jacob Blake and stuff. She [is] always like is the first one to reach out to me and asked, like, how are you doing, how do you feel in this sort of thing. Like, I know this sort of thing can be stressful and I just want to, you know, [be] here to help. Again... she's not promoting this like white Savior effect like I'm the only one that can help you and I'm the one that steps into this but just being a friend at some that's there and supportive and understanding is really someone who really helped me get through it. (William, STEM peer)

William describes the ability of his STEM peers to comprehend or have similar feelings of understanding towards the participant.

Relatable also appeared across multiple domains within one relationship type. Professionally, participants viewed the person as having a common ground where the participant currently is and where the participant sees himself professionally. Socially the person was able to relate to the participant during social interactions and spiritually, the participant is able to relate to the spiritual background of the person. Matthew described his mentor who is also a Black man and how it impacts not only his interactions with the mentor but how he views his level of advice:

Even though he has a different personality than I do, I can identify with a lot of the social, professional, and spiritual struggles that he goes through and I'm having someone that's like... 10 maybe 15 years older than me like having that sort of look into the future, to see how things play out and like having that advice from the future to the past. It's pretty great. (Matthew, Other)

For Matthew, his mentor impacted many domains: professional, social, and spiritual. In the quote above, Matthew explicitly describes how having the interconnected domains with his mentor makes for a more fulfilling relationship. Similar to Matthew, several of the interpersonal relationships mentioned during the interviews overlapped with multiple domains.

4.2.9 Informed

Informed was found in five domains: academic, emotional/mental, financial professional, and social. Informed was used to represent interpersonal relationships where the participant gained information from a variety of domains. The relationship clusters that had Informed characteristics were: family, institutional staff, housing peers, STEM peers, industry personnel, Non-STEM peers, and other. Four adjectives created the category informed and it was viewed by 14 participants. More details pertaining to Informed is in table 12 below.

Table 12 - Overview of Informed Category of Description

Domain	Adjective	Relationship Cluster	Participants
Academic	Helpful	Other; Family; Institutional staff; Housing peers; STEM peers	Alanson, Bryce, Cholin, Clayton, Daniel, Marvin, Matthew, Ryaan, Sherrard, Shannon, Sloan, Travis, William, Zachary
	Insightful	Other; Industry personnel; Family; Institutional staff; Housing peers; STEM peers	Alanson, Bryce, Cholin, Marvin, Matthew, Ryaan, Shannon, Sherrard, Zachary
	Knowledgeable	Family; Institutional staff; Other; STEM peers	Alanson, Bryce, Daniel, Marvin, Matthew, Shannon, Sherrard, Travis, Zachary
	Resourceful	Other; Family; Institutional staff; Housing peers; STEM peers	Alanson, Bryce, Cholin, Daniel, Marvin, Matthew, Ryaan, Sherrard, Shannon, Sloan, Travis, William, Zachary
Emotional/ Mental	Helpful	Other; Family; Industry personnel; STEM peers; Institutional staff	Alanson, Bryce, Cholin, Clayton, Marvin, Ryaan, Sherrard, Sloan, William
Financial	Helpful	Family; Institutional staff; Housing peers; STEM peers	Alanson, Daniel, Shannon, Sherrard, Sloan, William, Zachary
Professional	Helpful	Industry personnel; Family; Institutional staff; Other; STEM peers	Alanson, Bryce, Cholin, Daniel, Matthew, Shannon, Sherrard, Sloan, Zachary
	Insightful	Institutional staff; Other; Industry personnel	Alanson, Bryce, Daniel, Matthew, Ryaan, Shannon, Sloan, Zachary

Domain	Adjective	Relationship Cluster	Participants
	Knowledgeable	Industry personnel; Family; Institutional staff; Other	Alanson, Bryce, Cholin, Daniel, Ryaan, Sloan
	Resourceful	Family; Other; Institutional staff; Industry personnel; STEM peers	Alanson, Bryce, Daniel, Matthew, Shannon, Sherrard, Sloan, Zachary
Social	Helpful	Other; Industry personnel; STEM peers	Bryce, Marvin, Shannon, Sherrard, Zachary
	Insightful	Other; Non-STEM peers; Housing peers; STEM peers	Alanson, Marvin, Shannon, Sloan, William
	Resourceful	Family; Other; Institutional staff; Industry personnel; STEM peers; Non-STEM peers	Alanson, Daniel, Matthew, Sloan, Travis

Academically, participants described their STEM peers and institutional staff as helpful and would provide feedback on the participant’s coursework. Typically, in the academic domain, the person would be resourceful as they were typically above the participant academically (i.e., professor, upperclassman) and provides learning opportunities for the participants. Cholin discusses his interpersonal relationship with his institutional staff as resourceful and insightful. *“Made me more feel like I was doing better and like I can learn more and I think they actually helped me get through the coursework and like learn and understand that this is how I'm supposed to do things.”* Cholin felt that he had a deeper level of resources that were available to him from his relationship with his professor.

Emotionally and mentally, participants felt that some of their interpersonal relationships assisted them as they overcame battles mentally. Marvin discusses how helpful his peers from high school are when it comes to his trust issues with other peers at the institution:

Some problems with like trust... because some people like to say some [stuff] behind my back that weren't true...they [my peers] said that I shouldn't really care what others say about me as long as I know it's not true... and those friends from high school, I really haven't talked to them that much, but every now and then I definitely do [talk to them]....[I talk to them about] like any like socially, mental health and everything like that [I] talk to them. (Marvin, Other)

For Marvin, although he didn’t interact with his high school peers often, they continued to provide a sense of relief and understanding as they’ve known him for a long time.

Financially, some participants received monetary funds from their interpersonal relationships. William discusses how his family is able provide additional support for him financially even though he himself does not appear to be in financial need:

I hate to say it sounds kind of like snarky but like monetary they [family] support me even though... I still like to work for my own money. Like my dad is very like well off, financially, so he's always willing to, like, help me if I need anything monetary. (William, Family)

William viewed his relationship with his family as financially helpful since they sent him money. Although a few participants described receiving monetary assistance from their family members, some participants described how being a work-study student under an institutional staff member was also financially beneficial.

Professionally, some interpersonal relationships allowed the participant to see how their own experience could be years later. The level of insight would often provide a positive perspective for the participant. Often the participant would describe a relationship with their mentor, family member, or institutional staff. However, one participant mentioned how he viewed his relationship with a major club peer in a professional domain. In the quote below, Shannon describes one of his major club peers and how he has a desire to adopt or mimic some of those traits or qualities:

Seem very professional and I like how organized they are so it kind of makes me sit there think that for the club like there is one person actually I don't know his name or anything, but I've seen him in most occasions and he's like he's in a fraternity. And he was like, president of two different clubs, I think. And so that kind of inspired me to try and do that myself. (Shannon, STEM peers)

Shannon explains how seeing his fellow peer hold multiple positions in organizations and carry himself in different settings increases his desire to be like him. Sometimes, professionally an interpersonal relationship provided a linkage for something that the participant learned in school and could apply to a real-world application, such as through a co-op or internship experience.

Socially, Informed appeared when a participant believes the relationship adds to their overall experience at the institution. For Alanson, he describes how his mentor was able to help not only academically with items pertaining to his major but socially as well with their knowledge:

Opportunity to get connected with other African Americans in the engineering program and somebody who had already gone through it was able to kind of mentor, get me off to a good start...I was able to kind of have a network of people there who had a wide background of not just engineering students but also a wide variety of other majors, but also many different years

of experience. So, I was able to also rely on that both helped me with my studies and to get a[n] outside of engineering perspective. (Alanson, Other)

In the quote above, Alanson’s mentor was able to help the participant adjust to a new environment. Like Alanson, several of the participants mentioned a sense of feeling helped as a common perception and experience of their interpersonal relationships.

4.2.10 Embracing

Similar to Informed and Relatable, Embracing is comprised of five domains: academic, emotional/mental, professional, social, and spiritual. Embracing materialized when a relationship had a high degree of concern for the participant. The relationship clusters that Embracing appeared in were: family, institutional staff, non-STEM peers, STEM peers, housing peers, industry personnel, and other. There are 12 adjectives that formed this category for 14 participants. Table 13 below showcases the Embracing category of description.

Table 13 - Overview of Embracing Category of Description

Domain	Adjective	Relationship Cluster	Participant
Academic	Encouragement	Other; Family; Institutional staff; Non-STEM peers; Housing peers; STEM peers	Alanson, Bryce, Cholin, Clayton, Daniel, Marvin, Matthew, Ryaan, Sherrard, Shannon, Sloan, Travis, William, Zachary
Emotional/ Mental	Concerned	Other; Institutional staff; STEM peers	Clayton, Ryaan, Shannon, Sloan, William
	Encouragement	Industry personnel; Other; STEM peers	Cholin, Marvin, Ryaan, Shannon
	Inspiring	Other; Family; Institutional staff	Alanson, Bryce, Daniel, Sherrard, William
	Loving	Family	Alanson
	Proud	Family	Daniel, Sloan, William
Professional	Encouragement	Institutional staff; Internship personnel	Bryce, Shannon
	Inspiring	STEM peers	Shannon
	Welcoming	Industry personnel	Cholin
Social	Brotherly	Other	Ryaan, Zachary
	Considerate	Other; Institutional staff; Family; Housing peers; STEM peers	Alanson, Daniel, Matthew, Ryaan, Sherrard, Sloan, William, Zachary
	Dedicated	Other; STEM peers	Sloan, William
	Engaging	Other; Family; Housing peers; STEM peers	Cholin, Daniel, Ryaan, Travis

Domain	Adjective	Relationship Cluster	Participant
	Friendly	Family; Other; Industry personnel; Housing peers; STEM peers; Non-STEM peers; Institutional staff	Alanson, Bryce, Cholin, Clayton, Daniel, Marvin, Matthew, Ryaan, Sherrard, Shannon, Sloan, Travis, William, Zachary
	United	Other	Alanson, Zachary
	Welcoming	Other; Institutional staff; Industry personnel; Housing peers; STEM peers; Non-STEM peers	Alanson, Bryce, Cholin, Clayton, Matthew, Sherrard, Shannon, Sloan, Travis, William, Zachary
Spiritual	Encouragement	Other	Bryce

Participants felt comforted from several relationships, ranging from a romantic peer to an undergraduate research member. Participants felt that they were encouraged, especially when it came to their academics. For Marvin, he discussed a feeling of encouragement from his family when it came to his academics:

She's, like, just try your best and would talk to me a bit over summer. Like don't beat yourself up too much over a grade that you don't like. Like, that's a good grade like you are in [institution] engineering, which is an accomplishment within itself. So, don't beat yourself up but as long as you just keep trying hard as you've always been, you definitely will reach all your goals. (Marvin, Family)

Marvin felt that his parents helped boost his overall self-esteem compared to how he originally viewed his academic progress.

In the emotional/mental domain encouragement provided a sense of motivation and care for the participant's overall well-being. Sloan elaborates on how he feels a member of the institutional staff at his institution is concerned about him. Participants also concluded similar perceptions of concern from their club sports peers, mentor, romantic partners, and STEM peers:

He's like [to] me have you been sleeping and like... He's always like that father figure or mentor figure who always checks it out to make sure you're good. You are doing things that you need to outside of just engineering because often engineers tend to forget that sleep is necessary or just get so focused on the tasks we have. (Sloan, Institutional staff)

For Sloan, he felt that the level of concern the institutional staff member had for them assisted with other items pertaining to his transition to college.

Professionally, the person encourages a sense of optimism and confidence for the participant. Cholin perceived his interpersonal relationship with industry personnel as going above and beyond when it came to making him feel like he was welcomed and belonged during his internship:

I'm really comfortable working there and I want to keep going back to it... my direct supervisor... was like the first person I more or less interacted with people that live there or work. I mean, He's really cool, he's like really personable... He was really into like building up the internship pool or the pool of interns when I got there. (Cholin, Industry personnel)

Cholin's relationship with his boss helped him feel comfortable enough at his internship where he wanted to intern there again.

Socially was sometimes viewed when the participant described a strong connection to their peers had a deeper level of connection. Zachary describes the brotherly connection he has with his fraternity in the quote below:

It's great to, you know, find that brotherhood first year to help you kind of find your way in college and make sure you have... [a] strong foundation of friends when you come in... there's not that many African American males or Black males at [institution] so to see them and have them about, you know is one of the one of the greatest gifts I could ask for...no matter where you go, you'll have somebody looking out for you. (Zachary, Other)

Zachary's fraternity helped him feel united by seeing other supportive Black men. While brotherly was used only in the social domain and appeared when participants talked about their fraternity or with their band peers, some participants expressed feeling welcomed from their interpersonal relationships. In the quote below, Cholin discusses the welcoming feeling he has with peers in a non-major club:

I think a lot of times [in club]... [it is] a nice open space where you feel... where everyone's very welcome, welcoming everything. So, it's just like a lot of fun, more [re]lax[ed]. It's like, just where I go to have fun... The people that tend to go to the [club]. They're always like really welcoming and everything and that that's like pretty important for me because I'm always I'm like very shy so like...if I feel like it's like someone that's like not... want[ing] me to be there. I'm going to feel like a little bit off put but normally, like the [club] everyone's always really nice and everything like that. (Cholin, Non-STEM)

For Cholin, he felt embraced in his non-STEM club even though he is an engineering major.

Spiritually, encouragement was perceived when the person poured themselves into the person and it subsequently gave the participant a boost. Bryce describes this feeling with his church peers:

When all the engineers are down in the dumps and like everything just kind of sucks because engineering can do that. Being able to go to people who aren't there. And those times are the different places that was incredibly helpful for, I don't know, just unpacking and unwinding. A lot of the stress of engineering that's sometimes hard to do as engineers... Being able to have people

outside of engineering to go to on a regular basis and talk to [was] super helpful...and like he poured into me a lot in terms of just like spiritual growth, but like also very practical life things. Additionally, I think they all poured into me in different ways for me... During the winter of like my first year, like I had some like medical issues going on in my family at home. And so that was really hard on be coming back my spring semester... One of my small group leaders like [church peer] was like there for me in that sense for emotional stability and like strength and so that structure was really amazing and then when it came time to, you know, like yeah, I've been moving forward. One of my closest friends currently is in one of those small group, [church peer], who I like interact with regularly and so like being able to have those common strings from my first year, all into my fourth year even though they they've already graduated and doing different things with their lives has been really helpful for me personally to see that. (Bryce, Other)

Bryce also adds to the viewpoint of how important it is to have friends outside of engineering and with things like spirituality to pour into others. Similar to some of the categories of description mentioned above there was overlap of how the participants discussed their interpersonal relationships.

4.2.11 Summary

The ten categories of description represent the ways participants experienced their interpersonal relationships. Table 14 below provides the definitions of the ten categories of description.

Table 14 - Summary of Categories of Description

Category of Description	Explanation of Category of Description
Competitive	Participants depicted a rivalry or contest nature, typically referring to the academic success of others
Solitary	Participants described feeling alone
Lighthearted	Participants discussed a jovial experience
Venturesome	Participants depicted trying new things typically out of their comfort zone
Uncivil	Participants expressed ill-mannered experiences
Indifferent	Participants illustrated the person had little to no interest in their affairs
Coming of Age	Participants described a newfound self-awareness of themselves compared to others and/or society at large
Relatable	Participants explained experiencing similar sentiments
Informed	Participants explained new knowledge that was gained
Embracing	Participants expressed a degree of concern or understanding of their needs

Although most of the categories of description were positive, two of the categories were indicated negative perceptions of their relationships. Nevertheless, my results show that the ways participants experience their relationship tends to fall in either the academic, emotional/mental, financial, professional, social, and spiritual domains. In addition, the categories of description provide a deeper understanding to Bronfenbrenner's Ecological Systems Theory as to not just what type of relationship, but how the relationship informs the participant's development.

4.3 Variation (Outcome Space)

My third research question focuses on the variation of interpersonal relationships that exists for Black men within and across their respected institutions. In order to visually capture the variation that exists between the relationship perceptions of the participants, I followed phenomenographic methodology that suggests creating an outcome space. The outcome space is constructed by organizing the relationship perceptions also known as categories of description, using formal phenomenographic terms, in a logical hierarchy (Juvonen, 2006; Juvonen et al., 2012; Martin & Dowson, 2009; Wentzel, 2010). I created an outcome space based on the prevalence that a category of description appeared at an institution. The categories of description are organized in a color gradient from least prevalent (bottom; red) to most prevalent (top; blue).

In the text below, I begin by presenting the outcome space of PWI1 and PWI2. I conclude with a summary highlighting the similarities and differences of the outcome spaces of PWI1 and PWI2. Next, I present the outcome space of the one HBCU participant in my research study. Though I discuss similarities and differences of the PWI outcome space compared to the HBCU outcome space, the data is presented to be viewed as a counterexample. I provide text to supplement each of the outcome spaces presented.

4.3.1 PWI1 Outcome Space

Figure 6 below is compilation of the outcome spaces from the eight participants from PWI1: Alanson, Cholin, Daniel, Marvin, Matthew, Ryaan, Travis, and William. Participants from PWI1 viewed their interpersonal relationships to focus on all ten categories of description. As a reminder, PWI1 is a four-year large, primarily residential institution in the Southeast.

As seen in Figure 6, the majority of participants from PWI 1 had relationships within the Embracing, Informed, Lighthearted and Relatable categories of description. Each PWI1 participant

expressed at least one of their interpersonal relationships within the Embracing and Informed categories of description. Lighthearted appeared for seven participants, while Relatable emerged for six participants.

Fewer participants from PWI1 experienced relationships in the Solitary, Competitive, Indifferent, Uncivil, Venturesome and Coming of Age categories of description. Coming of Age and Venturesome showed up for five participants and Uncivil appeared for four participants. The remaining categories were Indifferent for three participants, Competitive for two participants and Solitary for one participant. Informed covered more domains than Embracing and similar to Informed, Relatable appeared for almost all of the domains.

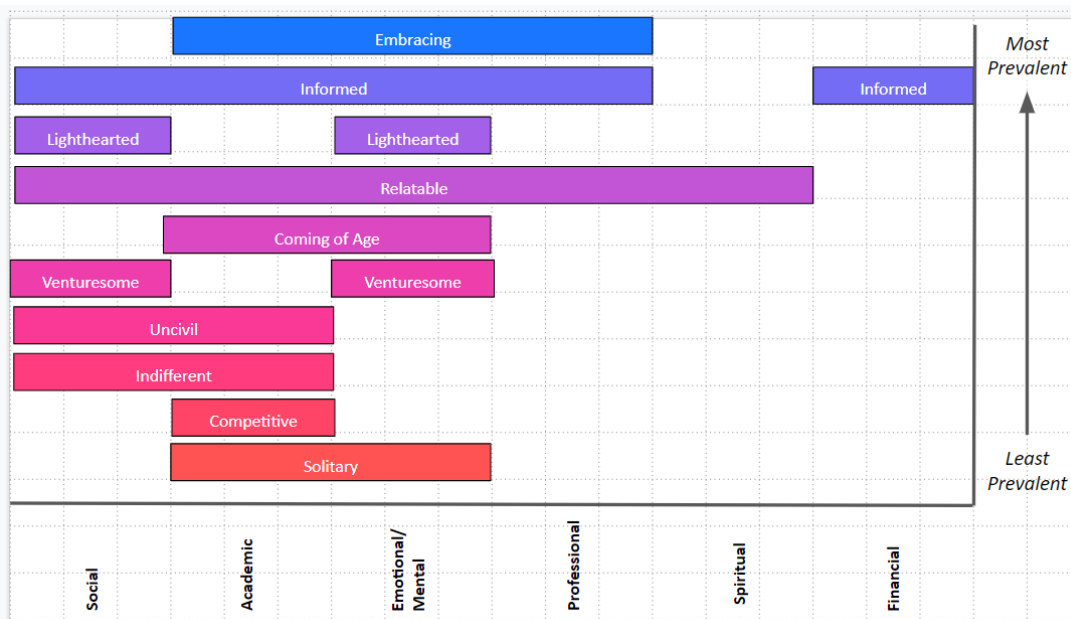


Figure 6 - PWI1 Outcome Space

4.3.2 PWI2 Outcome Space

Figure 7 below represents the outcome space of PWI2 which included five participants: Bryce, Clayton, Sherrard, Sloan, and Zachary. PWI2 is also a large four-year, primarily residential institution in the Southeast.

For PWI2, all five participants expressed Embracing, Informed, and Relatable categories of description. Fewer participants described Indifferent, Coming of Age, Competitive, Lighthearted, Uncivil, and Solitary categories of description.

Embracing and Relatable shared the same five domains while Informed also had five domains but did not include the spiritual domain which Embracing and Relatable shared. Four participants

explained Indifferent and three shared Coming of Age, Competitive, and Uncivil. Lastly, one participant emphasized Solitary. Participants from PWI2 viewed their interpersonal relationships were from all of the categories of description except Venturesome.

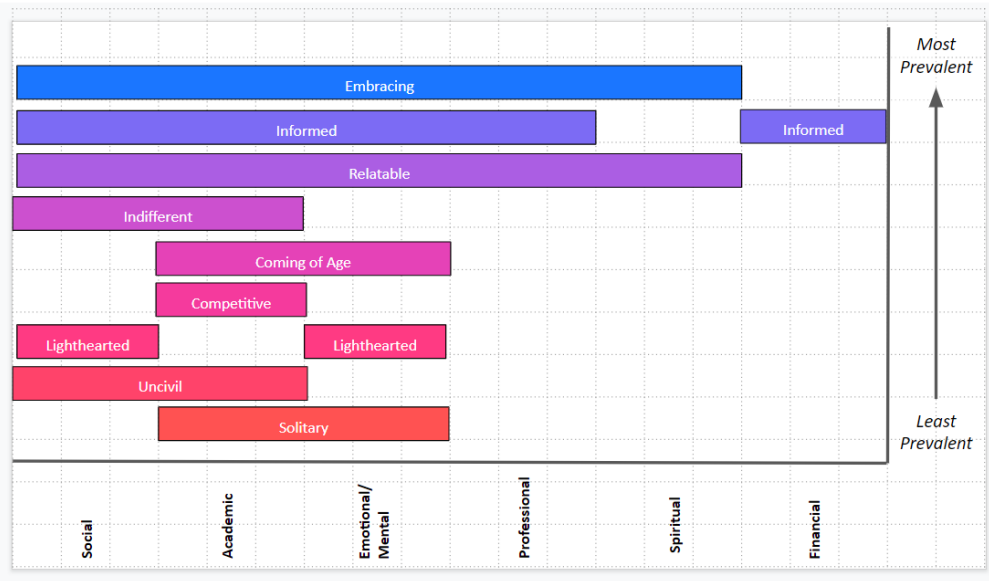


Figure 7 - PWI2 Outcome Space

4.3.3 PWI Outcome Space Summary

The outcome spaces of PWI1 and PWI2 provided unique similarities and differences. In the social domain, both PWIs showed similar categories of description; however, PWI1 had the category of Venturesome which PWI2 did not. Academically, both PWIs had the same categories of description. Academics held the most categories of description for both PWIs followed by tie with social and emotional/mental domains. Similar to social, PWI1 had the category of Venturesome for the emotional/mental domain where PWI2 did not. Professionally, both PWIs had the same categories of description and spiritually, PWI2 had the added category of embracing which PWI1 did not. Both PWIs showed the same categories of description for financial. For PWI participants, more interpersonal relationships focused on the social, academic, and emotional/mental domains. While fewer relationships emphasized the professional, spiritual, and financial domains. Table 15 below provides a summary comparison table of the similarities and differences of the PWIs.

Table 15 - Comparison of PWI Outcome Space

Domain	Categories of Description	PWI1	PWI2
Academic	Coming of Age	X	X

	Solitary	X	X
	Uncivil	X	X
	Indifferent	X	X
	Embracing	X	X
	Relatable	X	X
	Informed	X	X
	Competitive	X	X
Emotional/Mental	Solitary	X	X
	Lighthearted	X	X
	Venturesome	X	
	Embracing	X	X
	Informed	X	X
	Coming of Age	X	X
	Relatable	X	X
Financial	Informed	X	X
Professional	Relatable	X	X
	Informed	X	X
	Embracing	X	X
Social	Lighthearted	X	X
	Venturesome	X	
	Uncivil	X	X
	Indifferent	X	X
	Relatable	X	X
	Informed	X	X
	Embracing		X
Spiritual	Relatable	X	X
	Embracing		X

4.3.4 Counterexample from an HBCU Student

Although potential HBCU participants were recruited for this study, only one participant (Shannon) participated who was from an HBCU and figure 8 represents their outcome space. The HBCU participant in this research study was enrolled at a four year, medium highly residential historically Black institution in the Southeast. For the HBCU participant, Embracing and Informed appeared in most of the domains followed by Relatable. Lighthearted and Uncivil appeared in the social domain and Indifferent and Coming of Age appeared in academic. Only seven categories of domain showed for the HBCU participant.

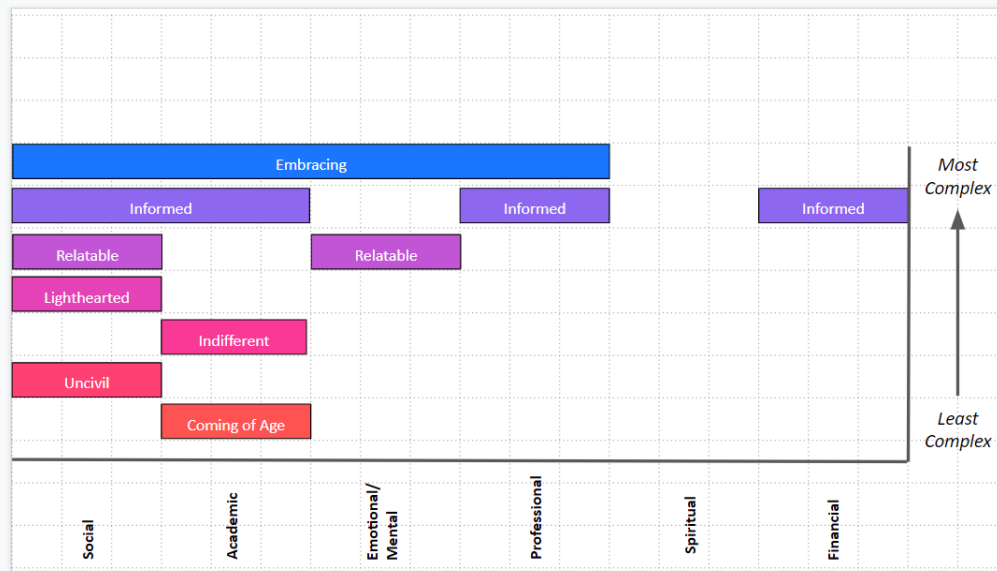


Figure 8 - HBCU Outcome Space

The HBCU participant showed a few similarities and differences compared to the outcome space of the PWI participants. Unlike for PWIs, which showed academics as the leading domain, social was the leading domain for the HBCU participant. Socially, the HBCU participant did not include the categories of description for Indifferent and Venturesome. Academically, the HBCU participant did not show categories of description for Solitary, Uncivil, Competitive, and Relatable. Emotionally and mentally the HBCU participant did not show Solitary, Venturesome, Coming of Age, Lighthearted, and Informed compared to the PWI participants. Professionally, the only category of description that the PWIs had that the HBCU participant didn't Relatable. Spiritual did not appear as a domain for the HBCU participant however, Informed appeared for both the HBCU and PWI participants.

As a whole, more interpersonal relationships focused on the academic and social domains for the HBCU participant while fewer relationships focused on the emotional/mental, professional, spiritual, and financial domains

4.4 Environmental Influences

Lastly, my fourth research question focused on understanding the environmental influences that impact the interpersonal relationships of Black men in undergraduate engineering programs. A total of five major environmental influences were discussed by the Black men in my study. The themes are: 1) institutional standing, 2) institution type, 3) gender 4) race/ethnicity, and 5) national events. I begin this

section by providing more details of each environmental influencer. I use quotes from the respected interviews to elaborate on each of the environmental influences that was identified within the domains that they appeared. The quotes used to represent each of the environmental influencers are not mutually exclusive.

4.4.1 Institutional Standing

Institutional standing appeared when participants described how their academic standing impacted their experience in engineering. Participants mentioned their specific engineering major, academic class year, and transfer status. Institutional standing was found in the academic, professional, and social domains.

Academic Major

Academically, a participant's major often impacted the perceptions as well as interactions and conversations of the participants. Participants stated that the perceptions of their STEM peers made them question their credibility as an engineer and also the rigor of their academic major. In the quote below, Daniel elaborates on the difficult nature of his engineering major:

It's definitely made my experience more difficult like in terms of like work. It's listed like everyone talks about like [engineering major A] or [engineering major B] is the hardest engineering to take and I'm like yeah, I'm not sure that I should have thought about that and maybe I should have just done [engineering major B] and then like the [concentration of engineering major B]. But I keep coming back to [engineering major A] like doing the [engineering major A] in a full [engineering major A track] like it's definitely affected me in turn of like workload and like a lot of concepts and stuff like that. But I definitely enjoy it though.

(Daniel)

For Daniel, although he questioned if he should continue to pursue an engineering major, he decided to ultimately stick with the major he chose.

In addition to academically, Bryce discussed how the makeup of his major encouraged more interactions and conversations with his peers which affected him socially as well:

I think [institution curriculum coordinators] kind of built in either directly or indirectly the [engineering major] program [which] fosters a lot of community on and a lot of small group interactions and so I mean, I didn't choose it for that reason, but I'm grateful that it does come

with a package and so I think the major of choice helped me to like be able to develop close like academic friends. (Bryce)

Bryce felt that his engineering major helped create an easier way to interact with his STEM peers. Not only was it easier to make friends, but Bryce was able to make a closer circle of friends.

Professionally, Cholin mentioned that he would have more access to jobs because of his specific major. "I wanted to be like an [engineering major] because of the money that they make in the job. Like everyone says that engineering and engineers are in high demand specifically [engineering major] engineers."

Class Year

In addition to academic major, a participant's class year impacted their interactions with others. In the interview Daniel reflected on how his class year dictated the types of clubs he could be involved in and subsequently his prospects of gaining technical experience:

Like as a freshman, I felt like I thought that I couldn't do anything... Because like when you go to [club]. They're like, we don't look towards freshmen [because] we want people with experience and I'm like, well, how do I get your experience if I don't work for you. Just like kind of like going back and forth like I felt like I was like I have to find a way to get this experience, but there's no new resources like that that kind of what helped me go towards design teams and stuff like that because now it's like I need to find a way to do so. Being a freshman definitely made me think about how to get experiences... technical experience, even though I haven't done a job or anything. (Daniel)

When Daniel was a freshman, his credibility was questioned by his academic peers.

Transfer

William was the only transfer student in my study. In the interview, he mentioned how he sometimes felt like he had to prove himself academically when it came to interactions with institutional staff. William describes more of these thoughts in the quote below:

It's honestly been a lot. I wouldn't say easier, but a lot seamlessly like in a bit like I've been able to integrate a lot seamlessly than I expected. I guess it's better to be over prepared than underprepared but I remember preparing myself and emailing all my professors. Once I registered for classes and formulated this giant, big plan and I think I just failed to tell myself these are you've taken classes before like we've done this before. (William)

William felt that as a transfer student he had to fit in with the academic rigor of not only the major, but the institution as well.

4.4.2 Institution Type

Given that this research study included participants from PWIs and one HBCU, some participants expressed their opinions on a different type of institution other than their own. Thus, personal institution refers to the participants' beliefs of the institution they currently attend and other institution type refers to participants perceptions on institutions other than their own. Institution type and other institution type was found in the academic, emotional/mental, professional, and social domains. I first discuss the perceptions of the PWI participants before elaborating on the beliefs of the HBCU participant.

PWI Experiences

Zachary describes the impact of attending a PWI and how he's needed extra support considering on-going National events:

A lot of people don't understand like the danger, we feel when we pass a cop or how they kind of question us before white people and how you know especially like I'm taking a class on race and engineering. And we were talking about all the specific cases about you know how George Floyd and Brown... and how police accountability and all that stuff is like a[n] enormous weight I think on our minds and [as] engineers and I feel like sometimes we feel like we can't do anything about it, or like we kind of feel helpless and like we continuously see these things happening. You know, in the news and that does affect us academically, I think, and I think we had this initiative. It's called [program name] at [institution] and it's where we come together as Black males and talk about, you know, these topics. I think that's been one of the things that has kind of lightened my mind when it comes to, like, you know, being Black... People are sharing their experiences and we're kind of related to each other and kind of get it off our chest about what frustrates us what scares us you know what's making us nervous or anxious as we like conduct ourselves around [campus]. (Zachary)

Zachary states that the National events going around him are hard to ignore and having a space to talk with other Black men has made it easier to cope.

Ryaan describes how impactful it was to see how not diverse his institution was especially some of his peer and sport groups:

Like it's not diverse like even... the smallest thing that like makes you realize that...it's different, you know...I remember like going to classes and stuff and... just seeing another like Black person like walking across the campus and stuff. We both looked at each other and we kind of like nod at the same time to, like, [to] make sure that we're both [the] real type [of] thing, you know, and it's just like those smallest interactions like that stand out to me...After like the recent events like Black Lives Matter and you know all the shootings and stuff like I would be vocal about it and I'd post on social media and stuff and I'd be vocal about it, but it's just I was able to like over the summer see who were like I was able to see people's true colors. I was able to see like who I need to like stay away from, You know, and it's just like there's some arguments that literally blew my mind... I was like shoot like this is, this is crazy. I can't believe you [are] like this, you know, it's just like, I got to see... a lot of my friends' true colors are not friends anymore, but like, and then I got to be close to, like, a lot of like people. I got to like make connections to a lot of like my white peers that were like backing me up, like all the way...

I think also in high school and like college like I have like been involved in stereotypical white activities... Like for [sport] like I did not see like a lot of...people of color like me and my brother, when we were in high school together were like the only Black people on the team... When I went to college, I'm pretty sure I was only Black person here [in the sport]... When I will go on races and stuff like you kind of just look around and just like oh okay so like one of like the small things is just like.. [I'm the] only Black person here like, do they underestimate me and stuff, you know, it's just like that always comes to [my] mind... I've been doing, like, like what's considered white activities and so like going into it to like diversify...Let's say [its] like a forest or something. Right. It's like a bunch of animals and you're all alone. And then like when something happens you're looking around and you're like, oh, like who's going to help me, you know, or like who's not going to be there. That's kind of where I felt like when I was like going into like [institution] and I got to look around...like who around here is a like minded or who's like ignorant about stuff, you know, and I think that like over the summer. Like I was able to like filter out the people...and I was also able to like share my perspective to other people. (Ryaan)

In the quote above, Ryaan talks about how his friend circle changed from seeing their true colors after National events. The events made him have a deeper level of reflection for what was going on.

Matthew states how events regarding BLM has been a harder to experience at his institution and there has been an increase of online racism:

To see others so unbothered by current events is a little you know it doesn't it doesn't feel too good like police violence and the surge of online racism. These sorts of the aftermath of the riots and protests in the summer and even those that are currently happening. And even current displays of police violence and brutality. These events for me and those in the community that I'm a part of our current events, but for others particularly those who don't share the same skin colors. They are almost like an afterthought, like, oh yeah, there's still the Black Lives Matter thing that's going on that's super important and it's like it's acknowledging that it's important but only after it's sort of brought up kind of thing. And you know, when only like four or five percent of population here in [institution] is Black. So that's what if you're constantly surrounded by it it kind of makes the issue feel really small and it's not which kind of sucks. (Matthew)

Matthew is doing the best to balance and increase his support of BLM with the contrasting views by several members of the PWI institution.

For William, he talks about the microaggressions that is often a downside from attending a PWI. However, he provides a unique perspective on being the only Black person in an engineering class and how he has leveraged that for his benefit:

In one way you can say, oh... I'm like the only Black kid in my engineering class and then again you can say in positive ways... I'm the only Black and I know like a lot more different perspectives and other students. Like for example...back in January we're doing a project and I was only Black student in my group, which was pretty normal and we were doing a project where we had to like reroute the bus. Some system where we chose to reroute like the bus online. So I'd go through like [city]...and one of the things that I brought up was that a lot of people in poor Black neighborhoods rely on the bus to get to work. So really putting a heavy emphasis on managing like bus lines that go throughout poor neighborhoods white or Black is definitely a huge thing I know for people. So having that sort of different like experience and different sort of like background even though I didn't come from those [poor] communities. (William)

William noticed that in his group project he was able to provide an alternative perspective that was respected by his STEM peers.

For Alanson, his upbringing encouraged him to see minimal differences in his high school experience compared to his college experience. However, it wasn't until he attended a different PWI institution did he realize the lack of diversity:

Because of the area I came from and the fact that it's not all that different than the environment that's here. I don't think it negatively impacted me as much as it might if coming here had been a

complete culture shock...But I will say, one of the scholarships that I did. It required me to go to a research conference at the [institution] and it was just really different walking around the campus seeing more people that look like me walking around. And it's hard to put into words exactly what it feels like but it's, it's different. (Alanson)

HBCU Experiences

In addition to the PWI participants' perspectives on their PWI, the HBCU participant had his own viewpoint of his institution. For my HBCU participant, Shannon, he recounted how there were times when he viewed the surrounding environment of his institution as racist:

Over up in [city] where my school is if you're driving the police will follow you. I've been followed multiple times and it's a very stressful situation with my skin tone and with my ethnicity and my gender. But like for example, if you have a group of people in your car, you're more than likely to get pulled over. And if you see one [police] car behind you. You may be okay but the moment you see the second [police car] you definitely [are getting] pulled over. I've even been pulled over for open air. (Shannon)

In the quote above, Shannon discusses how he is often targeted by the police in the city of his institution because of his race/ethnicity and gender. Academically, Shannon mentioned how around 90% of his professors are foreign so he has to adapt when it comes to learning the material:

So professors just happens to be foreign and their accent is not necessarily always easiest to understand and some of them like there's a different way to do math in the country that they may originate from and so sometimes they do things a little bit differently than you do, and you just have to learn to adapt and adjust to the way they do things...His notes that he wrote on the board [are] like hieroglyphics, and I couldn't understand what he was saying...In that case I will say 90% has been like that for me. (Shannon)

In addition to having to understand foreign professors, Shannon talks about how his class sizes are small and have a family-like air to them:

Our classes are a lot smaller. So it's kind of a bit more close knit it seems just a tad bit more like a family, but not quite there yet... I think that it definitely helps out a lot because you get to know the teachers a tad bit better or like the representatives that come from each job they get to learn you a little bit better because there's not as much competition. (Shannon)

Since the class sizes are smaller for Shannon, he gets to have more relaxed interactions with his professors and company recruiters because there is less competition which helps professionally. Lastly, Shannon emphasized the lack of resources available to him at an HBCU:

I'm the president right. There have been two or three different teams who have built cars on my team. Come, our time to build the car, we were left no resources whatsoever. There was no instructions on how to do it. Like most other teams have like we have no foundation to truly learn how to build a racecar from scratch and this is not like we could just search. How do you, how do you build a racecar...So it's very custom and we, we didn't have any tools really we barely had any script. We didn't have any screwdrivers... I was able to get some tools to work on cars, but there's still a lot we need to learn like we need fabrication tools and we need people who know what they're doing. We need a welder. No one no one in our club knows how to weld or there's a lot of things that we haven't been exposed. (Shannon)

Shannon had to improvise not only as the President of a STEM-based club, but because he didn't have any guidance on how to overcome the few resources he had to meet the club's purpose.

4.4.2.1 Other Institution Types

Other institution types refers to the beliefs that one participant had on another institution type. For example, what the HWI participants believed about HBCUs and what the HBCU participant believed about PWIs. Showcasing both perspectives is not meant to be representative of the entire experience for HBCU and HWI participants, but to be used as a counternarrative.

HBCU Assumptions

Professionally, for Cholin, he felt that he would have joined diversity-focused engineering clubs sooner if he attended an HBCU and would overall feel more support and even be provided more job opportunities:

I feel like there's a lot more support systems for specifically catered towards like Black engineers at HBCU rather than at a PWI. I think that because there you have when people would go to like, they, we want to get more Black engineers in like a company like oh, like we realize that we are probably not too diverse... There's probably like Black engineering alumni that'd be like oh I want somebody to come to the company. They'll be like, oh, I do have someone from my alma mater.
(Cholin)

Cholin believed that thought that HBCU alumni would be more inclined to recruit for students from their alma mater. However, Cholin also mentions the lack of resources that an HBCU he considered attending had compared to his current PWI institution:

But I would I think unfortunately I think [HBCU] they had like the smaller campus, so I had less resources. So that's both, whereas [PWI]. They have like everything for like it engineering. Suppose, because it's a larger school and it was a specifically catered towards engineers. Whereas [HBCU] was like a more general university. (Cholin)

Cholin posits that because his PWI institution is catered towards engineers and has the resources to support engineers unlike an HBCU which is a general institution.

Sloan discussed how by attending a PWI, he was more prepared to engage in meaningful interpersonal relationships with people in the real-world and during his internship experience:

I think he had I attended had I not attend a PWI. I don't think I would have recognized the real-world...most work of the work environment is white female well white males and other people, different from myself and that's a fair representative of the company. So I'm leaving the interview, but often it's just two white males doing the interview or like a white female and the white male... So being at [PWI] made me recognize and be mentally prepared for being with that group of people. I went to school in [city] where majority of people weren't Black so for me it wasn't too much of shock because I had done programs where I was the only Black kid. (Sloan)

Sloan's upbringing also impacted his views on what his experience might be like if he had not attended an HBCU.

PWI Assumptions

In addition to PWI participants speaking about their viewpoints of HBCUs, my one HBCU participant spoke about PWIs. For Shannon, he had a unique perspective on PWI students. Shannon believed that several PWI students are unaware of the realities that exist for Black men. He thinks that PWI students have a more negative view of Black males and part of the reason for this is the lack of exposure and interactions to people who share the same racial identity:

It's like someone that attends an HBCU I think they have a more positive mindset on the Black male. I think their perspective comes from, like, at [an] HBCU you're mainly surrounded by other Black males and females. I feel like the main the perspective comes from, like, most of everyone

around you has had either the same experiences some worse or maybe even less. And there's just a great, great understanding and everyone kind of understands what we have to go through, because we fall in some way, shape, or form had been through it. But as some students who may go to a PWI they may or may not have been through the same experiences and so they may not understand. They may not be wired like that to understand. (Shannon)

Shannon also alludes to the notion of the academic coursework might be harder at a PWI however an HBCU student is just as capable of doing a similar level of work. *“But I'm not necessarily sure... the work will be harder at a PWI or not, but I know that anyone at [an] HBCU is just as capable of doing any task given to them.”* Lastly, Shannon mentions the size of the two institution types and how HBCUs are smaller than PWIs:

Like if you go to a PWI most of them are huge and you could drive around for about 30 minutes or so and still be on the campus when you could drive for five minutes and have gone through my whole campus.

Shannon views that people think HBCU students are not as academically capable as PWI students.

4.4.3 Gender

Gender appeared in the participants' academic, professional, and social domains. Gender often impacted the participants when it came to their interactions and perceptions with other STEM peers. Socially, participants mentioned their gender when it came to being an ally for other women in the field and aspects of masculinity. William mentions his gender and how he tries to make women in the field of engineering more comfortable:

I can see how a female coming into engineering might feel it might feel really daunting to any female. So I think being a man in engineering isn't really that like unique... It's not unique in the sense that they're just a lot of men in here, but I think it's unique in the role that you help and uplift like women that come into engineering. I think that's one of the things that I really am passionate about too because I've definitely seen like women that come into engineering classes and feel like really alone and scared... I always try and say, like, hey, do you want to like partner and work on this project or something together or work on these like problems or something just to try and like get them around like you know, say, hey, there is like a friendly guy here in engineering, you know, that isn't like isn't just want like a guy who just wants to, like, who likes for you know who I am, you know, and not even like pursuing it like romantic or something. Just

trying to like just be a friend, you know, because I know how daunting. It is there's like a box being like a Black student and I can't imagine how daunting and maybe only female. So I think that's where the role of like men come and to play in engineering, even though there are so many men. So sometimes it can be to figure [out]. What is my role. You know, I think that is a very like obvious one to play. (William)

William has a strong desire to help women in engineering and is intentional about making women feel welcomed in the field. Academically, he also alludes to the privileges that he has as a man in the quote above.

Professionally, Cholin talked about his privilege in engineering and how it impacts more than the peers around him but society at large as well:

I think that being a man as an engineering student you get like the privilege of being in a major where society is more expecting of the people in that major to be a man so you don't have to deal with... the fact that, oh, I'm the only person that might be like, oh no, I'm the only man in this class, like, oh, you don't have an alienation or anything like that in terms of when it comes to your gender. It is an easier transition when you get to be in a job plus they are more inclined to want to hire you. (Cholin)

Cholin mentions how because society looks at the field of engineering as male-dominated that he does not feel the same impacts that a woman would face as being the only woman in a classroom. In addition, he sees being a man as more valuable professionally. On the other hand, Daniel emphasizes sometimes feeling like a token in some of his spaces:

I feel like I don't do enough like I should be doing more to. Like diversity I guess just like you know make sure everything kind of fits right you know like not like having only male people do like maybe we should find people who aren't just the same. Now also, like, I feel like I don't want to make people feel how I did as a token piece of like...I am thinking of like how we perform and stuff like that and the role I play in forming those groups. (Daniel)

Academically, Daniel recognizes that by being a male in some spaces he plays a role in increasing the diversity at his institution. Likewise, he also doesn't want to be seen as the only person to be able to show an increase in diversity.

Some participants explicitly mentioned Black women as a counternarrative in their discussion of gender. Zachary elaborates on Black women in the quote below:

I think like a lot of Black men forget that, you know, we're males and we have a privilege of, you know, not having to go through some of the things that women do. So especially like now with

the you know Roe v. Wade and having some of their I guess some of their rights infringed upon its kind of another thing that I would never have to imagine or go through, you know, on a daily basis. So I think that's another that's just a privilege I was, I was born with and something I just need to have empathy for other women especially Black women. Like engineering women in STEM that they have another battle that they're also facing on their front and we just need to support them on that as well as Black men. (Zachary)

Zachary shows a sense of empathy for Black women and alludes that because Black men also exist in STEM that they should be very supportive of what they experience.

Sloan more explicitly emphasizes the masculinity that he feels that he should embody from his peers.

The downside for me because I'm a man often, people expect me to behave, a certain way. For me, I'm more reserved I'm someone who will instead of going out will be cooking on a Friday night for myself or invite people over and cook for them and stuff like that. So often people will come in and they're like, are you gay or not, but I'm like, no, I just, I just don't subscribe to you or things are considered as a man... There are also times that people expect me to do some things as a man by I don't. They yeah they often have to consider what they think of as a man, I just think and recognize that I'm not just a man I'm [participant name]. (Sloan)

For Sloan he sees how his peers have stated that he doesn't prescribe to traditional norms of what it means to be a man and masculinity as a whole. In addition, Sloan mentions his sexuality being questioned because he does not align with the masculine standards of his peers.

4.4.4 Race/Ethnicity

The impacts of race/ethnicity emerged in the academic, emotional/mental, financial, professional, social, and spiritual domains. For some of the participants themes emerged surrounding African culture, a desire to defy stereotypes, feelings of being the token Black person, and elements of colorism.

African Culture

Some participants discussed their race/ethnicity via their African culture and self-identified during the interview as a first- or second-generation African descent. For example, Ryaan mentioned a sense of academic rigor when it came to their interactions and conversations with their family members:

They're always like pushing me. You know, it's just like the one thing about... African parents is like they always like want better for my whatever you do. Like I could be, Hey, you got 100% of those and they're just like is there extra credit like would you do, would you do it? Did you do anything else and stuff? And so they're always like wanting like more. (Ryaan)

Ryaan's parents often put higher academic standards for him and he constantly felt a need to achieve more.

Similar expectations were shown in Sloan's interview transcript. Sloan felt an obligation to give back to his home African country based off of his experiences growing up as a child.

We literally had no electricity for approximately a year so they know those kind of stories and, you know, while it was hard we've come, we've been able to make it through. So, I recognize that the things I'm doing. It's not just for fun. No doubt whatever we have, we have to give back and recognize where we come from... So it's always like, go back and I'll go back and recognize where you come from. (Sloan)

Sloan consistently remembered his dedication to give back to where he came from. Also, Sloan, learned to consistently extend a helping hand to those in need. He expands on his culture by discussing how his spirituality also impacts how he looks at his experience at his institution:

Obviously, my culture and my faith in God. For me coming into [institution] I had to take all kinds of things... So technically, I don't even need to worry about what credits are going to graduate and that's because of my faith in God. It was hard, but I trusted that God had a plan for me and he knew was going to do... So, my experiences are so let people know that my faith in God has brought me where I am... So just having faith in God in knowing that God is all the help [to get] me through all those tests and quizzes and the number of things I do want to do. (Sloan)

While faith was heavily tied to Sloan's environment and identity, one of the participants mentioned how he felt conflicted to identify with a particular sub-group.

In the quote below Bryce talks about trying to emotionally/mentally and socially negotiate between the different identities that he has and those that are placed on him because of his race:

I'm a first generation [African country] which you know comes with a lot of blessings, as well as like some some things to process on that end... [My], parents came from an immigrant third world country and so there's this expectation to, you know, do well...it feels like the intersection of, like, three worlds. Right. I think, you know, traditionally, if you're Black you're working with, like, you're...kind of...in the intersection of, you know, predominantly white culture and then a

Black culture, which is very diverse, not a monolith there at all, but now, those are the kind of the two interactions, but like I think being, you know, first generation immigrant, [my] Parents [are] from [region of African country]...It's like kind of three things are working with where you know, culturally, like you're going in, like in society, you're viewed as Black and then you're in a predominantly white culture right so that's kind of navigating those three different circles, when there's sometimes in this association like some things that that don't feel completely compatible. Interesting enough between like being Black and being here... there's some cultural things and there's some understandings that don't carry along the same way even through society...

There's a mindset among [region of African country] that like [region of African country] who immigrated to the [United] States that like we are not Black. And that is, unfortunately, like... very stereotypical and unfortunate things that a lot of like African immigrants might like put on on African Americans. And so this, this idea of like don't dress like that don't look like that. Don't talk like that you're not them your separate... It's more of a cultural thing my parents don't do it directly or at least intentionally if it is, it's like implicit... Knowing that my experience isn't always the same as a lot of African Americans and just kind of like navigating like, you know, do I do, I refer to myself more as like a an African American, or like an African and they're just know small nuances. (Bryce)

Bryce was able to provide another level of insight into the various stereotypes that exist among African cultures towards African Americans.

Defy Stereotypes

In addition to African culture, several of the participants stated how they felt a stronger desire to defy stereotypes based off of their interactions and conversations with their immediate peers and acquaintances. In align with defying stereotypes, some participants highlighted how academically they believed that people underestimated their abilities. William talks about his frustration with being primarily viewed and assessed by the color of his skin:

You only got in [institution], because you're Black, and a lot of things don't make me like physically mad that statement makes me like actually mad and actually angry because it essentially I just think of all the nights that I spent like until like five in the morning in the library, just to get this one problem, right and then for someone to say that it matters because of the color of your skin not how hard you work is really downplayed to me and luckily I've learned to

just kind of throw it over my shoulder and say you're full of BS. I don't care... I see myself as sort of this person to kind of...like skew the results of what people have as people think of like a Black person in engineering. Like when people think of what other like white people might think of Black people. Um, I don't think they think of me. You know, like when people always get surprised at how I talk or how articulate...that is a huge motivator for me to just like do better and to present Black people in a better way, other than just like an athlete or just someone who got in, because they were Black through affirmative action or any other like thing. (William)

William felt a desire to prove someone wrong and other participants mentioned similar sentiments.

Professionally, Shannon states how he felt that he had to prove some of his non-Black co-workers:

I feel like a lot of us will prove some others, like for example at my first dealership that I worked at working on cars. I walked in on a few a what's called a few non-Black coworkers, while they were in one department. I walked in on them trying to say that I would not amount to anything and that, I will funk out of college and everything. So I feel like as a Black male engineer, I'm kind of proven them wrong even and care less what they said. (Shannon)

Shannon viewed his race as a deterrent for his co-workers to engage with him.

Like Shannon, Alanson felt that he was underestimated in his perceptions by others. Alanson, discusses feeling like he consistently has to do things to make sure people look at him unbiasedly:

I guess this is kind of going back even to when I was little, I was kind of always told like you have to almost have to earn your place more than other people will have to. So that kind of has stuck with me that I have to really be the best I can be in order to make it. So I kind of took that into coming here as well. Really trying to make sure I stay on top of my academics, but in addition doing other things doing [club a] joining [club b] just trying to expand my network and yeah, make sure that I had people that I can talk with and make sure that if somebody you know looked at your resume, they don't have a reason to say no. Well, my mom told me I was back in probably elementary school and I don't remember so much the context of the conversation. It was something that stuck with me. I mean, I'm sure that's something that she learned growing up yourself. Just something that can be imparted to us. (Alanson)

In the quote above, Alanson reflects on how he started having this perspective from as early as elementary school and how he should perceive his interactions with others because of his race.

Token Black Person

In addition to defying stereotypes, some participants mentioned feeling like a token in regard to their race. Daniel states more about tokenism in the quote below:

At times I feel like... I'm really wanted for input and stuff... like [on] how things affect different communities and there are times I feel like I'm just like the token piece to be like hey look, we have a Black person here to represent and like, I don't know. I would like I would like my role to be more than that, you know, be more like my actual work and experiences then just being like, you know, being a Black person. (Daniel)

For Daniel, he wants to be known as more than a Black person in spaces.

Zachary discusses what it means to be the only Black person in spaces and how joining with someone who shares similar identities can make the engineering experience more bearable:

Have another Black male along with you in that journey is like really powerful because you can like tag team stuff... and we bounce off each other and it kind of we kind of just like iron sharpens iron type thing as we, as I get better he gets better... We work on, you know, our assignments and stuff together so we always know what's up. (Zachary)

Sharing the same race and gender as peers created more degrees of freedom for Zachary. For Marvin, he saw his race as something to help better position him for job opportunities:

I'd say [it] increase my chances of like getting this job or like going to the program because if they crave that recipe there's something to be aware that since I carry that recipe that means that there's a lack of it. And if there's a lack of it in there might be some micro aggressions like some resentment towards you and how you got it, I got it got it got program or job [a] bit better than other people. (Marvin)

Colorism

Although Marvin has his race as an overall positive feature when looking for jobs, some participants expressed feelings of racism. Shannon talks about one of his experiences with racism in the quote below:

Like I've noticed, like in predominately white areas the darker someone's skin is the more afraid they are even though they don't know a single thing about that person. So it's it's crazy. My best friend for example, he's way darker than me. And it's like, when he walks around like especially people who aren't like those just like you see him as intimidating already, even though he hasn't even done anything just chillin... but I get the same the same thing every now and then just not

as bad and I don't know it's just seems like the the prejudging before they even get a chance to understand their mindset or anything. (Shannon)

For Shannon, he discussed how the darker the skin tone, the more likely someone will find you intimidating based on his experiences. Also, Shannon mentions that he has felt similar sentiments even though he has a lighter complexion than his best friend. Nevertheless, there were participants who didn't see a difference their race had on their interpersonal relationships with others.

4.4.5 National Events

The two National events came out of the interview transcripts: Black Lives Matter (BLM) and Coronavirus (CoVID). National events impacted the academic, emotional/mental, professional, and social domains. Given the timing of data collection, participants had varying degrees of exposure to BLM, which started July 2013, and CoVID, which started January 2020. Data collection occurred October 2020.

Black Lives Matter

BLM impacted many of the interactions and conversations the participants had in their social interactions and interpersonal relationships with their peers and institutional staff as well as the surrounding people of the world. For some participants, their peers expressed an understanding or were more concerned while others had heightened levels of fear. Socially, Matthew discussed how he became more questioning of one of his close peers at his institution:

Some of my friends that I have, I've since grown a little distant in their choices of apparel, or the logos...the logos or certain political mantras in which they adopt seem a little more harsh now. It's a little more difficulty than benefit of the doubt...one of the individuals, I mean, she goes to [institution]... I noticed her laptop... it was a sticker that supported the police, which is again perfectly fine. We, you know, I can get into the politics of that. But, you know, least in and of themselves. That's, that's pretty straightforward...it was just sort of the wording kind of came off a little like aggressive, it was kind of sort of along the lines of the Blue Lives Matter sort of thing where it's sort of trying to like change the Black Lives Matter Movement... Like of course you know the lives of police officers matter. That's very clear. Everyone's like, you know, we don't just throw people under the bus, obviously, but I just feel like with the Black Lives Matter Movement and all of the all of the importance that's behind it all the hurt that's associated with it to kind of

like sort of change around the name of it and related to the very institution that we're working to reform is a little Inconsistent and that sort of in consideration in my eyes always has a little bit of a sort of sassy and sarcastic feel to it. (Matthew)

Matthew began to take a heightened sense of awareness when it came to different political stances of his peers and for some he is no longer close with.

In the lengthy quote below, Zachary talks about a similar emotional/mental struggle with BLM and his peers:

You're also kind of put at a disadvantage because, you know, not everybody knows, kind of like the struggle we went through especially like with the news and stuff... I remember back in high school, I was kind of surprised when you know Trayvon Martin, Michael Brown, and all those people were like in the news and like they were just like a like a Black face that people saw especially in my high school. There were like a lot of controversial views and a lot of conservative people at my high school who likes supported the police and didn't really understand the plight of Black males in America and how like we were kind of discriminated against, especially when it comes to law enforcement...and especially now, like our conversation [is] getting more intense because all these issues that are especially now rising Black Lives Matter and stuff like that.

I remember high school back in 2016 like people were arguing that and I thought it was just something normal that yeah All Lives Matter. But now when I came into college... I had empathy for people that said all lives matter. I just, you know, I was like, yeah, sure, but I didn't know that saying all that last minute was a refutation against Black Lives Matter. I shouldn't say against Black Lives Matter now... being educated more about, you know, the issues that we face, I realized that, you know, especially being Black how many hoops you had to jump through of systemic racism and systemic racism [is where] you get where you are and seeing.... [people] going to me and talking about this stuff. We had to talk about this stuff last semester [in an African American Studies class] and we kind of broke down what we had to go through in high school and things like that to get to where we are today and the list was over you know over 50 items long 50 to 100 items long and it's just like we made it through that and all of our peers didn't have to go through what we've been through. (Zachary)

Zachary had a revelation in college on what it meant to say Black Lives Matter versus All Lives Matter. In one of his college classes, he was able to get a deeper understanding of the systematic racism that exists and its impact on him as a Black scholar.

Nevertheless, Shannon expresses how despite what is going on Nationally related to race, he has to stay committed to his education and not engage in any of the current events going on around him:

The way society views us and everything I feel like we're, we have a lot of stress built up due to that and so we kind of have to learn to balance it and focus on our school work. Like there's multiple riots going on right now and you kind of feel their pain. You understand why rioting and you kind of have to sit back and will you not necessarily sit back when you don't want to sit back and just watch everything before. But see, you can't do so much because you're in a school and you need to make sure that you get your education and don't get kicked out. (Shannon)

Shannon wishes that he could actively engage in the riots however he is cautious that it could negatively impact his academics. Similarly, Shannon noticed how events circling Black Lives Matter impacted his professional spaces as well when it came to his internship:

Yes, like for example my own when I went to [internship company], my boss invited me to his son's birthday party, which he just so happens to be Black and he's adopted and his whole family and a lot of other white people in there not necessarily [internship company personnel], but a lot of other non-Black people in that area were very unaware of some of the things that were taking place and why people are rioting like they only heard of George Floyd... They haven't heard of the thousands of thousands of others... They're just not necessarily aware of all the things [in] the US that people have to go through and he even one of his reasons for inviting me to his son's birthday party was he wanted me to teach his son how to grow up as a Black man and how to deal with that and explain the whole police brutality things to him and everything else. (Shannon)

Shannon was instructed to explain how to be a Black man to his boss's son as well as educate his boss's family members on the events surrounding BLM.

For some participants, the political events brought them closer to their peers. Daniel found refuge in his friend group to help balance the stress around him:

I guess it's kind of brought me closer to my friends.... It was like January to June and July, right. There were a lot of political events and climate and everything in that. In those moments I got like kind of depressed... It's like the 15th time [someone's gotten shot] we've done this in like my lifetime, and nothing has really changed... My friend...they're like, oh, man, it's gonna get better

working towards that...kind of take the small steps and we'll finally get to where we need...They definitely have helped me get through... I think sometimes back of like [how] different times were like, wow... I'm trying to think of like like a Trayvon Martin and like all those like events of like a Black teen [that] gets killed or a Black man or woman is...nothing really gets changed since then even though if there's like a moment like a really do something get these things passing nothing gets past like that. (Daniel)

Daniel felt emotionally distraught by the lack of change that was being put in place.

Global Pandemic

CoVID impacted participants primarily academically and socially. Academically, Sherrard was studying abroad when CoVID came so he was unable to have a complete abroad experience:

I was there for almost three months... the thing about the program was that we had just started classes before it [CoVID] hits. So, I had to come back and I had only been in class for like a week. So, really it was mostly online classes and this [study abroad institution] semester started later than like [institution] semester. So, by the time I had like come back they were like, halfway through the semester when I had just started mine. So, when everybody was like on summer break, I was like, still do like finals and finishing things up so yeah... A combination of being abroad coming back dealing with CoVID. There's just a lot so that definitely put a lot of strain and stress on me like additional. (Sherrard)

Because Sherrard's study abroad experience put him at a different place in the academic calendar compared to his home institution, he had delayed academic breaks with the onset of CoVID.

Participants also mentioned how it was harder academically to show a level of engagement with their professors. Ryaan elaborates on this in the quote below:

I haven't obviously because of the virus and stuff. Having to like reach like the teachers one on one but like last year like second semester I was able to like go up to the teachers and introduce myself and be like, hey, like I like this lecture, like this is good stuff now. And I unfortunately I wasn't able to like continue that this year. But you know, I try here and they're like trying like smallest things of, like, you know, turning on your camera and focusing and asking questions like, I try that. But it's just they still doesn't feel right it feels like a TED talk, instead of like, like I like them actually teaching you know just feels like a lot like that is a lecture bus just like, you know what I mean, like, it's just I just feel like they're there because they have to talk instead of

like seeing me and being like, Oh, like, like I can like help you and guide you like this one stuff, you know. (Ryaan)

Ryaan compares his experiences pre and during CoVID when interacting with his professors. While Ryaan tries to be engaging by doing things like turning on his camera and asking questions, he still feels that there is a level of distance and the professor is mostly talking at him.

In addition to academics, some participants expressed how CoVID impacted their level of engagement with their peers:

Like we tried to meet up. It kind of hit us hard when we all had to leave at spring semester. I'm really getting over [not having] that closure, but we all actually got together again. Probably sometime during the summer, we were able to kind of meet up and do like socially distance techniques and those things. (Alanson)

In the quote above, Alanson expresses how he wanted a sense of closure from his friends since some of them graduated without an ability to say good bye. Nevertheless, Alanson was able to find time to meet up with those peers and receive closure.

CoVID did produce a few positives for participants. For example, Cholin mentioned that it was easier to learn some of his more rigorous classes since professors would record their lectures. It gave Cholin the chance to go back and re-watch them. In addition, Alanson mentions how CoVID impacted his internship below:

For [industry name] that was just kind of weird because it was all online... the one thing I like[d] the best that they did was they had these end of day groups. So at the end of most days we would get together with a smaller group that's probably like nine ish people and that was kind of the only time we got to actually interact directly with people, but there it was a four week program and for the last week, we got to do a project together more or less with our end of day, and we actually really kind of became close knit group, even though it's all virtual and after you know, working together for that week it actually made me keep in touch now. (Alanson)

For Alanson, having the transition to a virtual internship helped him to stay in touch with his colleagues and have more connections with others.

4.4.6 Summary

The results in this chapter indicate that Black men tend to utilize seven relationship types. The relationship types provide positive and negative perceptions for the Black men in my study. A total of ten different ways emerged as to how Black men experience each of their meaningful interpersonal relationships. Looking across the participants by institution type, there were few differences between the two HWIs. Five environmental influences surfaced for the participants which impacted how they perceived some of their interpersonal relationships with others. Overall, participants mentioned a vast number of implications their environment had on their interpersonal relationships in engineering. Each of the environmental influences can be mapped to the exosystem, macrosystem, and chronosystem of Bronfenbrenner's Ecological Systems Theory. In tandem, each of the environmental influences impacts the exosystem and macrosystem while the chronosystem establishes how several of these items change over time.

Chapter 5

5 Discussion

My dissertation is focused on understanding the various interpersonal relationships of 14 Black men in undergraduate engineering programs at one HBCU and two PWIs. Bronfenbrenner's Ecological Theory was used as a lens to explore the impact of interpersonal relationships on the experience of Black men in their engineering programs. While literature has looked at interpersonal relationships, there has been a scarcity of research that examines the positive, negative, and neutral types of interpersonal relationships Black men have with others beyond role models and mentoring. There is also a limited amount of literature that looks at the complexity of interpersonal relationships as several studies refer to an interpersonal relationship as an isolated event or interaction with someone, typically an instructor (Endo & Harpel, 1982; Pascarella, 1980; Sax et al., 2005).

I build on the growing level of literature that emphasizes approaching students in a holistic, ecosystem approach (Anderson et al., 2014; Lord et al., 2019; Pinar et al., 2011) and subsequently argue the need to look at a student experience as a living entity that has the potential to be influenced by factors both known and unknown to the student. In alignment with my interpretivist worldview, my exploratory study was aimed at qualitatively understanding the different aspects of interpersonal relationships experienced by Black men in undergraduate engineering programs. Although literature cites some examples of interpersonal relationships and their influence on a student (den Brok et al., 2010; Frymier & Houser, 2000), there is minimal information on how specific relationship types are meaningful to students and how environmental influences also impact those relationships. My dissertation addresses this literature limitation and provides a conversation surrounding interpersonal relationships, especially for Black men.

In the following sections, I first discuss my findings before connecting them to current literature on interpersonal relationships and when applicable to Black students and/or Black men in engineering or more broadly STEM. I conclude my chapter with implications and suggestions for research and practice.

5.1 Relationship Types

The participants in my study utilized a variety of interpersonal relationships that consisted of people both internal and external to the structure of the institutional environment. However, all of the

participants described two interpersonal relationships—STEM peers and institutional staff members, which was similar to previous literature on interpersonal relationships (Baker, 2006; Jager, 2011; Juvonen, 2006; Kelley et al., 1983; Love, 2009; Martin, 2014; Martin & Dowson, 2009; Palmer & Gasmna, 2008; Zandvliet et al., 2014). STEM peers encompassed numerous relationships, from peers in the same engineering major as the participant to peers from a STEM-based summer transition program. For example, Daniel’s STEM peers included those who he participated with during a STEM-based summer transition program, peers who were in a club that was specific to his engineering major, peers who were in his engineering major, peers who were in a STEM diversity-focused club, and peers who were in other STEM majors. Each of these interpersonal relationships with STEM peers were impactful to Daniel and influenced his undergraduate experience in engineering. Like Daniel, several of my participants mentioned a variety of STEM peer relationship types.

My findings both align with and do not align with previous studies regarding the usefulness of peers in the undergraduate experience. While I referred to these interpersonal relationships as peers for my study, it appears that literature sometimes calls these interpersonal relationships “friendships” during early adolescent ages, suggesting that it is during mid to post adolescent age when friends become peers (Hartup & Stevens, 1997; Rubin et al., 1998). While others have created scales to measure how a person defines a friendship (Spencer & Pahl, 2006), my dissertation opens an area for conversation to further understand the nuances between when a person is designated as a friend versus a peer. For my study, I chose the word peer to designate someone who has a similar status (e.g., academic year, age) as the participant. Nevertheless, peers have been shown to be important in student development. In fact, Erikson’s theory of psychosocial development states that a major developmental task of a person in their early 20’s is to create close relationships (Erikson, 1963). As students get older, peer relationships change and peers are often viewed as a primary attachment figure (Carbery & Buhrmester, 1998; Fraley & Davis, 1997). Peers have also been shown to have positive impacts on the academic and social development of students including their satisfaction at an institution (Astin, 1992; Chickering & Reisser, 1993; Martin, 2013; Martin & Dowson, 2009; Pianta et al., 2012; Wentzel, 2010).

Despite the numerous studies that mention peers within the context of a relationship, my study adds to literature on interpersonal relationship types by open-endedly exploring how students assign meaning to peer relationships. In doing so, I expand the definition of peer beyond confinement to a particular area of the student experience. For example, Ryaan, one of the participants in my study, mentioned a falling out with one of his friend groups in college. At the time, the fall out was detrimental to Ryaan; however, he made a new friend group and learned better study skills. Ryaan’s story can be

viewed as a counter example to literature that posits that peer relationships with conflict is correlated to maladjustment and poorer grades of the student (Burk & Laursen, 2005). For Ryaan, the conflict with his friends was a catalyst for him to re-evaluate his levels of engagements with his peers and sent him on a more positive academic trajectory.

In addition to peers, various employees of the institutional were mentioned by all of my study participants, where the majority of participants referred to instructors/professors within this relationship cluster. Although a professor may have a short duration to interact with a student, i.e., an academic semester of five months, they can still have a lasting impact on a student's development (Mansour & Martin, 2009). For example, Ladson-Billings (1995) emphasizes the need for teachers and professors to use culturally relevant pedagogy, especially those who instruct African American and Hispanic/Latino students, to promote successful learning and engagement opportunities for students. Some of my participants mentioned having an academic advisor or a director focused on engineering diversity who created an environment that encompassed some of the tenants of culturally relevant pedagogy when interacting with the participant. Culturally relevant pedagogy encourages instructors to provide an experience for a student to: experience academic success, develop and/or hold cultural competencies, and develop a critical consciousness. Sherrard, one of my participants, summarizes this notion best when he reflected on his relationship with an institutional employee who was focused on engineering diversity. Sherard describes his employee as someone who, "was always there to just listen, whatever the conversation was you know he was a part of it." For Sherrard and other study participants, feeling valued and seen by institutional employees increased their levels of engagement.

Family has also been highly cited by literature and was mentioned by my participants. Some authors have found that a student's relationship with their parents' and parents' network impact one's educational attainment and aspirations (Zandvliet et al., 2014). And when it comes to parents, the higher a parent's academic expectations and educational values and standards, the stronger a student will be academically (Martin & Dowson, 2009). My findings align with prior literature suggesting that family plays an important role in the academic achievement of students (Bempechat & Shernoff, 2012; Pomerantz & Moorman, 2010), some of which highlights a linkage between parental involvement and educational outcomes (Furrer & Skinner, 2003; Martin & Dowson, 2009). These studies illuminate the unique role that parents have on their children. My dissertation expands this notion, however, by adding culture as another compounding factor to why a parent might set high academic expectations. By moving away from Westernized ideals on the role of parents, my work discusses how culture can impact students who identify as first-generation Nigerian, Ghanaian, or Haitian.

Participants also described relationships with mentors and industry personnel. When mentors are described in higher education, they are typically discussed within a formal or informal mentoring program. However, the participants in my dissertation also discussed non-traditional types of mentoring, where the mentor was unaware that they were viewed as a mentor. These insights parallel (Smith, 2015)'s work on the mentoring experiences of African American females in undergraduate engineering programs and literature that suggests mixed findings regarding if same race/gender or cross race/gender mentor-mentee pairs provides more successful student outcomes (Cohen & Steele, 2002; Hu et al., 2008; Johnson et al., 2007).

My study aligns with work that encourages the need mentors and role models for students (Burke, 1984; Ensher & Murphy, 1997; Jacobi, 1991; McKeen & Bujaki, 2007; Mondisa & McComb, 2015; Mondisa, 2014; Redmond, 1990; Scandura, 1992) and extends current literature by highlighting industry personnel as a relevant interpersonal relationship in the experience of undergraduate engineering students. Interacting with industry personnel such as an internship experience can shape a student's view on the internship value (Hoyle, 2013; Thompson et al., 2021) and increase their self-efficacy and career aspirations (Morales & Jacobson, 2018; Parker et al., 2016). Similar to prior work Brooks et al. (1995), my participants valued their internship supervisor as they helped increase the relatability of their academic coursework by providing a real-world experience to utilize their gained knowledge.

5.2 Relationship Perceptions

My research aligns with prior literature on student's positive and negative perceptions of interpersonal relationships. Interpersonal relationships that are viewed as positive have been shown to positively impact a student's motivation, engagement, self-esteem, and self-worth (Ryan & Deci, 2000). Participants like Sloan discussed one of his positive interpersonal relationship with the director of an engineering-focused diversity office. Sloan viewed the director as a father figure or mentor who consistently checked in on him and was instrumental in helping him discover he had a learning disability. Sloan later revealed during the interview that the director was a white man and how he had been almost more helpful than the formal mentor who was a Black man he was assigned through a formal mentoring program. Nevertheless, negative perceptions can cause adverse student development and outcomes (Connell & Wellborn, 1991; Furrer & Skinner, 2003; Martin & Dowson, 2009). In my dissertation, Cholin described how a negative interaction with his professor led to subsequent negative experiences and interactions with his professor.

My study also aligns with literature regarding common and uncommon perceptions of relationships. Some students seek out relatedness from others in academic domains so that they are able to have similar beliefs, values, and orientations to those around them (Aron et al., 2001; Ketay et al., 2020). Relatedness among others has been shown to increase students' motivation, engagement, and achievement (Pittinsky, 2012; Wright et al., 2002). Self-expansion theory has sometimes been used to understand close relationships. In essence, self-expansion theory posits that individuals are encouraged to expand themselves with the hopes of achieving self-efficacy and self-growth (Beckes & Coan, 2011; Coan & Sbarra, 2015; Jakubiak & Feeney, 2016; Jakubiak & Tomlinson, 2020). Thus, interactions with people who are complimentary instead of identical have shown increased self-enrichment and self-efficacy (McCabe, 2016).

In her study, McCabe created a social network analysis to understand the complexity of a student and the interconnections of their friendships. McCabe (2016) describes meaningful friendship networks developed in college as three categories: tight-knitters, compartmentalizers, and samplers. Tight-knitters are students whose friends almost all know each other; compartmentalizers are students whose friend circles can be grouped into two to four clusters; and samplers are students who have friends that are less connected to each other. For Black students in Schnall et al. (2008)'s study, several of them engaged in tight-knitter networks of dense interconnected friendships. The author suggests that this is due to students of color who prioritize friendships with people of a similar race as a sense of social support and to combat race-based isolation. Similar to McCabe (2016), several of my participants could be described as having a tight-knitter network as most of their friend circles revolved around an aspect of STEM. Participants like Ryaan were involved in non-STEM based activities and organizations. However, he befriended STEM peers within the non-STEM organization. Nevertheless, under McCabe (2016)'s definition, some of my participants would be considered compartmentalizers as some of their friend circles had no relation to each other. Zachary is a prime example of a compartmentalizer as he had groups of peers in a variety of networks.

When we examine literature on some of the uncommon perceptions that emerged from my dissertation, a variety of data exists. Although Venturesome was a less common perception, research has shown that having a close bond with a person can help decrease perceived risks and encourage exploration (Allport, 1954; Festinger, 1954). One research study found that simply having a friend stand with someone could urge the person to perceive a hill to be less steep than when standing alone (Aron et al., 2013; Wright et al., 2002). As seen with my study, several participants experienced a positive Venturesome relationship that impacted their emotional/mental domain.

Also, social comparison theory (Harris, 2009) has been used to understand why some people might seek out a relationship in order to increase or decrease their own self-esteem. An interpersonal relationship can boost a person's self-esteem even if for a brief moment in time. For example, Cholin highly sought out relationships with industry recruiters at careers fairs to gauge his ability to obtain a job at their company. Cholin believed the industry recruiters would give him a good understanding of any academic deficiencies he might have as well as steps on how he could be a strong applicant. One researcher has taken this a step further to position there is a positive correlation between self-esteem and academic success for Black students in engineering (Martin & Dowson, 2009).

Another, less common perception that can be connected to theory was Coming of Age. Coming of Age emerged only from a handful of participants however, the theme had a lasting effect on the engineering experience of participants. Self-expansion theory highlights that some people purposely seek out relationships with people of different backgrounds than their own to add to their own knowledge and self-efficacy (Kane, 2000). This phenomenon could be seen with Ryaan who started to engage with new peers who did not come from his high school with the hopes of increasing his academic success.

Combined with current literature, my study highlights cultural differences in the treatment of students by their family. Some studies posit there are culturally specific family patterns for different demographics. Kane (2000) suggests that the African American family tends to have five primary traits: (1) extended family networks; (2) adaptable family roles; (3) strong religious affiliation; (4) strong work ethic; and (5) flexible and strong coping skills. Adding to views on the African American family, my study provides another dimension as my non-domestic Black participants cited Competition as a perception from their family members that was not perceived by my domestic Black participants.

Lastly, my research adds to literature on identity, specifically multiple identities. Multiple identities is a conceptual framework that was developed to address traditionally oppressed identity dimensions like race and gender (Jones & McEwen, 2000) and is used to understand how demographic, cultural, and social identities intersect and simultaneously interact with each other (Abes et al., 2007; Settles, 2004). Multiple identities is prevalent even for Black men. While some identities are more visible (i.e., race), the identity held most central by the student could differ. For example, Bryce discussed how they did not identify as African American culturally despite being looked at as Black, by their skin color; they were taught to not identify with domestic U.S. Black people. This belief is evidenced as role distancing as described by (Baumeister & Leary, 1995). In role distancing, Black immigrants will disassociate with domestic Black or African Americans in the hopes to not be associated by the same

stereotypes that commonly exist for Black people (e.g. athletic, aggressive, etc.). However, some domestic Black participants expressed how they felt more impacted by their racial identity over their gender identity. My findings suggest that race should not be looked at as a sole aspect of a person's identity, which combats looking at Black men as a monolith.

5.3 Relationship Domains

In order to further describe the relationship type and perception of my study participants, I created a third area, domain, to provide context to the relationship perceptions. As stated previously, the domains emerged from the data and included: academic, emotional/mental, financial, professional, social, and spiritual. The relationships that my participants considered most impactful affected the academic, emotional/mental, and social domains. The relevance of the domain is supported by literature such as (Ainsworth et al., 1978; Pianta, 1999) who posit that educational programs should have elements that address the interconnected relatable components of the social, academic, and affective dimensions of a student. Thus, my study intertwines with current literature that address academic, emotional/mental, and social student development and expands by adding financial, professional, and spiritual as other areas to address and consider.

There has also been some research to highlight the influence of the emotional/mental support on student development. The notions of the emotional/mental domain in the classroom align with attachment (Lederer et al., 2021; National Academies of Science, Engineering, 2021) and self-determination theory (Ryan & Deci, 2000). Students who feel that they are emotionally and mentally supported are more motivated to learn (Hamre & Pianta, 2001; Silver et al., 2005); and when those feelings are nurtured in the classroom by an instructor, results have shown positive academic and social trajectories (Hurtado et al., 2007; Kuh et al., 2010; McCabe, 2016).

Although I coded my interviews using different domains, several research studies discuss the interconnectedness of these domains especially academic, social, and emotional/mental domains. Socially, it is important for students to have strong relationships with faculty and peers in order to have student success in STEM fields and higher education (Christensen, 2016; Tudge et al., 2009). Moreover, social and emotional/mental skills grow through interactions and relationships (Immordino-Yang, 2011; Immordino-Yang & Damasio, 2007; Nagaoka et al., 2015). Social and emotional development includes the skills needed to create and maintain relationships as well as process information which are connected to the school environment and student success (academic) (Johnson & Weiner, 2017; Jones et al., 2014; Jones & Kahn, 2017). Using multiple domains to describe a relationship perception

appeared repeatedly in my study with several participants. Overall, academic, emotional/mental, and social domains are major areas to consider when it comes to human development and learning (Jones et al., 2014; Jones & Kahn, 2017).

In addition to the domains described above, some of my study participants described their perceptions in the financial, professional, and spiritual domains. Building on previous student retention models by Cabrera et al. (1988), one researcher has added a financial aspect that is important to acknowledge especially for non-traditional students (Sandler, 2000). William in my study provides a unique narrative to Sandler (2000)'s position as he is a transfer student but he doesn't need additional monetary help from his family. Similar to my study, when it comes to the professional domain, literature has shown a relation between the professional development of instructors and student learning (Guskey & Sparks, 2004). Participants in my study heavily utilized not only instructors but other members at the institution as well for their professional concerns. Lastly, some research has looked at spirituality as a connection to the development of ethnic identity (Chae et al., 2004). Ethnic identity refers to a person's sense of belonging to an ethnicity and a person's actions to confirm their identity to a particular ethnic group (Rotheram & Phinney, 1987). Through my dissertation stories like Sloan who briefly his race/ethnicity and he ties to spirituality, my study supports literature suggesting the connectedness of these two areas.

5.4 Environmental Influences

My study adds a significant amount to literature regarding environmental influences on the undergraduate engineering experience. Of the environmental influences, my study helps fill literature gaps on institution types, stereotypes, gender, and national events.

Similar to other research studies, the institution type mattered in my dissertation. A common negative feature of HBCUs is a lack of resources (Moore, 2003). In my study, Shannon mentioned how having a lack of resources impacted his availability to fully engage his student design team. Luckily Shannon was able to temporarily fix this dilemma by borrowing a few tools from his job to assist his student design team. Another participant, Cholin, mentioned how availability to resources deterred him from attending an HBCU. Cholin explain that even though he received a full ride to attend an HBCU to pursue an engineering major, he believed that his current institution would provide him more job opportunities in the future. Positive and negative beliefs about institutions, if never contested, have the

potential to evolve into stereotypes, which appeared in all of the conversations with my study participants.

Stereotypes and beliefs held by participants and others highly influenced how they perceived others as well as themselves. Several of the stereotypes expressed in my study were related to their race/ethnicity and masculinity. My study adds to the growing literature on prove-them-wrong syndrome, which explains the academic and social attitudes of Black men who are able to persist in engineering (Haldar et al., 2020; Schoen et al., 2018). Students who embody prove them wrong will try to defy or counter stereotypes set by others about Black men with the hopes of being viewed more positively. Several studies highlight Black men at PWIs who experience elements of prove them wrong syndrome. Within my dissertation, various participant stories add to this ongoing body of literature. For example, Matthew highlights sitting in the front of all of his classes to make a good impression on his instructors so that he can uplift how his instructors might interact with other Black students at his institution. Similar to a desire to defy stereotypes, literature also cites tokenism as a common feature of some organizations to defy stereotypes (Browning et al., 2021; Son et al., 2020; Wang et al., 2020; Zhai & Du, 2020). While tokenism often refers to sexual inequality, some studies have expressed how people have used tokenism to counter racial inequalities as well. Several of my study participants stated examples of feeling like they were token Black people at their institution.

In regards to gender, participants in my study mentioned elements of toxic masculinity throughout their interviews. Toxic masculinity refers to a simplified idea of “manliness” that is often centered on behaving according to biased characteristics such as violent, devaluing women, and suppression of emotions (Connell, 2005). Research has shown that various aspects of toxic masculinity appear in higher education (Elliott, 2018). In my study, Sloan felt pressured to embody certain traits as a man by his peers. Because Sloan was confident in himself, he did not feel the need to adhere to the stigmas encouraged by his peers.

It is also important to acknowledge how my gender, a Black woman, could have impacted my participant interviews with Black men through the lens of othermothering. In othermothering, children are viewed as members of a community who need a large supportive network (Collins, 1990). Othermothering traces to slavery and is defined as an African American woman that assists another African American woman’s children (Bernard, Issari, Moriah, Njiwaji, Ogban, & Tolliver, 2012; Case, 1987; Collins, 1990). Other mothers ensure that the children are well taken care of as well as their psychosocial development (Collins, 1990). Othermothering has been studied not only in community

environments, but also in education where Black or African American students gravitate towards Black faculty and staff and especially Black women (Edwards, 2003; Guiffrida, 2007). Thus, my study participants could have viewed my role as interviewer in a comparable perspective as an other mother and were more inclined to be transparent and vocal during the interview process.

In addition, this study speaks to the impacts that national events have on students and how it impacts their relationships and even their evaluations of themselves. Research has shown several academic areas that CoVID has impacted for students (Hooper et al., 2020). My study adds to that literature by showcasing how beyond academics, CoVID has impacted participants in other domains, especially emotionally and mentally (Outcalt & Skewes-Cox, 2002; Palmer et al., 2009; Williams, 2014). Also, Black Lives Matter has shown a large impact on participants even for those who do not identify as domestic U.S. Black (Meyer & Turner, 2002). The U.S.'s racial climate surpasses borders and impacts the racial climate for students at institutions (Mwangi et al., 2018) where there has been a surge of racial justice movements (Bonilla-Silva, 2017).

5.5 Implications and Future Work

My findings hold both research and practice implications. Research implications are targeted towards those who are interested in expounding upon this study and further exploring the theories explained. Alternatively, practice implications can be used by practitioners, community engagement personnel, and professionals outside of academia as a program development resource.

5.5.1 Research

First, my research encourages utilizing Bronfenbrenner's Ecological Systems Theory as a flexible framework to analyze interpersonal relationships in addition to its previous applications to campus environments, student identity, academic advising, mental health, and the pre-college spaces. Similar to other critiques of Bronfenbrenner (Kerckhoff, 1986; Toldson, 2008), the physical representation of Bronfenbrenner's Ecological model of showing concentric circles provides a picturesque representation of each of the systems (mesosystem, microsystem, macrosystem, chronosystem) and the interplay between them all. Thus, my research conveys how the macrosystem has a larger impact than expressed in typical studies that use Bronfenbrenner's theory. Like an ecosystem, I have shown how the various systems work in tandem with each other to represent the undergraduate experience for Black men, which is far from monolithic. Nevertheless, some of my study results do align with African American

Male Theory (AAMT) (Bush V. & Bush, 2013). AAMT was created using elements of Bronfenbrenner's Ecological model to understand the experiences of African American men and boys via undermining oppression (Bush & Bush, 2018). AAMT includes an area called the subsystem, which refers to items of the supernatural and the spirit. In my study, four of my participants described interpersonal relationship(s) with a spiritual domain. However, the exosystem for the AAMT includes elements pertaining to urban/rural access to healthcare and the unemployment rate, which did not appear in any of the conversations with my participants.

Secondly, my research heightens awareness of interpersonal relationships and their value in the undergraduate engineering student experience. The Belongingness hypothesis states that individuals have a desire to form at least one lasting, positive, and significant interpersonal relationship (Mcgrath & Bergen, 2015; Rudasill et al., 2010). The hypothesis indicates that this desire is furthered when an individual is undergoing a significant life change or process, such as matriculation through college. A person's desire to fulfill this need yields a positive emotional response which some posit can impact a student's participation and responses to adversity (Martin, 2010, 2013; Martin & Dowson, 2009). Interpersonal relationships, and the support that individuals gain from them, can play an imperative role in a student's perception of themselves, their abilities, and their feeling of belonging in a learning environment. Thus, interpersonal relationships are more than just a "soft skill" and research on interpersonal relationships tends to focus on the relationship types that are important for student success (peers, teachers, family, etc.) (Martin & Dowson, 2009). It can be interpreted that interpersonal relationships are a form of support that students may not know that they need but will benefit them.

In regard to instructors, research has shown how teachers' perceptions impact their levels of engagement with students (Martin, 2013). My research aligns with the notion of connective instruction. Connective instruction provides a framework to incorporate positive interpersonal relationships into educational pedagogy (Martin, 2013, 2014) and leans on the notion that students need relatedness with their instructors and in return have positive academic development (Martin, 2013; 2014). Connective instruction creates an intentional connection between the student and the instructor on three levels based on the: who (interpersonal), what (substantive), and how (pedagogical) (Martin, 2014). In other words, students are motivated when they have a connection to 'who' the instructor is, 'what' the instructor is saying, 'what' tasks and activities the instructor administers, and 'how' the instructor administers the tasks (Martin, 2014). Peers play a variety of roles for students and can influence their academic motivation and satisfaction (Palfrey, 2017).

Although several participants mentioned face-to-face interactions, one should also consider virtual interactions. Virtual interactions especially when it comes to student learning can positively and negatively impact a participant's level of engagement. Virtual learning can be more accommodating to students as it allows a student to "catch up" on any missed work (Ofsted, 2009). Being able to catch up on missed work was particularly useful for Cholin in my study as he was struggling academically in a course and with the transition to online learning because of CoVID, he was able to repeatedly review his professor's lectures. Because Cholin mentioned having negative interactions with this particular professor, the feature of re-listening was beneficial however it did not remove having less than ideal interactions when he asked for academic help. Nevertheless, literature also indicates that the virtual learning can encourage students and at times professors to adopt more passive rather than active learning styles (Bromage, 2004). In my study, Ryaan talks about how he had to adjust from having active levels of engagement pre-CoVID to having passive levels of engagement during CoVID and now he is trying to engage more actively with his professors. Ryaan describes how he feels as though his professors are not really teaching or that he matters in the course, but instead his classes feel like a Ted Talk. My study results provide a deeper insight into how virtual environments can be useful for students however the instructor plays a critical when it comes to student engagement.

In regard to engineering culture and higher education, cultural norms, values, and standard institutional practices and policies have a larger impact on the degree of equalizing education. The rigor of being a STEM major and the expectations that come with being a STEM major often conflate non-realistic ideals that students attempt to strive towards.

Lastly, national movements like CoVID and BLM has shown several levels of influence on participants and their educational experiences. Although research has dove into CoVID and how it has impacted the emotional and mental states of students especially for Black and Hispanic students, there are more impacts to discover as CoVID has not been eradicated as of spring 2021. For BLM, students across the world have expressed their concerns about the multiple shootings of Black people.

There are several areas of future work that would advance my research study. The first would be to interview more students and expand this study into a longitudinal study to understand how relationship perceptions change over time. One could look further into the impacts of CoVID and national events such as BLM and how they influenced other support structures for students. In addition, one could seek more HBCU participants to create an accurate representation of their experience. Another research area to explore is the impact of interpersonal relationships and environmental events on one's identity. Given that negative and positive relationships existed, more research could focus on

understanding more of the negative experiences that participants had. Similarly, looking into the top two relationship types (peers within their STEM classes and professors) to understand more of those perceptions.

5.5.2 Practice

This study shows the need to create and foster positive peer-to-peer relationships. As shown through literature, peers provide several positive benefits for students (Rubin et al., 1998; Swenson et al., 2008). Peers gained through summer bridge program were very helpful for incoming first-year students even after they completed their first year. Participants who participated in a summer bridge program at either PWI1 or PWI2 mentioned that they were still in close contact with those peers and some even shared the same academic major. With that being said, peers who are outside of STEM are also beneficial to students especially for students who do not have a strong STEM identity or have experienced more negative interactions in STEM. For example, Cholin did not feel like he fit in with the ideals and expectations of typical engineering students and he was able to find refuge with a non-STEM club. Also, affinity-based student clubs and organizations and mentoring programs are helpful for students who share similar racial identities (Juvonen et al., 2012).

Secondly, one should create more spaces for students to acknowledge and talk about a variety of topics. In my study, Zachary mentioned having a comfortable space to talk with other Black men about items relating to being Black and BLM. Creating places like safe and brave spaces is imperative for students (Arao & Clemens, 2013). Palfrey (2017) suggests looking at safe and brave spaces as a spectrum with each term on either end where speech is progressively less protected and students need environments with varying levels of each space in order to learn and grow. Having a brave space to talk about National events with racial/ethnic implications was very comforting for him. In addition, there is a sense of positive relatability among those individuals.

Lastly, programs should acknowledge multiple identities. While there are numerous programs aimed at assisting or exposing specific demographics to STEM (Cola et al., 2010), one should be mindful of the unintentional bias that could be reinforced. An example would be picking a t-shirt color pink to designate a camp for girls and blue for boys. According to Martin & Dowson (2009) educational programs should have elements that address the interconnected relatable components of the social, academic, and affective dimensions of a student. Also, the model of multiple identities can be used to represent the constant construction of identities and the impact of changing context based on the

experiences of identity development (Jones & McEwen, 2000). Programs with elements of multiple aspects of identity, would be beneficial for my dissertation participants, especially those who were non-domestic Black.

5.6 Conclusion

Engineering is a field that has disproportionately negatively impacted minoritized students. While there are countless efforts to mitigate the negative experiences of students—such as establishing engineering student support centers, creating mentoring programs, and providing affinity-related scholarships—, the problem continues to persist. One understudied area to understand is interpersonal relationships. Although at first glance interpersonal relationships appear to be an elementary area to explore, relationships are complex, living organic systems that are impacted by items both unaware and aware to an individual. Similarly, Black men in undergraduate engineering programs are often overlooked and type casted as they are a gender majority and racial minority in STEM.

Thus, through this exploratory research study, I set out to understand how Black men experience interpersonal relationships in undergraduate engineering programs. In order to holistically understand how Black men perceive interpersonal relationships, I looked at this study from two institutional contexts. Findings suggest that there are common relationship types and perceptions on how students describe meaningful relationships in their undergraduate engineering experience.

Leveraging my initial purpose and motivation for this study (i.e., to encourage engineering education research to have more conversations that talk *to* and *with* Black men), it is my hope that this work does this and more. Although I was only able to have 14 conversations, each of these conversations brought an enriching perspective that moved from solely an interview to a conversation between myself and each of the participants. Thus, there is something to be said about the level of comfortability that can be gained from a researcher who looks like the participants that they are interviewing. Throughout all the interviews, my participants repeatedly used the phrase “*you know.*” Given my methodology approach, I was unable to provide reassurance for participants during their interview; however, I am fairly certain the ease and relaxed nature of participants was created by talking with someone who shared an identity like them. Overall, this study highlights the need for more researchers, especially those of minoritized groups to study people like themselves and pushes educators of all backgrounds to be cognizant of their interactions and engagement, whether in-person or virtual, with those of different backgrounds.

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Appendix

A. Email to Gatekeepers

Subject: Recruitment Assistance Needed for Black Men in Undergraduate Engineering Programs

Greetings,

My name is Karis Boyd-Sinkler and I'm currently a doctoral candidate at Virginia Tech. I am conducting a research study on the relationship experiences of Black men in engineering. I am writing to see if you would be willing to share the opportunity to participate in my research study with your engineering students. I am also available to discuss this opportunity virtually and/or in person with your engineering students during one of your classes. All students who are selected for the study will receive a \$25 gift card.

If you have any questions about this study, please feel free to contact me at karisb@vt.edu or 757-343-8051.

About the researcher

My name is Karis Boyd-Sinkler and I am a Black woman studying Engineering Education at Virginia Tech. Before attending Virginia Tech in 2016, I majored in Nanomedicine Engineering from the University of Virginia. During my time at UVA and Virginia Tech I have been very active in the National Society of Black Engineers (NSBE) and other efforts aimed at supporting underserved populations (Black/African American, Hispanic/Latino, Native American, and women) in engineering. Feel free to find out more about me at [linkedin.com/in/karisbsinkler](https://www.linkedin.com/in/karisbsinkler)

Best,

Karis

Karis Boyd-Sinkler
Doctoral Candidate, Engineering Education
Student Support and Program Staff, CEED at VT
Virginia Tech

[attachment recruitment flyer/email]

B. Recruitment Email

[Recruitment Email Attachment]

Dear Students,

My name is Karis Boyd-Sinkler and I'm currently conducting a research study on the relationship experiences of Black men in engineering.

I would like to invite you to meet with me for an interview about your relationships at [school name].

Your responses are completely confidential and you will receive a \$25 gift card if you meet the qualifications and decide to participate in the interview.

If you have any questions about this study, please feel free to contact me at karisb@vt.edu or 757-343-8051.

If you are willing to participate, please first complete the questionnaire www.tinyurl.com/blackmenstudy to ensure you qualify to participate in the study. If you are selected, I will contact you and we can set up a time that works for your schedule to meet.

Best,

Karis

About the researcher

My name is Karis Boyd-Sinkler and I am a Black woman studying Engineering Education at Virginia Tech. Before attending Virginia Tech in 2016, I majored in Nanomedicine Engineering from the University of Virginia. During my time at UVA and Virginia Tech I have been very active in the National Society of Black Engineers (NSBE) and other efforts aimed at supporting underserved populations (Black/African American, Hispanic/Latino, Native American, and women) in engineering. Feel free to find out more about me at [linkedin.com/in/karisbsinkle](https://www.linkedin.com/in/karisbsinkle)

[Recruitment Flyer Attachment]

C. Recruitment Flyer

CALL FOR RESEARCH PARTICIPANTS

Are you a Black man studying engineering?

Go to tinyurl.com/blackmenstudy to take a survey to see if you qualify.

Selected participants will receive a \$25 gift card for their time.

This is a Virginia Tech Research Study IRB #20-436

Title: Exploring the Interpersonal Relationships of Black Men in Undergraduate Engineering Programs

The purpose of this research study is to understand the interpersonal relationships that Black men in undergraduate engineering programs utilize. Individuals are needed to take part in a confidential interview about their interpersonal relationships. The interview process will take approximately 45-120 minutes via zoom video conferencing.

Eligibility Criteria:

- Black male
- Undergraduate engineering student
- Sophomore or higher
- 18 years or older

For more information please contact Karis Boyd-Sinkler at Karisb@vt.edu



[linkedin.com/in/karisbsinkler](https://www.linkedin.com/in/karisbsinkler)

D. Screening Survey

Start of Block: Default Question Block

Q1

Welcome

The purpose of this questionnaire is to provide background information about participants in the Interpersonal Relationships of Black Men in Undergraduate Engineering Programs Dissertation Study.

The goals of this research are to better understand the interpersonal relationships of Black men in undergraduate engineering programs. Anticipated benefits of this research are to better understand how to support Black men in undergraduate engineering programs. To participate in the study, you must identify as a Black man. The survey will take about 5 minutes to complete.

Responses in this questionnaire will be utilized to select participants for interviews. If selected to participate in an interview it will take 45-120 minutes. The data will be stored electronically in a password protected location. Only the research team will have access to the raw data. It is possible that the Institutional Review Board (IRB) at Virginia Tech will view this study's collected data for auditing purposes. The IRB is responsible for overseeing the protection of human subjects who are involved in

research. If you have any questions about the survey please contact Karis Boyd-Sinkler at karisb@vt.edu.

About the researcher

My name is Karis Boyd-Sinkler and I am a Black woman studying Engineering Education at Virginia Tech. Before attending Virginia Tech in 2016, I majored in Nanomedicine Engineering from the University of Virginia. During my time at UVA and Virginia Tech I have been very active in the National Society of Black Engineers (NSBE) and other efforts aimed at supporting underserved populations (Black/African American, Hispanic/Latino, Native American, and women) in engineering. Feel free to find out more about me at [linkedin.com/in/karisbsinkler](https://www.linkedin.com/in/karisbsinkler)

Q2 Please indicate whether or not you give consent for participating in this study. If you are not selected for the research study, your information will be deleted.

- I give consent to include my responses in the research study and I am willing to participate in an interview (1)
- I do not give consent for the research study (2)

Page Break-

Q3 Part I: Personal Information

Q4 Please complete the following information.

- First Name: (1) _____
- Last Name: (2) _____
- Preferred Name: (3) _____
- Email Address (4) _____
- Cell Phone Number (6) _____

Q5 Do you identify as a Black man?

- Yes (1)
 - No (2)
-

Q6 Age

Q25 What is your citizenship?

- U.S. Citizen (1)
- Non U.S. Citizen (2)

Q7 Race(s) and ethnicity(ies) you identify with (i.e. African American, Black, Hispanic, etc.).
If you identify with two or more races/ethnicities, please list all races and ethnicities (i.e. African American and White, Black and Hispanic).

Q9 Part II: High School Information

Q10 High School Information

- School Name (1) _____
- School Location (City, State, Zipcode) (2) _____
- If you attended more than 1 high school, please list the other high schools. (3)

Q11 Part III: Institution Information

Q12 Please type the name of the institution that you currently attend.

Q13 Current academic year

- First Year (1)
 - Second Year (2)
 - Third Year (3)
 - Fourth Year (4)
 - Fifth & Above Year (5)
-

Q14 What is the highest degree completed by your mother/female guardian?

- Less than high school (1)
 - High school (2)
 - Some college (4)
 - 2-year degree or certificate (5)
 - 4-year college degree (6)
 - Master's degree (7)
 - Graduate/professional degree (e.g., MD, PhD) (8)
 - Other (9)
-

Q28 What is the highest degree completed by your father/male guardian?

- Less than high school (1)
 - High school (2)
 - Some college (4)
 - 2-year degree or certificate (5)
 - 4-year college degree (6)
 - Master's degree (7)
 - Graduate/professional degree (e.g., MD, PhD) (8)
 - Other (9)
-

Q15 Current Major(s)

Q15 Current Minor(s). If none type none

Q26 Please select all activities that you have participated in since becoming a student at your institution

- work study or another form of part-time or full-time employment (1)
- internship, co-op, or field/lab work (2)
- living-learning community (3)
- STEM-club or student chapter of a professional society focused on underrepresented groups (e.g., NSBE, SHPE, SWE, oSTEM, SACNAS, etc.) (4)
- STEM-related fraternity/ sorority or honor society (Theta Tau, Alpha Omega Epsilon, etc.) (5)
- non-STEM social fraternity or sorority (CPC, IFC, NPHC, etc.) (6)
- volunteering/outreach programs (7)
- undergraduate research (8)
- formal or informal mentoring program (9)
- out-of-class student design project/competition (10)
- STEM club or student chapter of a discipline-specific professional society (IEEE, ASME, ASCE, etc.) (11)

End of Block: Default Question Block

E. Invitation to Participate in Research Study Email

Subject: You have been selected for the Interpersonal Relationships of Black Men Research Study

Hello, I hope you have been well!

I am pleased to announce that you have been selected to share your experiences with interpersonal relationships. As a reminder, I am investigating the interpersonal relationships of Black men in undergraduate engineering programs. I invite you to participate in a 45-120 minute video interview. You will be compensated with a \$25 gift card for your participation.

Your identity will be kept confidential at all times and will be known only to members of the research team. The results of this study will be used for my dissertation. In addition, the results may be published in conferences and aid in understanding the experiences of Black men who are able to persist in engineering. If you have questions, please contact Karis Boyd-Sinkler (karisb@vt.edu).

If you understand the above information, please contact me at karisb@vt.edu or 757-343-8051 to schedule an interview.

Questions about this study can be directed to the WIRB (800-562-4789, help@wirb.com).

I appreciate your time, attention, and support.

Have a great day,

Karis Boyd-Sinkler
Doctoral Candidate, Engineering Education
Student Support and Program Staff, CEED at VT
Virginia Tech

F. Interview Protocol

Section 1: Introduction

Thank you for meeting with me today and agreeing to talk. I have a few questions to guide our discussion about your experiences with interpersonal relationships in and around your undergraduate engineering community. Throughout the time we are talking, please be aware that I will consistently ask you to explain your responses in further detail so that I can accurately capture the extent of your relationships. To get us started,

1. Can you tell me a little bit about yourself including where you are from, your major, the school you currently attend, and some activities you are involved with?
2. Can you tell me how your experience has been in engineering so far?

Section 2: Specific Relationship

Now, we are going to transition and talk about interpersonal relationships. For the purpose of this study, an interpersonal relationship refers to social and/or emotional interaction between two or more individuals. For example, a relationship you may have with a significant other or a relationship you may have with a sibling. During this interview, I am interested in whichever relations you believe have impacted your experiences as an engineering student.

3. Can you tell me about some of the interpersonal relationships that have impacted your experience at [institution name]?
 - a. Can you tell me about your experiences interacting with ____?
 - b. How would you describe those relationships?
 - c. What makes those relationships meaningful?
 - d. How have those relationships impacted you?
 - e. How did those relationships start?
 - f. Why are these the first relationships that come to mind?
 - g. Can you tell me a story that summarizes your relationship with ____?
 - h. Are there any other relationships that you can think of?

Next, we are going to specifically focus on the interpersonal relationships you may have with those in engineering

4. Can you tell me about your experiences interacting with:
 - a. engineering faculty or staff?
 - b. other engineering students?
 - c. academic advisors?
 - d. people within your academic major?
 - e. Have you made any meaningful relationships in the activities you are involved in?
 - f. How have these relationships impacted your experience in engineering?
 - g. In the pre-screening survey, you mentioned being involved in a few activities. How have those relationships impacted your experience in engineering?
 - h. How would your experience be if you did not interact with those people you mentioned?

In order to help me better understand your relationships and their level of meaning, I am going to ask you to create a visual. On the google slide, you will see a stick figure person in the center with circles that expand outward. While you were talking, I typed the names of the people you mentioned. I would like you to drag the boxes with the names of your relationships onto the circles based on the degree of meaningfulness. Relationships that are more meaningful should be moved closer to the stick figure person and those that are less meaningful should be moved away from the stick figure person.

Probing Questions

- Could you explain that further?
- What do you mean by that?
- Describe that to me from start to end
- What do you mean here, I am not clear
- Tell me how you felt about that
- Can you tell me a story that summarizes your relationship with ____?
- Is there a specific experience you remember interacting with ____?

Experiences with those beyond engineering

5. Can you tell me about your experiences interacting with:
 - a. friends?
 - b. non-engineering students?
 - c. family members?
 - d. On the pre-screening survey, you mentioned being involved in a few activities. How have those relationships impacted your experience in engineering?
 - e. How have those relationships impacted your experience in engineering?
 - f. How would your experience be if you did not interact with those people you mentioned?

Probing Questions

- Could you explain that further?
- What do you mean by that?
- Describe that to me from start to end
- What do you mean here, I am not clear
- Tell me how you felt about that
- Can you tell me a story that summarizes your relationship with ____?
- Is there a specific experience you remember interacting with ____?

Section 3: Environmental Influences

Now we are going to transition to understand environmental influences. An example of an environmental influence might be recent national events involving Black men or the results from a political election. Literature has shown a variety of experiences and outcomes for students that attend Historically Black Colleges and Universities (HBCUs) and Predominately or Historically White Institutions (PWIs/HWIs). Several research studies discuss the differences African Americans have felt related to their sense of community climate, availability of services, and occurrences of racism and microaggressions.

Given the current research surrounding environmental influences from as attending an HBCU or PWI,

6. How do you think _____ has impacted your experience as an engineering student?
 - a. attending an HBCU/PWI
 - b. choosing your specific major
 - c. being Black
 - d. being a man

7. In the previous question, you addressed your university context, major, race, and gender. Is there anything else that's important to discuss to understand your experience?
 - a. Thinking about your relationships, are there influences outside of your institution that impacts your relationships?
 - b. What, if any, impacts have the current racial climates had on your relationships?
 - c. How have perceptions or beliefs by others impacted your relationships?

Section 4: Closing

8. As a reminder, the purpose of this study is to understand how Black men who have persisted past their first-year year experience interpersonal relationships in undergraduate engineering programs. Is there anything else you would like to discuss?

Thank you for taking the time to participate in this interview. If there is anyone that you would recommend to participate in this interview, please let me know so that I may contact them.

G. Co-Constructed Participant Figure

