BSTiE: A Proposed Conceptual Framework for Black Student Thriving in Engineering

Stephanie A Damas

Stephanie Ashley Damas is currently a National Science Foundation Graduate Research Fellow at Clemson University studying to get her Ph.D. in Engineering and Science Education. Her area of interest is Diversity and Inclusion in Engineering. She holds a bachelor's degree in electrical engineering from Florida State University.

Lisa Benson (Professor)

Lisa Benson is a Professor of Engineering and Science Education at Clemson University, and the Editor of the Journal of Engineering Education. Her research focuses on the interactions between student motivation and their learning experiences. Her projects include studies of student attitudes towards becoming engineers and scientists, and their development of problem solving skills, self-regulated learning practices, and beliefs about knowledge in their field. Dr. Benson is an American Society for Engineering Education (ASEE) Fellow, a member of the European Society for Engineering Education (SEFI), American Educational Research Association (AERA) and Tau Beta Pi, and the 2018 recipient of the Clemson University Class of '39 Award for Faculty Excellence. She earned a B.S. in Bioengineering (1978) from the University of Vermont, and M.S. (1986) and Ph.D. (2002) in Bioengineering from Clemson University.

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Abstract

Motivation & Background

Studies of Black students' experiences and journeys to success at Predominantly White Institutions (PWIs) show that the experiences of Black students are uniquely complex and need to be examined through a lens that can capture the distinct intersectionality of Black students in engineering programs. In a previous pilot study, we explored the experiences of two Black students at a PWI. That study captured their stories in which they described elements of engineering thriving and engineering identity that need to be further explored. There are currently no existing theories that explain Black student thriving in engineering. In this theory paper, we present a new framework, Black Student Thriving in Engineering (BSTiE, pronounced "bestie"), that combines the tenets of Engineering Thriving by Juliana Ge, Engineering Identity by Allison Godwin, and Black Student science, technology, engineering, and mathematics (STEM) Identity by Kristina Collins. We aim to show that at the intersection of these three frameworks there exists a unique space that can be used to capture the experiences of Black student thriving in engineering.

Theoretical Frameworks & Sources
Engineering Thriving

Engineering thriving (ET) is seen as an output of achieving high measures of competency in the engineering culture and leans on the studies of thriving from a psychological context to support the need to achieve holistic growth. Engineering thriving is defined as the optimization of academic and personal competencies strengthened in the engineering culture that is then used for engineering success.

Engineering Identity

Engineering identity (EI) encompasses the way that students identify with the role of engineer. This theory pulls from broader role identity theory and situates itself within the culture of engineering. A student's EI comprises three components: interest in the subject, perceived recognition by others, and performance/competence beliefs, and in some cases a fourth component, self-awareness.

Black Student STEM Identity

Black student STEM identity (BSSI) is situated within the context of the external and internal environments where Black STEM students perceive their reflective identity (how they view themselves), their competence and ability, their values and interests, and their assimilation into STEM culture. These four perception components are influenced by Black students' gender-based racial identity.

Significance

Drawing from existing literature, we seek to identify overlapping elements in ET, EI, and BSSI. We are developing a culturally relevant theory of Black Student Thriving in Engineering (BSTiE, pronounced "bestie") situated at the cross-section of the aforementioned theories. In this paper, we aim to provide an overview of the origins of the theories to lay the foundation for their application in our context of interest. It is our belief that researchers can use BSTiE to

understand how Black students thrive in engineering, with results that can give students a working model for how they can integrate their own individual culture to feel good, achieve holistic growth, and function well in engineering cultures at PWIs.

Introduction

Studies of Black students' experiences and journeys to success at Predominantly White Institutions (PWIs) show that their experiences are complex and need to be examined through a lens that can capture the multiply marginalized identity intersectionality of Black students in engineering programs. It is true that Black talent development is lacking in science, technology, engineering, and mathematics (STEM) fields in the U.S. and that these numbers are reflected in undergraduate and graduate admissions as well as the workforce. In this paper, we focus on the experience of Black students in academia because it is particularly rife with gross inequities in participation and prone to racial stereotypes about ability and competence [1]. To understand the context of this study we must first understand the history of engineering in institutions of higher education in America.

Background

The Morrill Act of 1862 established engineering as a major at institutions currently known as PWIs. From the very conception of the engineering collegiate culture in 1862, minoritized groups have been ostracized and unwelcomed. Engineering as a major was not created with Communities of Color in mind. In studies dating back to the late 1900s, the journeys of Black students have been scattered with negative interactions and traumatizing experiences at PWIs [1]. These experiences are often filled with, but are not limited to, the presence of racism, microaggressions, and stereotype threat [1], [2]. In 1965, the Higher Education Act, as amended, defined a historically Black college or university (HBCU) as any institution that was established and accredited, or making progress toward accreditation, prior to 1964, and whose principal mission was, and is, the education of Black Americans [3]. HBCUs have long struggled with receiving equitable resources such as funds and technology [3], [4]. To this date, HBCUs are owed millions in back pay from funds promised to them by the American government [4]. Over the course of history, HBCUs have been forced to prove their competence and relevance [5] while navigating the struggles that came with maintaining a full-functioning university with minimal resources.

Although HBCUs make up 3% of the higher education institutions in America, the United Negro College Fund reported in 2008 that 50% of Black engineers in the workforce were graduates of HBCUs. Studies have shown that the journeys of Black students in engineering at HBCUs include influential faculty interaction, increased engineering identity, a strong sense of meaning, and an overwhelming sense of community [3], [6], [7]. Clearly, the experiences of Black students at PWIs and HBCUs are drastically different. Many studies have juxtaposed HBCUs and PWIs in efforts to highlight these inequities. In contrast, we have chosen to include key elements of the experiences of Black students at HBCUs to better understand how Black students at PWIs can be supported in their efforts to maintain success. We acknowledge that the

experiences of all Black students at PWIs are not the same and come with their own nuances that are dependent on the backgrounds of each individual student; however, we assert that the negative experiences of some Black students should be of concern to all stakeholders at PWIs and thus we position our research within the PWI space.

Redefining Success
While much of the prior research on Black student experiences in STEM focus on Black failure, there is a gap in the literature with respect to success of Black STEM students [1]. Ge et al. examined multiple studies and reports on engineering success and found that success is often defined in terms of academics [8]. These authors posited that these defining factors are problematic when independently used to define success. They concluded that success needed to be redefined in a way that would take into consideration the overall well-being of engineering students and propose thriving as a way to achieve this. Thriving students are engaged in learning, invested in reaching academic goals, are effective at time management and prioritizing, have a positive perspective toward their future, appreciate differences in others, and feel empowered to serve their community. Positive Psychology positions thriving as a process that allows individuals to rise to a level of function that exceeds their circumstances [8]. Thus, we position the phenomena of being Black in engineering programs at PWIs as circumstance and the navigation of achievement in engineering programs at fundamentally racist PWIs [4], [9] as the level of functioning that exceeds circumstance.

We assert that success for Black students at PWIs can not only be defined by their academic achievement, as often reported by PWIs, but also in the ways they maneuver the cultural landscape of their own identities in tandem with that of the engineering programs at their university. The experiences of Black students are specific to that racial demographic and only examining one marker of success minimizes the journeys they often face at PWIs. Thus, we aim to highlight interpersonal, intrapersonal, and academic factors that contribute to the overall achievement of Black students in engineering at PWIs. We take a critical look at the presence of these factors and surmise the ways they are at play in the experiences of Black students by situating them within internal (cultural identities and commitments) and external (engineering culture at PWIs) environments. We choose to focus on the experiences of Black students and not African Americans exclusively because research has found that although Black students have diverse backgrounds and nationalities, they often have similar experiences at PWIs and face similar stereotypes that have negative effects on their navigation to success.

Introducing BSTiE
There are currently no existing frameworks that explain Black student thriving in engineering. Although existing studies highlight factors outside of the commonly defined markers of success, none quite achieve the wholistic view we aim to present with this work. In this paper, we present a conceptual framework, Black Student Thriving in Engineering (BSTiE, pronounced "bestie"), that combines the tenets of engineering thriving (ET) by Juliana Ge, engineering identity (EI) by Allison Godwin, and Black student STEM identity (BSSI) by Kristina Collins. A tabulation of all

abbreviations used in this paper is provided in Table 1. We aim to show that at the intersection of these three frameworks there exists a unique space that can be used to capture the experiences of Black students thriving in engineering.

Table 1: Abbreviations used in paper in order of appearance

| Word	Abbreviation
Predominantly White Institution	PWI
Science Technology Engineering Mathematics	STEM
Historically Black College or University	HBCU
Black Student Thriving in Engineering	BSTiE
Engineering Thriving	ET
Engineering Identity	EI
Black Student STEM Identity	BSSI
Ford's Female Achievement Model in Excellence	F^2AME
Black Male Scholar Identity	BMSI
Minority Serving Institution	MSI
Hispanic Serving Institution	HSI

Theoretical Frameworks

In this section, we aim to discuss the theories that inform BSTiE and explain why they are important for understanding the experiences of Black engineering students. We highlight why each framework cannot stand alone to understand the phenomena at hand.

Black Student STEM Identity

In her review of the existing frameworks that aim to identify the experiences of Black students in STEM, Kristina Collins established the conceptual framework of BSSI at the intersection of Ford's Female Achievement Model in Excellence (F^2AME) and Black Male Scholar Identity (BMSI) Model [10]. Although these are notable models that have been widely used alone, the lack of consideration of both female and male experiences in these models dismisses the role of gender much like color-blind ideology invalidates individuals' racial identity [11]. By including both models, Collins addresses these concerns by presenting a framework that is gender neutral.

BSSI is situated within the context of the external and internal factors of a Black STEM student's life. The external environment is the STEM culture that exists in work, school, or other public areas. The internal environment encompasses the community to which the Black student belongs outside of academia. This includes but is not limited to family, friends, and cultural space. The innermost construct of Black Student STEM Identity is their own gender-based racial identity. This construct acknowledges the experiences and identity development of male and female students that identify as Black. The extent to which they have achieved different stages of their own racial identity development affects other aspects of their STEM identity.
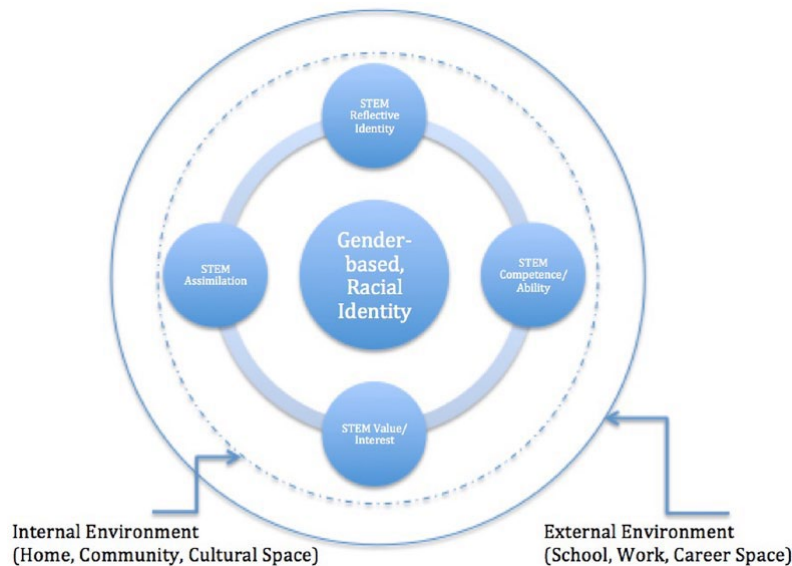
Figure 1: Contextual model for Black student STEM identity from Collins [10].

BSSI posits that a Black student's STEM identity is framed by four perceptions: 1) their reflective identity (Do I belong?); 2) their competence and ability (Can I succeed?) 3) their values and interests (Do I want to succeed?); and 4) their assimilation into STEM culture (How do I succeed?)—as visualized in Figure 1. These four perception components contribute to a Black student's motivation to persist in STEM areas.

1) *Reflective Identity:* STEM reflective identity posits that Black students should be able to visualize themselves in their field of choice, which allows students to develop a sense of belonging in their STEM area. Faculty representation and mentorship are factors that feed into the reflective identity of Black students.

2) *Competence/Ability:* Competence and ability span the extent to which a Black student perceives they can "do STEM." Factors such as GPA and cognitive ability are key, as well as opportunities for success that combine Black students' internal and external environments. Internal environments include informal learning and problem-solving at home and in their community that helps students gain confidence in their abilities. Black students benefit from being able to transfer these informal learning experiences into their classrooms and other external environments.

3) *Values/Interests:* Values and interests are similar to competence and ability in terms of blending internal and external environments (identifying connections and benefits between what Black students learn in STEM and their community). Their perceptions of the value of STEM topics increases when those topics are relevant to their innermost circle. Their values and interests in STEM can also benefit from increased representation in their external environment.

4) *Assimilation:* Assimilation into STEM culture for Black students is defined by negotiations they feel they must make between who they are and who they feel STEM culture thinks they should be. An essential secondary question Black students

consider is, "Can I be my whole self and be accepted in this culture, or must I pretend to be someone else?" If a Black student's perceptions of their personal characteristics are in conflict with the dominant STEM culture, this construct will have a negative effect on their STEM identity. Studies show that in situations or environments where Black students find conflict between who they are and who the STEM culture wants them to be, they lean into defense mechanisms that trigger their survival techniques [1], [12].

BSSI aggregates science, technology, engineering, and mathematics identities to establish a culturally relevant framework as a foundation for understanding the experiences of Black females and males in STEM. Although rich in cultural context, it does not disaggregate disciplinary identities in the environmental context. Studies have shown that despite their pervasive grouping, STEM disciplines have distinct cultural norms and hardships [13]. Thus, when understanding the experiences of Black students in engineering, one must view these experiences through the lens of engineering identity as it presents itself in Black student experiences.

Engineering Identity

Engineering identity (EI) encompasses the way that students identify with the role of engineer. This theory pulls from role identity theory and situates itself within the culture of engineering [15]. These authors drew from the models of math, science, and physics identity to establish the importance of disaggregating STEM majors. How one enacts their role identity is heavily influenced by their social identity, or the group to which they ascribe. The role of an engineering student is within the social identity of belonging to the group "engineers." A student's EI comprises three components in the context of engineering: interest in the subject, perceived recognition by others, and performance/competence beliefs, which are visualized in Figure 2.
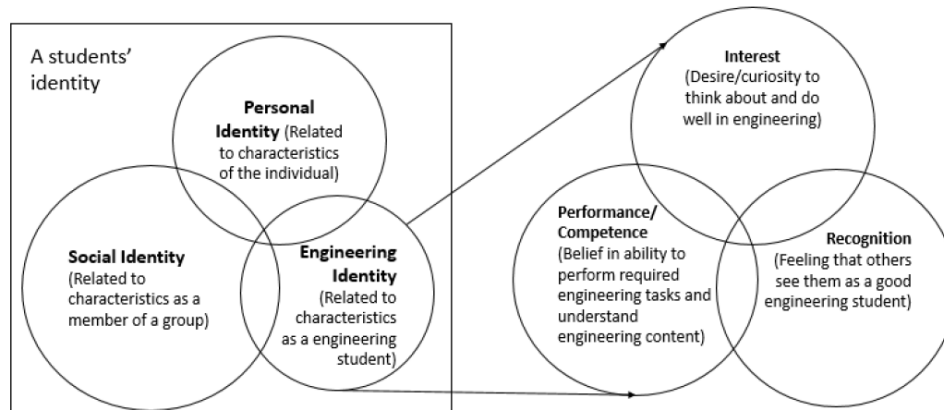
Figure 2: Framework for students' engineering identity adapted from Hazari et al. [14] and expanded by Godwin et al. [15]

1) *Interest:* Interest in the subject can be defined as a "person's likes, preferences, favorites, affinity toward, or attraction to a subject, topic, or activity" [16]. In most

cases, interest determines the extent to which a student remains engaged in course material and involved in departmental organizations. This construct can contribute to a student's sense of belonging, thus increasing the chances of that student assuming that role identity [17].

2) *Recognition:* Godwin's model of engineering identity posits that recognition from peers and others influences the way in which a student view themselves. Students' perceptions of themselves as an engineer is either strengthened or weakened by the extent to which they feel their professors, peers, or family members view them as engineers.

3) *Performance/Competence:* Performance/Competence beliefs reflect an engineering student's perceived understanding of engineering concepts. This construct is identified by a student's perception of how well they are doing academically and how well they feel they can perform and understand engineering tasks and concepts. This construct also touches on how a student perceives content in terms of their ability to achieve within it.

Black Students' Engineering Identity

Research on the experiences of Black students at PWIs demonstrates that although PWIs typically possess necessary resources to successfully graduate students of color, some Black students are adversely affected by factors such as lack of a sense of belonging. These difficult experiences can negatively affect their engineering identity development. Tinto's model on integration, retention, and graduation rates of minority students at Minority Serving Institutions (MSIs), which include HBCUs and Hispanic-serving Institution (HSIs), suggests that research exploring Black students at HBCUs may be more fruitful in understanding engineering identity development compared to minority students at PWIs [18]. The work of Outcalt and Skewes-Cox also posit it is "important that we understand exactly how HBCUs create beneficial environments for their African American students" [3], [5]. Hence, we use this section to present indicators of student success in engineering at HBCUs through the lens of identity development to lay the groundwork for supporting the experiences and engineering identity development of Black students at PWIs.

A mixed-methods study of the engineering identity development of Black and Hispanic second-year students at MSIs found that engineering identity development for these students supported the constructs of engineering identity among others [7]. When asked about the characteristics of an engineer, these students often answered with words such as "we" and "our," indicating that even at an early stage, students adopted the notion that they were engineers and identified with the preferences and characteristics of engineers. The students also spoke about their connections with peers and professors and the affordances of the community, representation, and encouragement they provided. Black students especially highlighted the benefit of having peers and professors of color that made them feel like they had a family at their university and valued the caring nature of their campus community culture. Because they asked for and gave advice to

peers, their competence as engineers were recognized by other students. Lastly, the study found that students perceived the content of engineering as challenging and leaned into it. Many students specifically highlighted how difficulty of the content affected their desire to be an engineer and that they would be "good engineers" at the end of their educational journey. The Black students in the study also noted the importance of going to an HBCU. Participants sought out HBCUs when applying to college because of the culture that was present at HBCUs. They also highlighted how the representation of diversity was key in their racial identity development as their HBCU exposed them to different types of Black people. The study showed the presence of their own culture was valued by Black students and had effects on how they viewed themselves and their roles as engineers.

Although some student experiences reported in this study aligned with the constructs of engineering identity, key elements of their experiences were not captured. Consistent with the BSSI model, for the Black students in this study, their culture and racial identities were important to their engineering identity development. They significantly benefit from being exposed to shared cultural identities (e.g.: Black culture) and commitments (e.g.: wanting to give back to their community, journey being a tribute to their family/race/ethnicity) because it affects their sense of belonging. In this same sense, with the inclusion of the BSSI model, we see that a Black student's culture and racial identity development has the potential to affect all constructs of engineering identity (interest, competence, recognition) regardless of institutional makeup. This consistency allows us to merge the constructs of BSSI and EI to begin to conceptualize Black student thriving in engineering.

Engineering Thriving

Julianna Ge builds on Positive Psychology and the measures of success in engineering found in higher education studies and professional reports to lay the foundation for understanding thriving among engineering students. When adapting thriving to engineering, she considered that engineering students exist within engineering culture as do the measures of competency established by existing literature: interpersonal, intrapersonal, and technical/cognitive, as visualized in Figure 3. Ge established engineering thriving to be an output of achieving high measures of competency and well-being in the engineering culture.

In Ge's model, academic and personal competencies are optimized and strengthened in the engineering culture, which then leads to engineering success [8]. Pulling from higher education research, Ge's model takes a holistic view of students' success that includes healthy relationships, a sense of community, contributing, and proactively coping with life's challenges. Adopting this definition, engineering thriving is not binary but is continuously developing and exists at the intersection of "feeling good" and "functioning well." Engineering competencies work in tandem as students navigate the engineering culture they are situated in. Engineering thriving goes beyond the development of skills and integrates individual culture and community in the processing of these skills.
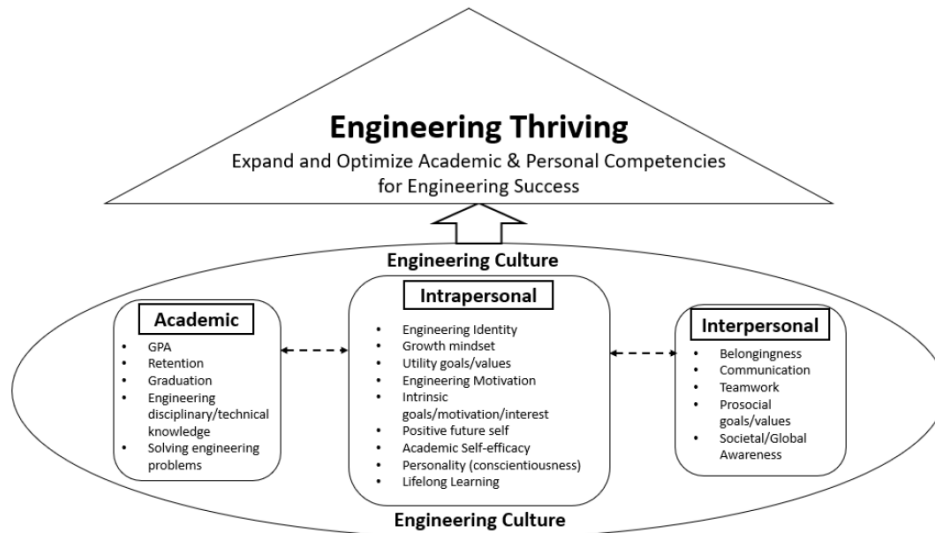
Figure 3: Conceptualization of Engineering Thriving. This framework represents individual competencies of thriving relevant to undergraduate engineering students [8]

When characterized by experiences or decisions that produce outputs such as retention, persistence, or high GPAs, engineering success has been defined as a binary construct in prior studies [19]. Engineering thriving seeks to redefine success as a cyclical nonbinary process that goes beyond singular outputs to embrace a state of being. It is important to note that thriving is context dependent. Researchers have pushed back on the notion that thriving is applicable to all and instead situate it in the context in which it is studied [8]. Considering this, it is important to add a critical lens to the study of engineering thriving when studying the experiences of Black students in engineering. As there is no existing literature that studies engineering thriving amongst black students, we lean on a study about Black students' predictors of thriving in college.

Laura Schreiner explored the process of thriving among Black college students and found that psychological sense of community, spirituality, and student-faculty interaction were the main predictors of their level of thriving [20]. Student-faculty interaction, driven by participation in ethnic organizations, contributed most positively to thriving in African American students. A psychological sense of community was twofold for Black students: It provided students with a sense of belonging as well as a sense of purpose that was motivated by spirituality. Shreiner's findings regarding spirituality are limited due to the religious affiliation of the universities included in the study. Nevertheless, studies conducted at non-religious affiliated universities have shown that spirituality is a form of meaning-making and potentially a coping mechanism for Black students.

We use these findings as a baseline to understand the process by which Black students show markers of thriving in their experiences. Intrapersonal skills such as a sense of belonging are consistent with both of the aforementioned studies. A key factor consistent with the findings of engineering identity development among Black students is the importance of student-faculty

interactions. With what we know about the effects of professors of color on black student engineering identity development, we can expand the findings of Schreiner regarding student-faculty interactions to make the claim that interactions with faculty of color serve as a contributor to black student thriving in engineering–providing major insight into the BSTiE model discussed in the next section.

Conceptualizing Key Factors of BSTiE

As highlighted in the review of Black student STEM identity, engineering identity, and engineering thriving, each theory contributes to the development of BSTiE. This section will illuminate the ways that these theories overlap to inform BSTiE and express how the framework will provide a culturally relevant, context-specific model of what it may look like to thrive in engineering as a Black student.
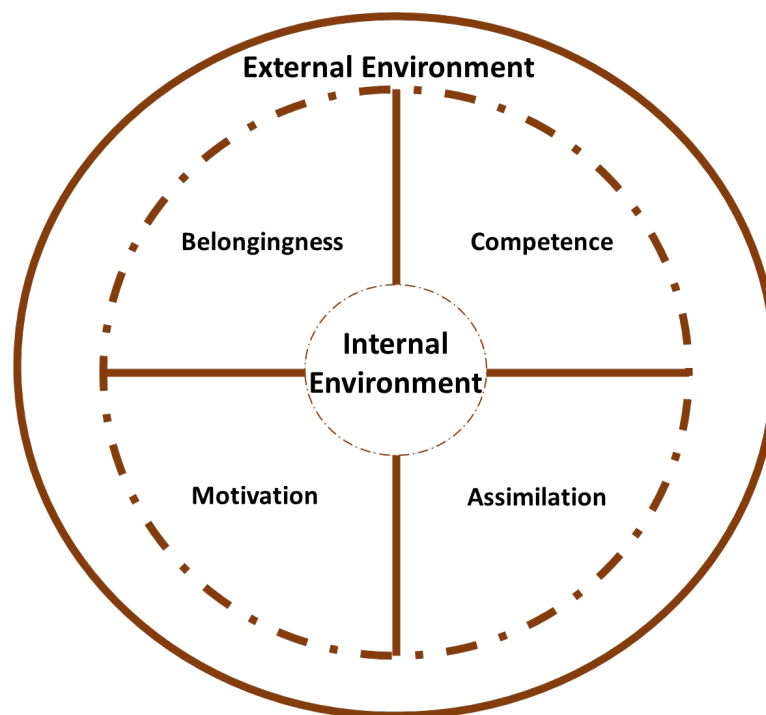
Figure 4: The conceptual framework of BSTiE

First, we establish that there are two environments at play when thriving in engineering as a Black student, similar to those in BSSI. The external environment provides a discipline-based context – the engineering culture at one's PWI. The internal environment provides a cultural context – one's cultural commitment and identity. Drawing from EI and ET theories, we define four quadrants, as shown in Figure 4, within one's external environment and surrounding one's internal environment that depicts the experiences of Black students in engineering at PWIs: competence, assimilation, motivation, and sense of belonging. Competence is defined as the way a student perceives engineering concepts and their ability to achieve. Assimilation encompasses the extent to which a student undergoes tradeoffs with who they are and who they think they need to be in engineering. Motivation is characterized by a student's willingness to succeed in engineering. Belonging is a student's perception that they belong in their engineering program at

a PWI. We aim to highlight the concepts provided by BSSI, EI, and ET that inform each construct while explaining what each construct means and its relation to the internal and external environment.

Competence
All the theories that inform BSTiE have in common one's perception of their ability to understand engineering concepts as key to their success and experience in engineering. According to F^{2}AME and BMSI, the theories that inform BSSI, Black males and females share a keen dedication to their academic success and their ability to achieve in their studies. This is consistent with the claims of BSSI, EI, and ET. EI research on Black students has shown that academic success contributes directly to their overall success in their engineering program. ET takes into consideration a student's perceived competence when outlining the process by which a student can be well and optimize their experiences. Studies have shown that oftentimes for Black students at PWIs this competence component is also a source of strife as they may be faced with stereotype threat, microaggressions, and racism that challenge their competence. In cases where Black students show strong signs of well-being, they tap into their resistant capital to continue to achieve in the presence of racism, microaggressions, and stereotype threats [1], [2], [6].

Belonging
Belonging is identified as the sense of fit and community the student perceives in the engineering culture at their university. This is often denoted by pride in one's program or the discovery of a group of people or organization that makes the student feel at home. Schreiner's work on Black students thriving in academia revealed that a psychological sense of community has a direct effect on the extent to which they thrive at a university. These findings are mirrored in the interpersonal skills that are optimized in ET which include belongingness. The importance of belonging is also consistent with the construct of reflective identity defined in BSSI. It is imperative that Black engineering students feel that they belong in engineering at the PWI they attend. Studies have shown that belongingness contributes greatly to well-being and achievement, as well as persistence of effort [7]. Black students at PWIs are often surrounded by others that do not look like them and come face to face with the "outsider within" [12] situation in engineering courses. These students should not feel like "outsiders within". The extent to which a Black student feels they belong in their engineering program at their PWI can determine whether that student can thrive in the program or assume a role of survival [21].

Motivation
Motivation is defined by the student's perception of whether they want to succeed in engineering. It can be identified as reasons a student chooses to succeed. This is important to the achievement of the student as well as their well-being [8]. The extent to which they want to succeed can be influenced by many factors. This construct is consistent with BSSI's value and interest component. Students will choose to persist in a major if they see value in it. This construct also overlaps with ET's intrapersonal dimension. According to the ET model, motivation is necessary for success in engineering that fulfills the "functioning well" nature of thriving. To understand

how motivation also presents itself in the "feeling good" nature of thriving in engineering, we must consider the nuances found in motivation as it appears for students of color. Motivation can be based on the value that the engineering degree has for the student. For Black students, this value often stems from what the attainment of their engineering degree would mean for their community. This line of thought is consistent with our analysis of academic thriving for Black students. We saw that spiritually, as defined by Schreiner et al., represented meaning-making and can be a coping mechanism for Black students. Their academic thriving model for Black students showed that this spirituality was a proven influencer of a Black student's process of thriving. At a PWI, motivation may also be influenced by representative faculty. The visualization of themselves in the role of engineer contributes to their motivation to persist in engineering as Black students [22]. It is imperative that representation is found in Black students' external environment to feed into their internal environment. This exchange can lead to increased motivation which in turn positively affects the process of thriving in engineering.

Assimilation
The concept of assimilation is highlighted in BSSI as the negotiations Black students may feel must occur between who they are and who they feel the culture thinks they should be. EI and ET do not capture this element in their current models, so we adapt this construct from BSSI and expand on it for BSTiE. We define assimilation as the extent to which a Black student feels they must change to be an engineer/engineering student at their university. This is particularly prevalent in the experiences of Black students at PWIs. Engineering culture from its inception has been permeated by the culture of PWIs, but we must consider that engineering culture can differ from university to university. Culture can include but is not limited to traditions, language, and opportunities for engagement. Black students may encounter a struggle involving internal and external environments that may not be experienced by other students. On one hand, they consider the desire to identify with the "in-group" [23] of their external environment. This "in-group" can be identified as the engineering culture at their respective PWI expressed in the form of language, mannerisms, ways of thought, or involvement in specific university/major traditions. On the other hand, they consider the desire to identify with the "in-group" of their internal environment, which encompasses their cultural identities and commitments. Their cultural commitments come with their own traditions, mannerisms, ways of speaking, and ways of thought, and their cultural identities may come with their own expectations.

Assimilation can also be defined as the extent to which a Black students' external environment and internal environment align. The existence of this alignment provides a space where the student can focus on building academic, interpersonal, and intrapersonal skills. When the environments are not aligned, Black students may enter a space where they feel like they need to prove themselves [1]. Sometimes these students may experience this phenomena and achieve in their program by developing a coping mechanism [1]. One mechanism is an inverted imposter syndrome, *Superman Syndrome*, defined by Majors and Billson as a Black student's inability to internalize one's own successes and the fear that peers will eventually recognize that he or she no

longer belongs or fits into their non-STEM identity [10], [24]. In this scenario, successful Black students begin to attribute their success to trivial factors such as their ability to outsmart or fool others, timing, or luck, instead of taking pride in or acknowledging their STEM aptitude and hard work [25], [26]. Other students take a resistant route where they strategically stray away from spaces that make them feel like they have something to prove and intentionally seek out safe spaces to help manage negative experiences [1]. In some cases, students may also decide to leave the PWI and seek an engineering program elsewhere [6]. Assimilation can contribute positively or negatively to a student's thriving process.

Discussion
Implications for Minority Engineering Programs
Many PWIs have initiatives and programs created to provide support for students in engineering–specifically Minority Engineering Programs (MEPs). MEPs often provide resources such as tutoring, networking events, resume building, and many others that they believe will help students attain their goals and be successful engineering students and future engineers. It is important also for these programs to present models to students that will expose them to what success may look like for them. For Black students in MEPs, it is key to acknowledge that their experiences are different from the experiences of other racial minority groups and that as an MEP, you understand that these experiences have influences from their own culture and from that of the university. It is also important as an MEP to understand what an effective model of success looks like. We believe that BSTiE provides an anti-deficit, culturally relevant model that can be used to understand the process of thriving among Black students in engineering at PWIs. Its consideration of multiple Black experiences and its redefining of success for Black students in engineering serve as building blocks for MEPs to build programs and initiatives to support the phenomena of thriving in engineering at a PWI. We acknowledge that BSTiE is not a one-size-fits-all framework and that the experience of every Black student may appear nuanced in the model, however, we believe it will provide a much-needed perspective to those that wish to serve the Black student community.

Implications for Researchers
There is a limited amount of work in engineering education that explores the process of thriving among Black students at PWIs. Among this limited group of work, very few look to the success of HBCUs to inform a model that can be used to understand Black students' experiences at PWIs. This work was begun by Arroyo and Gasman in their introduction of an HBCU-based educational approach for black college student success [3]. Much is to be discovered about what we can learn from how students experience engineering at HBCUs [27]. As a framework that considers this, BSTiE can be used to advocate for reform in engineering programs at PWIs.

Future Work
We plan to use BSTiE to understand how Black students thrive in engineering, with results that can give students a working model for how they can integrate their own individual culture to feel good, achieve holistic growth, and function well in engineering cultures at PWIs. BSTiE serves to begin to highlight the ways that students already achieve success in engineering and to examine the ways that students may perceive the process of thriving in their own lives. We aim to conduct a study informed by BSTiE to explore this phenomenon. We aim to develop a phenomenographic interview protocol that includes questions that will allow us to capture how students identify constructs of thriving (competence, belonging, motivation, and assimilation) in their own journeys.

Conclusion

When students assume the complex role of being Black at a PWI, they take it on knowing that they will be the racial minority [28], and yet, some even choose to pursue STEM careers where their minority status often increases [29]. Competence, belonging, motivation, and assimilation exist with a student's internal and external environments. Although these four constructs may or may not affect each other, each is greatly affected by the internal and external environments. It is no longer feasible for students to "wait on the world to change" in external environments that perpetuate negative experiences for them. It is imperative that stakeholders of engineering programs take stock of the state of their culture and assess if the environment they have cultivated is conducive to the diversity goals they set out at the onset of every academic year. Success as we know it needs to be redefined. The markers of achievement must be expanded to include the nature of the experience of the student. Black Student Thriving in Engineering presents a new model of success that ensures the student is prioritized. It takes into consideration the gender-based racial identity that is specific to Black students in efforts to support their experiences at PWIs. This reframing of success shifts the focus from what a Black achieving engineering student can do for the university to what the university can do for a Black achieving engineering student. Although PWIs have not been created with them in mind, Black students yearly make the decision to attend them in high numbers. It is the duty of the university, then, to ensure that the students do not consistently feel like the university currently operates without them in mind.

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