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## **Black Male "Buoyant Believers" in Engineering and Engineering-Related Fields**

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Dr. Leroy L. Long III recently earned his PhD in STEM Education with a focus on Engineering Education within the Department of Teaching and Learning at The Ohio State University (OSU). He earned his Masters in Mechanical Engineering at OSU and his Bachelors in Mechanical Engineering at Wright State University. He has been a Graduate Teaching Associate with the First-Year Engineering Program and a Research Affiliate with the Center for Higher Education Enterprise at OSU. He has also served as the Outreach Chair of the OSU American Society of Engineering Education Student Chapter. His research interests include: (a) technology use, (b) diversity and inclusion, and (c) retention and success, with a particular focus on students in STEM fields. To contact Dr. Long, e-mail [long.914@osu.edu](mailto:long.914@osu.edu).

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Trevion's research interests center on three foci in STEM Education: pedagogical strategies, practices and policies that broaden minority participation, and the impact of workforce and industry needs on curriculum.

# Black Male “Buoyant Believers” in Engineering and Engineering-Related Fields

## Abstract

Strategies for improving student success are particularly important in high-demand fields like science, technology, engineering, and math (STEM). As the U.S. experiences a decline in skilled STEM workers and a growing number of racial/ethnic minorities, it is critical that more attention be paid to the college success of underrepresented populations majoring in STEM. While some strategies for increasing STEM student success have focused on social-psychological factors such as academic self-efficacy and resilience, little attention has been given to these factors among specific minority groups in STEM such as Black men. To extend the current literature, interviews with 27 Black male collegians majoring in engineering or engineering-related fields were analyzed through the lens of the ‘buoyant believers’ framework. Based on the model, individuals can be described across four typologies as: (a) students who are confident and resilient, (b) students who are confident but lack resilience, (c) students who lack confidence but exhibit resilience, and (d) students who are neither resilient nor confident. Using the ‘buoyant believers’ framework, we highlight excerpts from interviews to depict students who fit in each category of the matrix. We describe the framework as a useful identification tool to assist college educators looking for clues when identifying strategies to build confident and resilient Black male students in engineering and engineering-related fields. This paper includes strategies related to mentoring, modeling, enrichment activities, and curriculum mastery recommended for the success of each respective student “type” that will prove useful to faculty, staff, and practitioners who work with Black male students in STEM.

## Introduction

The nation strives to maintain a competitive edge internationally by contributing significant and innovative advances in science/engineering. However, our postsecondary institutions are not producing the number of graduates with degrees in science, technology, engineering, and math (STEM) fields, necessary to keep pace with demand. To curb projected shortages, it is imperative that the country invests in developing and educating a talented pool of qualified STEM graduates. It must do so with an increasingly racially/ethnically diverse society and college-aged population. Despite the high demand and urgent need to develop a well-qualified and diverse STEM workforce, underrepresented racial/ethnic minorities (URMs) such as Blacks and Latinos continue to make up only 7-10% of the science and engineering workforce.<sup>1</sup> Even when URMs enroll in engineering and related majors, they are more likely to switch to non-STEM majors and much less likely to complete their degree within 6 years than their White peers.<sup>2-4</sup> URM students in STEM report feelings of alienation and invisibility, difficulty applying theory and curriculum to practice, and a lack of pre-college preparation in STEM majors – all of which may contribute to the aforementioned enrollment and departure trends.<sup>5</sup>

To reverse these trends and address many of the challenges and barriers facing URMs in engineering and related fields, additional work is needed that examines the academic and social experiences of underrepresented students in STEM. These jarring statistics suggest an urgent

need to intervene and create pathways to success for URMs majoring in science/engineering through intentional and strategic efforts on the part of college educators.<sup>6-7</sup> Understanding the factors that influence the success of STEM students who fit this demographic profile and familiarity with effective and appropriate strategies is critical and may be the key to addressing projected science and engineering shortages in the U.S. labor market.<sup>8-9</sup> Social-psychological factors that impact URM success in STEM are one area of research that requires greater attention to broaden our understanding of what facilitates collegiate success for underrepresented groups. Scholars have previously examined the role of several psychological factors (e.g., self-efficacy) in minority student success in STEM fields.<sup>10-11</sup> However, additional work is necessary to better understand the multiple pathways to success (or failure) available to URM students and—just as importantly—to identify tools and frameworks for college educators to use to address those challenges and facilitate students’ success in STEM. The need for such work is particularly salient for Black students who often receive negative information related to their academic abilities that affects social-psychological well-being (e.g., self-efficacy) and ultimate college achievement.<sup>12</sup>

## **Literature Review**

### *Black Student Success/Failure in STEM*

As a nation, we are at a crossroads demographically and economically. The need for well-qualified experts in U.S. STEM fields continues to intensify, alongside growing racial/ethnic diversity in the country. In light of these parallel trends, the need for improving minority representation in U.S. STEM fields has become increasingly apparent.<sup>13</sup> In particular, the statistics for Black students in STEM are staggering. Thirty-six percent of Black STEM students switch to non-STEM majors and 29% leave postsecondary education without a degree.<sup>14</sup> These attrition rates are higher than any other racial/ethnic group in STEM. Numbers for Black male students in specific fields like engineering paint an even bleaker picture. Only about 14% of Black male students intend to major in engineering and they constitute just 4% of the engineering student population.<sup>15</sup> Furthermore, Black male students/professionals remain the most underrepresented population in the STEM educational pipeline and workforce.<sup>15</sup>

Several factors contribute to these dismal entry and attrition rates for Black male STEM students. Prior to college, Black students often receive insufficient funding, preparation in mathematics and science, and encouragement to join engineering.<sup>8,16</sup> This often leaves Black students underprepared for the rigors of STEM education. Upon entry, Black students often struggle to find a sense of belonging in STEM majors leading to lower rates of academic and social satisfaction.<sup>17</sup> These students also report feeling “invisible” in the classroom, where they receive insufficient academic and social support.<sup>18</sup> The aforementioned issues have the potential to impact the academic self-efficacy, resilience, and ultimate success of Black men in STEM.

### *Academic Self-efficacy*

Self-efficacy is one's belief in their capability to perform a specific task.<sup>19</sup> In turn, self-efficacy regulates one's behavior. That is, people with low self-efficacy tend to (a) avoid demanding or challenging tasks, (b) have tempered or low expectations and goals, (c) harbor self-doubt and self-defeating thoughts regarding their goals, and (d) exhibit low commitment to accomplishing their goals.<sup>19</sup> Conversely, people with high self-efficacy (a) set more ambitious goals, (b) are not dissuaded by challenges or obstacles, and (c) have high levels of commitment to their expectations and goals.<sup>19</sup>

In educational contexts, academic self-efficacy refers to students' feelings and confidence about accomplishing academic tasks.<sup>20</sup> These academic tasks may be small (e.g., completing an assignment, performing well on an exam) or large in scope (e.g., attaining a college degree). However, studies suggest that academic self-efficacy may play a large role in students' ability to manage the difficult transition to college, experience academic success once there, and persist to degree attainment.<sup>20-21</sup>

### *Resilience*

In the context of education, resilience is represented by “the heightened likelihood of success in school and other life accomplishments despite environmental adversities brought about by...traits, conditions, and experiences.”<sup>22</sup> It represents a student's ability to overcome setbacks and challenges that threaten their educational progress and development.<sup>23-24</sup> That is, academically resilient students are able to “bounce back” from academic setbacks and untimely negative experiences in order to achieve academic success.<sup>25</sup> Resilience has been linked to a number of positive educational outcomes including academic achievement.<sup>20,26</sup> Pertinent to the current investigation, among low-income Black students, there is evidence to suggest that resilience promotes academic achievement.<sup>21</sup>

Despite the challenges Black men face in STEM, we know that some do, in fact, persist and earn bachelor's degrees. Extant research explaining the success of Black men in STEM points to a number of factors that motivate and facilitate their college achievement. For instance, Moore, Madison-Colmore, and Smith offered the “Prove Them Wrong Syndrome,” wherein Black male engineering students persist in order to disprove negative perceptions, stereotypes, and characterizations, rather than quitting because of adverse racialized experiences.<sup>27</sup> Moore et al.'s “Prove Them Wrong Syndrome” is a remark on the resilience of Black students in engineering and related fields despite facing challenges and barriers to their success.<sup>27</sup>

### *Buoyant Believers*

Emerging evidence connects academic self-efficacy and resilience to student success among Black collegians. For instance, Strayhorn posits that a combination of varying degrees of academic self-efficacy and resilience creates four different types of students: (a) those with no resilience or confidence, or “avoidant give-up'ers,” (b) resilient students with no confidence, or “the ballers,” (c) confident non-resilient students, or “the blamers,” and (d) confident and resilient students, or the “buoyant believers.”<sup>20</sup> This combination of confidence and resilience in

turn affects a student's orientation toward educational achievement and success in college and ultimately should guide practice among college educators when working with students, particularly those who are typically underserved, underrepresented, or vulnerable such as Black men in engineering and related fields. A schematic of the model has yet to be created. However, below is a description of each category:

- (1) *Buoyant believers* are resilient and confident. They are confident in their academic abilities. Their confidence is less susceptible to change following academic setbacks. Instead, buoyant believers rewrite negative scripts related to academic performance. "I am not smart enough" becomes "I am, indeed, capable." Buoyant believers also exhibit resilience and bounce back from setbacks or academic failure. Strayhorn found that students who are academically resilient and have higher academic self-efficacy are more likely to achieve academic success.<sup>20</sup>
- (2) *Blamers* are confident but not resilient. They exhibit high degrees of academic self-efficacy. However, their confidence has a dangerous lack of vulnerability. That is, as negative experiences and academic setbacks begin to mount, "blamers" are less likely to change their action and *more* prone to attribute their failures to the actions and behaviors of others without accepting some personal responsibility.
- (3) *Ballers* are resilient but lack confidence. They often look and behave intellectually confident, but they are, in fact, struggling academically. These students, while less likely to leave their major than their "avoidant give-up'er" counterparts, are also less likely to seek aid during challenging circumstances. Students in this category are likely to "stick with" their major and persist through setbacks without necessarily addressing the challenges they face or building the competence and confidence necessary to succeed.
- (4) *Avoidant give-up'ers* lack both resilience and confidence. Students categorized as "avoidant give-up'ers" face challenges and experience academic setbacks (e.g., a low grade, negative feedback from a professor) that in turn impart negative feelings about themselves and their abilities. These students may experience thoughts such as "I am not smart enough" and "I do not belong in STEM," which may in turn become self-fulfilling prophecies. As negative experiences continue to occur, these students become less engaged in their education until they ultimately "give up." They lack confidence in their academic abilities and do not "bounce back" from failure.

## **Purpose**

The purpose of this paper was to critically examine the narratives of Black male students in engineering and related fields to understand the role of social-psychological factors in their college achievement and success. Specifically, the study drew on Strayhorn's 'buoyant believers' framework to explain the role of self-efficacy and resilience in the success of Black males majoring in engineering and related fields.<sup>20</sup> The framework offers practitioners, faculty, and staff with a guide for helping minority STEM students address and overcome challenges and proceed down pathways toward college achievement. Importantly, this framework allowed the researchers to go beyond typical explanations for racial disparities in student success (e.g., lack of pre-college preparation or interest) to provide new insights into Black student success in engineering and related fields during college. The current investigation depicts how the 'buoyant believers' framework can be used by college educators as a key for addressing social-

psychological factors among Black men in engineering and related fields with the ultimate goal of encouraging college success and degree completion.

There is precedent for using matrices or typologies to assist college educators in interpreting behaviors and identifying college students' needs that directly parallel the structure that undergirds the 'buoyant believers' framework. For instance, James Marcia famously operationalized Erik Erikson's identity development theory, positing four typologies organized along the lines of two factors, identity exploration and commitment among adolescents and young adults.<sup>28-29</sup> Over the years, this typology has been used by many college advisors, practitioners, and educators alike to help them determine a student's status in their identity development and ultimately to assist students in making decisions related to their major and career of choice.<sup>30</sup> The 'buoyant believers' model takes a similar approach, framing the question of college success in terms of two other influential factors impacting student development: academic self-efficacy and resilience.

## Method

This study is part of a larger, longitudinal study titled, *Investigating the Critical Junctures: Strategies that Broaden Minority Participation in STEM Fields*, funded by the National Science Foundation (NSF). The study focused on Black and Latino college students majoring in STEM fields. While the larger study consists of both quantitative and qualitative components, this report is based on interview data only.

The qualitative approach of this study is concerned with finding/sharing deep insight into the experiences of a few participants (i.e. depth) rather than a large/generalizable population (i.e. breadth).<sup>31, 32</sup> Therefore, in-depth interview data from 27 Black male students majoring in engineering or engineering-related fields were analyzed through the lens of the 'buoyant believers' framework. The 'buoyant believers' framework is a typology that encompasses students' academic self-efficacy and resilience in an effort to describe students and to guide our understanding of students' college experiences. Results can be summarized in one of four categories including: (a) students who are confident and resilient, (b) students who are confident but lack resilience, (c) students who lack confidence but exhibit resilience, and (d) students who are neither resilient nor confident. Each category is associated with particular student characteristics and college outcomes. Strategies to ensure student success can be tailored to fit the needs of students in alignment with their placement in the 'buoyant believers' typology. Building on the utility of the 'buoyant believers' typology, we describe strategies related to mentoring, modeling, enrichment activities, and curriculum mastery recommended for the success of each respective student "type" that will prove useful to faculty, staff, and practitioners who work with minority students in engineering and engineering-related fields.

**Participants.** To critically examine the role of academic self-efficacy and resilience of Black male students in engineering and engineering-related fields, "information rich" participants were selected using a purposeful sampling approach. According to qualitative texts, "information rich" participants are those who meet our sampling criteria, have experiences that align with the phenomenon under investigation (i.e., they identify as Black in engineering or related fields), and have a capacity to talk about their experiences in some detail. Specifically, all participants shared

several important characteristics. First, only undergraduates were recruited as participants to eliminate any unforeseen variability in experiences between undergraduate and graduate students. Second, all participants had declared a major in engineering or a related STEM field, as defined by the National Science Foundation (NSF).

Participants were recruited using a variety of strategies including electronic announcements, college listservs, Black fraternities, as well as the National Society of Black Engineers. Willing participants were contacted via telephone or email by the researcher(s) to confirm their participation, review informed consent information, and schedule a day and time for interviews. This approach yielded 27 Black male collegians majoring in engineering and other STEM fields, whose ages ranged from 18 to 24 years. The sample included a range of STEM fields, and hailed from diverse family environments (i.e., single-parent, guardian-led, both parents). All of the participants are referred to by their self-selected pseudonyms.

**Data Collection and Analysis.** The primary methods for data collection were semi-structured one-on-one and group interviews. Interviews were conducted by the researchers in a private room, centrally located on campus. Each interview lasted 90 to 120 minutes. All interviews were digitally recorded and subsequently transcribed by a professional.

Prior to analysis, transcript data were organized and stored in NVivo®, a qualitative data analysis software. Data analysis, in short, proceeded in several stages using the constant comparison method by reducing a preliminary set of codes into larger themes through an iterative process of reading, categorizing, and comparing categories/codes both within and across transcripts.<sup>33</sup> Several strategies were employed to establish credibility: member checking (i.e., asking a participant to review his transcript for accuracy and completeness), triangulation of data sources (e.g., interviews, demographic questionnaire), and peer debriefing (i.e., researchers talked with colleagues regularly for the purpose of exploring implicit aspects of the study).

## Results

### *Category 1: Confident and resilient (Buoyant Believers)*

Using Strayhorn's typology as a guide for the first time in engineering, one group of undergraduates can be described as both confident and resilient.<sup>20</sup> Therefore, they are labeled as "buoyant believers." These individuals have a high degree of academic self-efficacy or confidence. They also exhibit a great deal of resilience in the face of adversity, which enables them to "bounce back" from difficulties in the classroom and in their STEM major. As an example, Samrawi, a 20 year-old Black mechanical engineering major, describes his feelings regarding his abilities.

Although I am a minority I think I have confidence in myself. If you show the professor and the other people that you're actually a good student that you know what you're doing, they'll just get past [the fact that you're a minority]. I feel like this day and age it's not like before, I feel like things are changing.



Samrawi is not only confident in his abilities, but he seems to also believe that others will ultimately acknowledge and recognize his efforts/talents. In addition to being confident, Samrawi displays how he overcomes difficult classes and academic hurdles.

Well, this happened last semester [I was in a difficult class and wasn't doing as well as I'd like], I just, I never like regret it, but I kinda feel like there's something wrong with me and I think I should try harder. I always blame myself, I don't blame other people for it, and I, I just try.

Like other buoyant believers, Samrawi doesn't blame others and keeps trying to improve when faced with adversity. In the recommendations and conclusions section, strategies will be discussed for helping engineering students maintain or increase their academic self-efficacy and resilience.

### *Category 2: Confident but lack resilience (Blamers)*

The second group of students can be depicted as being confident but not resilient. These individuals believe in their intellectual abilities. However, their academic self-efficacy leads to a lack of resilience since they tend to blame others and quickly give up when faced with adversity. As a result, these individuals are labeled as "The Blamers." A Black chemical and bio-molecular engineering student named Abraham showcased his confidence when saying, "whatever you want to do you can do, there's nothing you can't do." Although Abraham believes anything is possible, he goes on to describe a troubling way that he handles tough courses.

If I have a difficult class I usually, after the first exam if you find out if you did good or not. After that, whatever I did well I continue doing what I'm doing, and if I did not do well I actually start studying more or maybe seeking help by going to office hours. If it's out of my hands, if it's before the third week I'll probably drop the class, that's my thought process.

The above quote offers insight into the thought process of some "blamers" while experiencing difficulty. In the excerpt, Abraham indicates how he devotes more time to studying if he does not perform well on an exam. He seems unsure about seeking help though when using words like "maybe." Furthermore, he appears to reach a point where he blames others by saying "if it's out of ... [his] hands," then, he will ultimately quit by dropping the class. Strategies for helping "blamers" will be described later in the paper.

### *Category 3: Resilient but not confident (Ballers)*

Students in the third category are characterized by their resilience and lack of confidence. Students in this category appear to bounce back from failure or setbacks and seem able to wade through challenges and barriers toward their goals. However, these students often lack confidence in their ability to navigate academics, coursework, and the like. Students in this category are known as the "ballers," students who consistently appear to bounce back from challenges but who emerge from those challenges with little to no significant change in their

academic self-efficacy or confidence. Take for instance Tyler, a 21 year-old African American STEM major:

[I think about leaving my major] all the time, you know you get into those certain challenging aspects, and you're like, is this something you want to do? I have thought about it numerous times, chemistry or you know there is a lot of areas you can involved with, but like I said at the end of the day it always came back to that first experience I had with it, so that's why I always kinda stuck with it.

Tyler lacks confidence in his ability to do well in his STEM major. He clearly articulates an internal struggle with his choice in major as a result of the challenges and barriers he faces in coursework. He has even considered changing majors. However, Tyler looks to a past experience for encouragement and resists changing majors, bouncing back from the challenges he faces without gaining any confidence in his ability to do well in the field. Such behavior, bouncing back and persistence through the major without any real change in one's confidence to do well, could potentially be damaging to his future success in the field or in college generally. Tony, a 22 year-old African-American science major, described sentiments similar to those expressed by Tyler. He says:

I thought about leaving my major a couple times, but not to the point where I was really contemplating it, because the thing is I'm really hard headed so once I start something I really like to finish it off, plus I really like challenges no matter how hard it is.

Tony lacks confidence in his ability to do well in his STEM major. The challenges Tony faces have led him to consider leaving his major on several occasions. However, his seemingly intractable resilience or "hard headedness" compels him to persist in his major no matter how well he is doing and despite the fact he lacks confidence in his ability to do well in the major. That is, even in the face of serious challenges that lead him to believe he cannot do well in the major, he endures simply because he is headstrong and wants to finish something he started—no matter if it's detrimental to his ultimate success in college.

*Category 4: Neither resilient nor confident (Avoidant Give-up'ers)*

The final category of students are neither resilient nor confident. These students are characterized by their lack of belief in their academic ability and their tendency to not bounce back from challenges/setbacks in college. These individuals, known as "avoidant give-up'ers," often have serious thoughts about leaving their major and have trouble navigating STEM classroom environments. Students in this category are particularly at risk for departure from college and STEM. Take for example Emmanuel, a 19 year-old African-American science major:

I have thought about leaving my major because I wasn't passionate my first year in college, I planned to leave my major but, thank God for courage and prayers. I decided not to leave because...it's UCLA. I mean, people that pass through UCLA do it why should my situation be different. So, I decided to stay in my major and I'll probably be in it until I graduate. [sic] I didn't really think about changing my major, because by the time I had gotten to that point, I thought about it, but I've gone too far to stop now, I'm going to keep going. Because I didn't struggle as much as some of my friends did, I mean I struggled barely passing some of my classes, I just had to keep going through.

Emmanuel currently remains in his major and indicates that he will probably stay in it until he graduates. Nonetheless, there is some indication of serious trepidation on his part that strongly signals that he lacks confidence in his ability to do well in his major. At the same time, what appears on the surface to be resilience (i.e., "I decided not to leave") seems to be rooted in weak/unstable ground. He suggests that he is staying in his major because he is not struggling as much as many of his friends. Simply put, his "resilience" appears to stem largely from his desire to graduate from a school of great renown and because others are able to do it, not necessarily because of his passion for the major or desire to pursue a STEM career. He is not necessarily "bouncing back" as much as wading through setbacks without addressing the academic challenges he's facing. This combination of factors and lower classman status may put Emmanuel in a particularly precarious position with regard to whether he does in fact persist and bounce back from setbacks in his major and build the confidence necessary to successfully pursue his STEM degree.

## **Discussion**

Overall, interviews exploring the experiences of Black undergraduates in engineering and related fields produced helpful findings concerning students' academic self-efficacy and resilience. Building confidence and resilience among Black students in engineering and other STEM fields is critically important for at least two reasons. First, prior work has provided compelling evidence to suggest the influence of academic self-efficacy and resilience on Black college student achievement.<sup>20</sup> Thus, it is imperative that educators work with students to build their confidence and resilience in order to ensure they succeed in college. Second, because of the link between self-confidence, resilience, and achievement, it is critical—at both the college level and as a society—that we invest in strategies to graduate more minorities in STEM and meet the growing need for workers in the field.

The 'buoyant believers' framework works like a key to help college educators interpret student behavior, assess student needs, and make decisions about actions that should be taken to ensure students succeed in STEM. In doing so, educators can have an impact on students by moving them toward becoming buoyant believers. For instance, one might imagine a STEM advisor or faculty member utilizing the 'buoyant believers' framework as a tool to help place struggling Black STEM students who appear to lack confidence or resilience in the typology. Subsequently, the advisor or faculty member could then consult our recommendations for the respective typology and decide on the appropriate interventions to move students toward greater confidence, resilience, or both.

What is presented in the current investigation is exploratory, empirical, qualitative research that suggests the usefulness of the ‘buoyant believers’ framework in guiding educators in their practices when working with Black students in engineering and related-STEM fields. There are several opportunities for future research with the ‘buoyant believers’ framework. Future studies could extend on this work by employing quantitative methodologies to demonstrate the link between characteristics of buoyant believers and academic achievement among STEM students. Additional qualitative research on students’ progression through the typology could also prove fruitful for STEM educators to assist in planning and ordering of interventions and strategies to ensure students’ success. Future studies might also investigate the usefulness of the ‘buoyant believers’ framework in STEM fields such as cross-gender comparisons or studies that focus exclusively on another underrepresented racial/ethnic group in engineering such as Latinos.

## **Recommendations and Conclusion**

Narratives of Black male students in engineering and related fields were critically examined to understand the role of social-psychological factors in their college achievement and success. Specifically, the study drew on Strayhorn’s ‘buoyant believers’ framework to explain the role of self-efficacy and resilience in the success of Black males majoring in engineering and related fields.<sup>20</sup> Strayhorn’s typology was used as a guide for the first time in engineering.

The current investigation demonstrates that the ‘buoyant believers’ framework could emerge as one of many useful tools for college educators working with Black students in engineering and related STEM fields. It can help faculty/staff identify issues, challenges, and barriers related to academic self-efficacy, resilience, and college achievement. Notably, the framework presents STEM advisors, faculty, and other professionals with the ability to identify students with a typology that in turn provides specific strategies they may employ to help move students lacking confidence, resilience, or both.

Using Strayhorn’s work, students were placed into four different categories based on varying degrees of academic self-efficacy and resilience: (a) confident and resilient students, or the “buoyant believers,” (b) confident non-resilient students, or “the blamers,” (c) resilient students with no confidence, or “the ballers,” and (d) students without confidence and resilience, or the “avoidant give-up’ers.”<sup>20</sup> To help produce more Black engineering and engineering-related undergraduates who are both confident and resilient (i.e., buoyant believers) and thus more likely to succeed, we offer several recommendations to faculty and staff:

### *Category 1: Confident and resilient*

To maintain a high level of confidence and resilience for individuals who are already classified as “buoyant believers,” we recommend:

- Affirming messages from faculty/staff so Black students recognize they currently possess characteristics that are desirable and helpful to their success in engineering and related STEM fields
- Periodic meetings between faculty/staff and Black STEM undergraduates to assess students’ current level of academic self-efficacy and resilience

- Attentive support and constructive feedback to ensure that students stay on track to earning a college degree in engineering or related STEM fields
- Providing leadership opportunities to connect Black “buoyant believers” with other Black STEM students to be peer mentors or role models for other Black STEM students who may fall in one of the other categories of the ‘buoyant believers’ typology

*Category 2: Confident but lack resilience*

To improve the resilience of “blamers” who are already confident, we recommend:

- Pairing Black STEM undergraduates with mentors in the field who can show the students how academic success can lead to a positive future <sup>25</sup>
- Social support from STEM peers, community members and family <sup>34-35</sup>
- Establishing relationships through well-designed STEM mentoring programs, learning communities, involvement in fraternities/sororities, and faculty-student research collaborations <sup>20</sup>
- Exercising empathy and caution when forming opinions in response to Black STEM students’ actions <sup>20</sup>
- Working with students to develop successful coping strategies to help them bounce back from setbacks and failure

*Category 3: Resilient but not confident*

To improve the confidence of “ballers” who are already resilient, we recommend:

- Mastery-based experiences that allow Black students to produce work and tackle challenging STEM curriculum with structured opportunities for improvement and mastery of materials when faced with setbacks or failure. For example, allowing students who fail an assignment to redo their work after receiving additional assistance <sup>20</sup>
- Providing constructive feedback to Black STEM undergraduates with actionable strategies for incorporating that feedback into building competencies and confidence in one’s cognitive abilities, possibly through the use of rewards <sup>36-37</sup>
- Building confidence by helping Black STEM majors re-write negative scripts. For example, work with students to change their hearts/minds with regard to their ability by directing their attention to their academic strengths and opportunities for improvement <sup>20</sup>
- Work with Black STEM students to help them set realistic proximal goals, with a series of attainable intermediate goals to give them a sense of accomplishment and progress <sup>37-38</sup>
- Connecting Black undergraduates to strong models in their respective STEM field with whom they can identify, such as successful same-race peers, professionals, or faculty in their discipline. Modeling behavior can positively impact students’ motivation, confidence, and achievement <sup>39</sup>

#### *Category 4: Neither resilient nor confident*

To improve the confidence and resilience of “avoidant give-up’ers” who lack both traits, we recommend:

- Employing strategies outlined in both Category 2 and 3.
- Working to build students’ confidence first with ultimate goal of building students’ resilience.
  - Building confidence or academic self-efficacy is related to students’ academic resilience and persistence<sup>37-40</sup>
  - This relationship exists because students with a high level of self-efficacy are more likely to use effective cognitive strategies such as relating newly learned material to prior information they’ve received<sup>37</sup>
  - Students who are confident in their abilities may be more likely to bounce back from setbacks based on the strategies they’ve learned to boost their confidence

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