Lessons Learned from Successful Black Male "Buoyant Believers" in Engineering and Engineering-Related Fields

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Abstract

In high-demand fields like science, technology, engineering and mathematics (STEM), more success strategies are needed to effectively recruit and retain college students. One-size fits-all approaches (i.e., those that are supposed to work for all students) often neglect the unique needs of underrepresented populations. Although some strategies exist for helping minority students succeed in STEM, the present investigation uncovered detailed information about how Black male students in engineering and engineering-related fields develop important academic traits such as confidence and resilience. To add to the limited body of literature on Black males in STEM, interview data from 27 Black male students majoring in engineering or engineering-related fields were analyzed through the lens of Strayhorn's 'buoyant believers' framework. The framework offers practitioners, faculty, and staff – who work with minority engineering students – guidance for addressing challenges students face and creating pathways for their success. 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. The present study focuses solely on the narratives of students who are "buoyant believers." Specific attention was given to the pre-college and in-college experiences of Black males in engineering and engineering-related fields in order to better identify potential sources of their current confidence and resilience. Findings revealed that research participants' current confidence and resilience seem to be connected to attributes such as a) childhood adversity, b) a refusal to quit, and c) prior academic success, which ultimately led to their collegiate achievements.

Introduction

Employment opportunities in science, technology, engineering, and mathematics (STEM) fields are projected to continue growing, at a rate that demands one million more United States STEM professionals by 2022.[1] Having a stable and sufficient supply of STEM workers is necessary for U.S. global competitiveness and national security. As the demand for STEM workers grows, the U.S. population is experiencing increased growth among historically underrepresented racial and ethnic minorities (URMs), including Blacks, Latinos and Native Americans. Providing equitable educational and occupational opportunities to an increasingly diverse U.S. society can help meet the large demand for more STEM workers.[2-4]

STEM fields have historically been dominated by men, but Black men have been and continue to be one of the most underrepresented demographic groups in STEM. From 2004 to 2014, the proportion of male science and engineering (S&E) bachelor's degree recipients who were Black men remained nearly the same, at 6.1 percent in 2004 and 6.3 percent in 2014.[5-6] When considering all S&E bachelor's degree recipients instead, Black men represent approximately three percent of degree recipients even though they account for over 6 percent of the U.S. population.[7-9] The educational challenges facing Black men and other URMs in STEM fields must be addressed not only though engagement and encouragement of students but also through

practice and policy in institutions, especially those policies and practices that pose unnecessary barriers for URMs.[10-11]

Researchers have previously studied the role of several psychological factors (e.g., self-efficacy) in minority student success in STEM fields, although few investigations have focused on minority men.[12-14] More work is needed to better understand, in depth, the multiple pathways to success available to URM students. The need for such work is especially vital for Black students who receive a bombardment of negative messages related to their academic abilities, which affects social-psychological well-being (i.e., self-efficacy) and ultimate college achievement.[15] More specially, it is important to hear from often unheard and misunderstood populations such as Black males who face unique academic and social barriers to their success in engineering and related STEM fields.[16]

Literature Review

Attrition rates for Black students in engineering are considerably higher than their White counterparts. For example, according to the National Center for Educational Statistics (NCES), Black STEM degree aspirants are both more likely to leave college, and more likely to leave STEM for non-STEM fields, than all other racial groups.[17] As a result, factors affecting success for minority students in engineering broadly, and Black students specifically, have received some scholarly attention. Notably, social and psychological factors affecting Black students' success in engineering have been covered in the scholarly literature.[12-13, 18-19] For example, scholarly literature has demonstrated that social factors, such as racially hostile and chilly campus and disciplinary climates contribute, in part, to racial disparities in engineering students' academic success.[19]

Academic Self-efficacy

Psychological factors related to the present study include students' self-efficacy beliefs and academic resilience. Self-efficacy is defined as one's belief in their capability to perform particular tasks in order to produce specific outcomes.[20] For example, self-efficacy involves a student's belief in his or her ability to use the substitution method to solve a system of linear equations for an electric circuit. A student's self-efficacy involving the substitution method may differ from his or her belief pertaining to other academic or mathematical tasks like using derivation to determine the position and acceleration of a moving vehicle.

Literature on self-efficacy has identified the importance of self-efficacy beliefs in academic contexts. Specifically, extant literature suggests that one's efficacy beliefs inform task selection, prioritization, commitment, and perseverance.[20-24] In educational settings, this suggests that students with high academic self-efficacy are more likely to engage in more challenging academic tasks. Moreover, highly efficacious students are more likely to commit to academic tasks, as well as persevere during challenging academic tasks. Research has connected efficacy beliefs to educational processes and outcomes such as academic major selection, scholastic achievement, persistence, and long-term, post-graduation career decisions.[20-24]

Most of the literature on academic self-efficacy comes from the field of educational psychology. However, engineering education literature has embraced the value of promoting high academic self-efficacy, especially when promoting engineering students' academic goals, success, and career interests. For example, based on findings from an engineering education study, students in an S&E career planning course who report higher self-efficacy beliefs earn higher grades and are retained longer than their peers in S&E disciplines who have low confidence.[23]

Resilience

Just as scholars have indicated that high academic self-efficacy is a positive predictor of academic achievement, motivation, and retention, considerable educational literature has also indicated that academic resilience plays an important role in students' success. Resilience is defined as students' ability to succeed despite challenges, temporary or long-term setbacks, and negative experiences.[25-26] That is, resilient students are able to recover from academic and social setbacks, which may include, but are not limited to, poor academic performance on exams or in coursework, and negative social cues from institutional agents and peers in academic environments.

Like academic self-efficacy, scholarly attention has been given to the role of academic resilience in mediating students' collegiate success. Notably, research indicates that academic resilience affects students' predispositions towards schooling and academic tasks, engagement in particular educational activities, motivation, and other critical determinants of students' success in school.[27-28] Thus, the study of academic resilience in the specific context of engineering education holds promising implications for educational practice in engineering.

Buoyant Believers

Relationships between and among academic self-efficacy and resilience have been studied across education and psychology literature. As an example, Australian high school students' academic self-efficacy is a significant predictor of academic resilience.[27] Similarly, low-income Black college students with high academic confidence who were also able to "bounce back" from academic challenges and setbacks in college (i.e., students labeled as "buoyant believers") achieve greater academic success, as measured by grade-point average.[29]

Using findings from the aforementioned study of low-income Black students, Strayhorn created the 'buoyant believers' framework. The framework positions students in four categories representing the intersection of various degrees of academic self-efficacy and resilience. The four categories include (a) "buoyant believers" or students who have high academic self-efficacy and high academic resilience, (b) "ballers" or resilient students with low confidence, (c) "blamers" or confident students who lack resilience, and (d) "avoidant give-up'ers" or students with low confidence and low resilience.[12,29] The present study focuses specifically on the narratives of students who are "buoyant believers." According to Strayhorn, "buoyant believers" are confident students, whose self-efficacy is less vulnerable to change, making them more likely to persist and succeed in academic settings.

Literature suggests that neither resilience nor self-efficacy are static traits; rather, resilience and self-efficacy are dynamic traits that can be developed and strengthened over time.[12,20-29] This is especially encouraging for understudied minority populations like Black men. Thus, understanding the factors that bolster Black male engineering and engineering-related students' academic self-efficacy and resilience is an area of considerable scholarly importance.

Purpose

The purpose of this paper is to critically examine the narratives of successful Black engineering students with specific attention to the intersections of two social-psychological dimensions: students' (a) academic self-efficacy and (b) resilience. The study draws on Strayhorn's 'buoyant believers' framework to describe Black students' experiences in engineering and engineering-related fields and to explain the role of self-efficacy and resilience in their success. The framework offers practitioners, faculty, and staff – who work with minority engineering students – guidance for addressing the challenges students face and creating pathways for their success.

This paper will explore lessons learned from the experiences of a few Black males in engineering and engineering-related fields who are classified as confident and resilient, or "buoyant believers." Strategies to ensure student success can be gathered from the stories of Black male "buoyant believers." Building on the utility of the 'buoyant believers' typology, we describe strategies related to building and maintaining both academic self-efficacy and resilience among successful Black males in engineering and engineering-related fields.

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). [31, 32] 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. In this study, specific attention was given to the pre-college and in-college experiences of Black males in engineering and engineering-related fields in order to better identify potential sources of their current confidence and resilience.

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. 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).

Findings

Using Strayhorn's 'buoyant believers' typology, several Black male engineering and engineering-related students were labeled as "buoyant believers" or students who are both confident and resilient.[12,29] Participants who are considered to be "buoyant believers" exhibit a high degree of resilience when they experience adversity, which allows them to "bounce back" from struggles they encounter as STEM students. "Buoyant believers" also have a great amount of confidence or self-efficacy regarding their ability to successfully complete academic tasks for their major. Although some strategies exist for helping current "buoyant believers" maintain a high level of resilience and confidence, the present investigation uncovered detailed information about how Black male students in engineering and engineering-related fields developed such traits. [12,29] Research participants identified attributes such as a) childhood adversity, b) a refusal to quit, and c) prior academic success, which ultimately led to their collegiate achievements.

Attribute 1: Childhood adversity

Several research participants who were labeled as "buoyant believers," described childhood adversity which helped them learn how to focus on and fight for academic opportunities even with limited resources and outside discouragement. For example, Charles, a senior aerospace

engineering major, talked about how he learned to focus on academics while growing up around rough neighborhoods in a large Midwestern city.

> I grew up in [a large Midwestern city], two parent household, neighborhood was pretty decent but where I travelled to and from school [the] majority [of] high school it was a pretty rough neighborhood, <u>I had a lot of adversities that I had to overcome</u> as far as being a statistic <u>but I had a great foundation with my parents</u>. I got a scholarship to play basketball in high school at a Catholic private school downtown. So, I took advantage of that so I didn't have to go to my neighborhood school which wasn't a great school. But, high school is where <u>I kind of transitioned from being focused purely on basketball not academics.</u> And, I just kind of used basketball as a tool to get me where I am now, which is in college.

Fortunately, Charles did not have to overcome numerous childhood adversities on his own. He mentions having a strong example in his parents, who were both present in his home, and earning an opportunity to attend a safer and academically stronger high school due to his athletic ability. Charles seems to believe he was lucky compared to many of his childhood peers who may not have had similar family support or academic and scholarship options that he thought helped him avoid being "a statistic." He not only talked about how he learned to focus on academics, but he also described the ways in which he learned to fight for academic opportunities and his future success.

> [My hometown] is a rough city and as a male you have a different experience than what most females have. So, you encounter a lot of people who just, a lot of get rich quick type – I just encountered a lot of people who were thieves and they want you to kind of join in with them and help expand how they rob. Just gang members you encounter getting on or off the train and off buses and a lot of the times they try to get the people who look like they don't have a great home so to speak. So, they can kind of offer you "brotherhood." But, growing up with my family I knew that, that wasn't an option for me. So, I never gave [into] it anywhere, [whether] it meant <u>I had to fight</u> or whether it meant I had to get jumped that's just what it was <u>because I wasn't interested in that</u>. That was just something I had to make a choice from a day to day basis between eighth grade and sophomore year.

Despite being faced with enticing opportunities to make fast money and feel a sense of belonging through negative means, Charles again relied on his family structure to fight for the things he valued. He made a conscious choice to pursue his true interests despite the opposition or attack he might face. Charles persevered through years of adversity. He displayed admirable mental and physical toughness.

Charles was not the only "buoyant believer" who experienced childhood adversity. For instance, Homer, a senior electrical engineering major, also had to learn to focus on and fight for academic opportunities. He spoke about attending inadequate schools where many of his classmates weren't succeeding academically.

> I'm originally from [a mid-sized city on the East Coast] and lived in [that] area all my

life, grew up there most of my family resides in that area and it was definitely an experience living there although it's a predominately African-American environment. So, I grew up around Blacks all my life, didn't really know much outside of my race. High school, middle school, elementary school was always predominantly Black and so I was always in a small bubble as to what the outside world was. Didn't really know much else besides the neighborhoods that I was from. Growing up in that environment was definitely a challenge, didn't go to the best schools a lot of my peers weren't doing the right things when it came to academics or what not. I always had the mentality that I was gonna go to school and make something of myself but I had my troubles as a lot of my peers did just following friends and be a knucklehead but overtime I grew out of that shell and I started to take school much [more] seriously. On my way to high school, I went to a military academy and got a chance to – the goal was to go to military academy was because the neighborhood school I was supposed to go to was not good either so it was the hope to attend military school would be better and bring discipline and stuff. It did have some good points as far as discipline and ROTC aspects but in the grand scheme it's just like a regular public high school. We had a lot of the neighborhood kids there so we had to deal with a lot of the troubles that, that brings and we didn't really have adequate resources to prepare us for a future after high school. Teachers just kind of showed us the material and we went through it. I did learn a lot and I did the best in my classes but if you're in environments where the teachers are spending more time correcting the students instead of instructing us then it would kind of be hard. So, a lot of the classes that I took – I took them but I didn't really learn as much from [them], I took chemistry once, physics once, bio once – I went all the way up to pre-calculus because that's all I was offered at my school. We didn't have any AP classes till my senior year of high school. I took what was there and really couldn't do much more about that and I did well in my classes and definitely stood out from my peers but I was always wanting more and always knew that in order for me to get to college I definitely was gonna have to – I needed more but couldn't do anything about that. So, as I was matriculating through high school, college started to become a dream and more of a reality as I worked my way through. But, it definitely wasn't easy to make it that far or eventually get to that point. Just because when you're in an environment where not a lot of people go to college or you can actually hope or get resources for it's kind of put a heavy burden on me. Just to actually get to college and actually succeed and then actually know what to do because there is a lot that I didn't know but I had to do a lot of the research on my own.

Unlike Charles, Homer did not seem to have better or alternative academic options available to him. He experienced some benefits from attending a military high school but felt that he still had to overcome a lot of distractions and lack of course offerings while trying to focus on his studies. Homer also had to carry a heavy load and do many things on his own to attend college since he was not surrounded by many people who had gone or planned to go to college.

It was a pretty rough environment. A lot of the students at my school were on free or reduced lunch, a lot of the neighborhoods that were coming there were like projects, a lot of students just had brothers and sisters that they went to school with – just really bad neighborhoods, a lot of crime, not a lot of role models or guidance in those neighborhoods. The goal was to try to send them to the school to maybe work them up

and get them in good shape but that wasn't the case and it was hard to do. The neighborhood was about five minutes away from the school so there ... was no way getting around that and so a lot of time was spent on trying to correct behavior of students but that didn't work. The neighborhood I lived in was a relatively urban neighborhood, we were pretty much middle class but a lot of my peers come from single parent homes. I was fortunate to have a mom, stepdad in my life and my biological dad in my life too, so I had my parents' guidance but a lot of my peers didn't. There was a lot of moms raising a family, a lot of teen pregnancies; just a lot that you would get in any urban school was basically there.

Similar to Charles, Homer describes how much he appreciated the support he received from his family despite growing up in a tough setting. He is very aware of how his socio-economic status and family structure compares to his primary and secondary school classmates. Homer also mentions how difficult it was to focus on academics and succeed in an environment where his educators spent a lot of time disciplining students instead of teaching them. In addition to Charles and Homer, Derrick was another "buoyant believer" who experienced childhood adversity. As a child, he relocated to the United States after initially being born and raised in West Africa.

> In … [my home country in West Africa], for us it was pretty nice. We went to private schools so we were kind of sheltered. Honestly, the only difference is our parents weren't there which was kind of hard but for the most part it was cool because we lived in a big house with my cousins and stuff. As I grew up, a lot of people thought my cousin was my sister, she grew up above me, so like we always do the same things – like walk to school together so that was kind of cool. [We] moved to America and moved to a place where my sister and I were the only people of color in our whole school. So, in elementary school, I remember they took like a group photo where the photographer sat on the roof and we could see like everyone sat on the playground area so you could see everyone and you could easily spot us out of the whole school. It was actually my first time in America. I didn't really know what or understand the prejudices that went on. I didn't really get it till I moved away to a more diverse area, that's when I started to notice differences and things that go on.

Derrick talks about the racial isolation he faced in predominantly White American schools. He quickly realized how he and his sister stood out among his peers. Derrick was initially unaware of the prejudices that people around him possessed but he began to understand as he grew older.

> Being in AP classes, most of the people in my class were White so my friends just became White – my first friends were White people and then I realized how those white people would get me in a circle and ... and that kind of stuff it's just the kind of things that you do obviously when you're the only Black person in the group of white people there is some blatantly racist things that go on. That also took me awhile to get because I'm someone that takes, I don't take myself seriously, so whenever someone says something I just think they are joking. But, after a while, you realize and once you learn more about just America, the way things are, you start to notice certain things so then

when you go to college it just makes that more interesting.

Derrick not only faced racial isolation after moving to the U.S., but he also describes prejudices he observed. He suggests that childhood adversities surrounding race helped to inform his perceptions by the time he went to college and attended a large predominantly White institution (PWI). Collectively, Charles, Homer and Derrick all faced childhood adversities which helped them learn how to focus on and fight for academic opportunities even with limited resources or outside discouragement. From an early age, each research participant showed signs of resilience while overcoming various childhood adversities.

Attribute 2: Refusal to quit

Charles, Homer, and Derrick turned their childhood adversities into fuel for college success where they each displayed a refusal to quit when confronted with challenges. They seem to all dismiss the very thought of quitting, even as many of their peers switch to other majors. Derrick spoke about why he refused to quit.

> I think it's one of those things where it's something you always wanted to do so there definitely are times where you're like man is this really for me. And, originally it was me [saying] 'I can't quit now I have been telling people that's what I wanted to do for so long. But, now I'm like '14 of the 18 years of my life' and decided I want to do it, so now I'm in college and I'm [not] about to just quit it. For me, quitting wasn't an option so it was just finding ways to make sure that I succeeded and through that like NSBE was one of those things that helped me out a lot and since that, it made me understand that I wasn't doing horrible. Because when you go from high school to college and in high school sometimes not even studying for an exam and you do well. Just the way you go about it, I guess you just think you're inherently smart that anything someone presents to you, you can do it and carrying something in the class in high school and take an exam and doing well is not the same as going to the lecture in college and then do an exam. So, I remember I got my first chemistry exam back and I got a C and I was like, 'oh my God what is going on' so I thought like I don't think I can do this college thing. But, then the [minority engineering] department I don't know if it was the minority engineering program and basically...I went to [a staff member's] office and said, 'I did bad' and she said, 'how bad did you do.' I told her 'I got a C' and she's like, 'oh that's not bad I know kids who barely got in college and got 50 percent.' So, putting everything into perspective really helped me. College is gonna be a lot harder to me, getting a B in high school is failing like...I couldn't just imagine that...to learn how to adjust to college. So, I definitely, I knew I wasn't gonna quit but whenever I was in doubt it was nice to know people that look like you. That was one of those important things, that people you could relate to that have gone through the same experiences that they could share because even the upperclassman that I talk to [say] – 'you'll be fine just do this, do that and just try harder.' Sometimes I think am I'm crazy or don't really understand like they say they understand but they don't, you know. It's nice to see people that had just gone through it and that really did understand.

Derrick's refusal to quit seems to be sparked by his childhood dreams, feelings of accountability, and will to succeed. He certainly is able to "bounce back" from adversity he faces in college. In addition, he recognizes the benefits of seeking help from supportive staff members. Like Derrick, Homer also talks about an unwillingness to quit.

> There was a lot that sustained my interest [in my major]. For one, during my time here [in college], I have funding through a NASA program that I got accepted to in high school. So, one big reason was keeping my grades up and knowing that I was having funding from them definitely kept me motivated to stay within the major...so I fell into that category and definitely knew that I needed the funding to go here [to college] so that was one reason. I didn't want to become like a lot of the few parents that I did know who went off to college and switched majors a bunch of times or dropped out. I just didn't really want to go through that route if I could avoid it. Circumstances happen and then I just knew that I was gonna get over it somehow whether it be more studying or reaching out to people, it just never crossed my mind to change my major or quit.

Homer discusses positive and negative sources of motivation. He talks about having funding from a prestigious STEM organization. Homer also says he does not want to be like adults he knew while growing up who previously dropped out of college. Like Derrick and Homer, Charles was determined to finish his degree program rather than quit.

> It was kind of shocking when we started my sophomore year my first major class there was like 130 of us of which I was one of three African-Americans. And, then from that probably late sophomore year early junior year went down from 130-140 to about 60. And, I think we're only graduating with about 50 so it's kind of shocking just to see the people that you would study with kind of fall off as the program progressed.

Despite a continued loss of study partners and low odds of succeeding in his major, Charles is resilient. He is surprised by the failures of his classmates but he remains. Charles, Homer and Derrick not only developed and displayed resilience but they also gained and used confidence to progress toward their goal of graduating with an engineering degree.

Attribute 3: Prior academic success

In the present study, "buoyant believers" noted several sources of their academic confidence. Consistent with literature on the sources of academic self-efficacy, prior academic success contributed to students' sense of academic confidence.[20] For example, Charles noted how early success in his first-year engineering courses contributed to his confidence, earning him a sense of academic momentum that propelled him to persistence and future success.

> I did well in those classes [I took before sophomore year] and that kind of built up my confidence, I had that momentum going into my major kind of help me get through it a little bit more.

In alignment with Strayhorn's description of "buoyant believers," Charles' academic confidence, while constantly bombarded by academic challenges and setbacks, persisted as a result of his

academic resilience and earlier academic success. For example, when Charles' confidence was challenged by exams or assignments, rather than retreat or quit, he responded by doubling down on his efforts for academic success:

> [In my major] I thought I knew everything and people were coming to me and I was helping them and I felt very confident going in [my major] and it just felt like constantly my confidence was like getting crushed by, whether it was, a test or assignments. And, that combined with a lack of sleep, a lack of a social life just because you – I couldn't do anything outside of that [school work] because I would feel guilty or I wouldn't get assignments done. So, it was constantly, you know Monday through Sunday almost 24/7 just going through, from the time I wake up to the time I go to sleep, just [aerospace engineering] work whether it was assignments or studying...

In this way, Charles' early academic confidence, as well as his resulting sense of academic momentum, contributed to his later academic resilience. Said differently, Charles' early academic successes contributed to his ability to "bounce back" from academic setbacks later in his college career. Like Charles, the experiences and dispositions of other "buoyant believers" in our study were informed by early academic success. For example, Derrick drew on his previous affinity for, and success in, math and science when he chose his engineering major.

> Actually the reason why I first wanted to be an engineer, my parents said that when I was four years old my uncle is a structural engineer in [West Africa] and I admire him a lot. And, sometimes he would take me to his job sites and kind of show me like this is what I'm doing, this is the bridge I'm doing and I'm in charge of making sure it's built. So, that was the type of stuff so I've always wanted to be an engineer, which is weird since I was four and most people don't know what engineering is till they are in college. And, then as I went through school like math and science were like my first subject so I always did well in those classes and I did first-year robotics and I kind of got interested in electrical [engineering] because I wasn't sure what kind of engineering I wanted to do. I always knew I liked electronics and gadgets and stuff like that because I always liked cars and then I think, well what do I most like about cars? Well it goes fast but also I like the cool gadgets you can put into it so doing first robotics that kind of stuff and then my dad advise me to go towards electrical engineering.

Similar to Charles, when experiencing academic challenges early in his collegiate career, Derrick drew on his previously acquired academic confidence and his belief that he could succeed. As a result, he responded to academic setbacks by doubling down on his efforts. Rather than disengage or altogether quit, Derrick responded to setbacks by seeking help from academic resources on campus.

> I had to take a lot of [general credit courses] and a lot of the classes required to get into the major and I thought a lot of those classes were pretty difficult just because [I] didn't really have that background before. I had to take calculus first time here [in college] so learning derivatives and all that stuff on a quarter system was a bit difficult. I started out in pre-algebra here [in college] but I worked my way up and got to calculus and all the differential equations so I think it would have been good to have some background

around that so I would at least know what to expect but having to learn that for the first time and then do well in it was definitely a challenge. Even with the chemistry and physics I had only taken one class and that was in high school and that was about 10th or 11th grade so it wasn't really fresh in my memory when I did take those to learn those materials again as well. I personally thought <u>a lot of the classes were difficult but I never got to the point where I didn't feel like I couldn't succeed</u> or that I didn't want to go through. There are a lot of resources here on campus that help me in that regards so I knew – the math stats learning center was one, physics department and chemistry department always had tutors and I was in [our university's diversity center] and they always had tutors for us as well.

Again, Derrick's experience underscores the important role of early academic success in building "buoyant believers'" confidence, which contributes to later academic resilience. For "buoyant believers," early academic success begot academic confidence, momentum, and resilience in the face of challenges.

Result: Collegiate Achievements

Finally, in the present study, "buoyant believers" were able to discuss significant academic achievements that resulted from their academic resilience and confidence. For example, each participant was able to proudly claim they had completed the courses required in their major, and the pride associated with such accomplishments. Charles stated:

> I'm a senior so <u>I'm done with all my major course</u>s and all of my general education courses...Right now <u>I feel a bit accomplished</u> being one of two African-Americans in the entire [aerospace engineering] program.

Similarly, Derrick discusses his academic accomplishments, and the resulting reward of being able to take courses that satisfied his academic interest.

> Once you apply to and get into your major you take intro classes that everyone has to take and once you get done with those there are still classes within a certain specifications that everyone is required to take: a) two things of power, b) absolute conductors, c) electro magnetics. So, <u>I've taken all of those classes [in my major]</u> and once you've taken those classes you get to choose what you want to specialize in so then you move on and branch out and I have decided I like power so I took more classes in power. Taking power electronics classes this semester and high voltage live.

Still, of note, and relevant to the guiding theoretical perspective of the present study, Charles' and Derrick's academic accomplishments were not without challenges and setbacks. However, the result of sufficient academic accomplishments coupled with the academic resilience necessary to "bounce back" from those challenges and setbacks led each "buoyant believer" to academic success, and even post-graduation prospects. For instance, Homer shared:

> I don't have the best GPA or I didn't do as well in that class as I like to but <u>I'm at a point now I'm about to graduate, I have a job after school</u> so I wouldn't trade those experiences

for nothing. I definitely feel that I got the most out of my time here. I definitely could have been another statistic, Black male who dropped out of college and didn't finish, but I definitely was able to weather the storm to get there and definitely with some luck and prayer involved. I definitely didn't get this far on my own but I definitely feel that minority students have to kind of seek out and show initiative. A lot of times students come here and, so used to doing things one way in high school and accustomed to having things given to them and you have to work and I think that's just the mentality that students have to develop over time. I developed that pretty quickly since I got here, like I knew that the success I had in high school wasn't going to be the same in college because a lot of stuff I didn't know. But, a lot of times you have to develop that mental toughness to tell yourself well if this class doesn't go well what am I gonna do to make sure that my next quarter goes a lot better. The biggest thing is learning from your mistakes. I did that a lot, a lot of reflecting and seeing how I can improve as a student and how to improve as a male in general and making the best out of the situation. I made sure I was active here [in college] in organizations and stuff and that kind of helped me a lot with my major and I just didn't want to have my experience here be that I really just was here just for classes and not much else. I think a lot of times students come in and get tied up in school and the time goes by so fast then you don't really have much else to look on besides the work in the classroom and not saying there's nothing wrong with that but I wanted to have a world wide experience so.

Ultimately, and consistent with Strayhorn's 'buoyant believers' framework, it was students' academic confidence, and their ability to "bounce back" from setbacks that played a key role in their ability to succeed in engineering. Students drew on past successes or resolve to find new sources of academic help.

Recommendations and Conclusion

Through in-depth one-on-one interviews, several Black males in engineering and engineering-related fields described pre-college and in-college experiences that helped them become both confident and resilient students. Narratives of these successful Black males were critically analyzed to better understand the role of social-psychological factors in their college achievement and success. Distinctively, the study drew on Strayhorn's 'buoyant believers' framework to describe Black male students' experiences in engineering and engineering-related fields and to explain the role of self-efficacy and resilience in their success.[12,29] The current investigation was a follow-up study to the initial use of Strayhorn's typology within the field of engineering.[12]

Findings revealed that research participants' current confidence and resilience seem to be connected to attributes such as a) childhood adversity, b) a refusal to quit, and c) prior academic success, which ultimately led to their collegiate achievements. The Black male "buoyant believers" from engineering and engineering-related fields who participated in the present study proved to be examples of the saying, "suffering produces endurance, and endurance produces character, and character produces hope." To help produce more Black male 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.

Attribute 1: Childhood adversity

To help students draw on past difficulties as sources of resilience, we recommend faculty and staff:

- Solicit responses from students which allow students to describe times when they previously faced and overcame adversity; encourage students to use lessons from prior adversity to handle present and future challenges
- Avoid deficit-based thinking when interacting with Black males - the notion that students, particularly low-income minorities, fail in school because their families experience deficiencies that obstruct their learning process [30,31]
- Empathize when students experience academic and social difficulties in college
- Offer alternative pathways for students to receive academic and financial support

Attribute 2: Refusal to quit

To help students develop an attitude in which they are committed and able to persevere, we recommend faculty and staff:

- Solicit responses from students which allow students to explain why they chose their major and what motivates them to succeed; inspire students to hold firm to their goals
- Develop opportunities for students to become involved in extracurricular activities on campus and to serve as mentors to their peers as well as mentees of alums so they have increased levels of accountability and support [11]
- Establish rapport with students, make them aware of your availability and create a welcoming office environment so students feel comfortable coming to you for academic and social support
- Create an atmosphere inside and outside of the classroom where all students feel a sense of belonging [19]

Attribute 3: Prior academic success

To help students build academic confidence, and draw on that confidence to build academic resilience, we recommend faculty and staff:

- Solicit responses from students about previous academic successes; remind students that their previous academic successes have earned them a place in the engineering classroom
- Establish an environment where academic challenges and setbacks become opportunities for learning and growth, rather than only being evaluative measures
- Create an atmosphere where student efforts to overcome academic and social challenges are encouraged and rewarded, rather than ridiculed or ignored

Bibliography

[1] White House Initiative on Educational Excellence for African Americans. (2016, March 16). FACT SHEET: Spurring African-American STEM Degree Completion. *U.S. Department of Education.* Retrieved from https://www.ed.gov/news/press-releases/fact-sheet-spurring-african-american-stem-degree-completion

[2] May, G. S., & Chubin, D. E. (2003). A retrospective on undergraduate engineering success for underrepresented minority students. *Journal of Engineering Education*, 92(1), 27-39.

[3] White House. (2014). Progress report on coordinating federal science, technology, engineering, and mathematics (STEM) education. Retrieved from http://www.whitehouse.gov/sites/default/files/microsites/ostp/STEM-ED_FY15_Final.pdf

[4] Strayhorn, T. L., Long, L. L., III, Williams, M. S., Dorimé-Williams, M. L., & Tillman-Kelly, D. L. (2014). Measuring the educational benefits of diversity in engineering education: A multi-institutional survey analysis of women and underrepresented minorities. Proceedings from *2014 American Society of Engineering Education (ASEE) Annual Conference and Exposition*. Indianapolis, IN.

[5] National Science Foundation. (2014). *TABLE 5-5. Bachelor's degrees awarded to men, by field, citizenship, ethnicity, and race: 2004–14.* [Data file]. Retrieved from https://www.nsf.gov/statistics/2017/nsf17310/static/data/tab5-5.pdf

[6] Bidwell, A. (2015, May 7). African-American Men: The Other STEM Minority. *U.S. News & World Report.* Retrieved from http://www.usnews.com/news/stem-solutions/articles/2015/05/07/african-american-men-the-other-stem-minority

[7] National Science Foundation. (2014). *TABLE 5-7. Bachelor's degrees awarded, by citizenship, ethnicity, race, sex, and field: 2014.* [Data file]. Retrieved from https://www.nsf.gov/statistics/2017/nsf17310/static/data/tab5-7.pdf

[8] U.S. Census Bureau. (2015). *Quick Facts: United States* [Data file]. Retrieved from https://www.census.gov/quickfacts/table/PST045216/00

[9] U.S. Census Bureau. (2013). *Current Population Survey, Annual Social and Economic Supplement* [Data file]. Retrieved from http://www.census.gov/population/race/data/ppl-ba13.html

[10] Long, L. L., III, & Mejia, J. A. (2016). Conversations about Diversity: Institutional Barriers for Underrepresented Engineering Students. *Journal of Engineering Education, 105*(2), 211-218. doi: 10.1002/jee.20114

[11] Strayhorn, T. L., Bie, F., Long, L. L., III, Barrett, B. A. (2014). African American and Hispanic STEM students' engagement at predominantly White institutions. Proceedings from *2014 ASEE Annual Conference and Exposition*. Indianapolis, IN.

[12] Long, L. L., III, Kitchen, J. A., & Henderson, T. S. (2015). Black male "buoyant believers" in engineering and engineering-related fields. Proceedings from *2015 ASEE Annual Conference and Exposition*, Seattle, WA. doi:10.18260/p.23623

[13] MacPhee, D., Farro, S., & Canneto, S. (2013). Academic self-efficacy and performance of underrepresented STEM majors: Gender, ethnic, and social class patterns. *Analyses of Social Issues and Public Policy, 13*(1), 347-369.

[14] Museus, Palmer, Davis, & Maramba (2011). *Racial and ethnic minority students' success in STEM education*. Hoboken: New Jersey: Jossey-Bass, 2011.

[15] Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of Blacks. *Journal of Personality and Social Psychology, 69*(5), 797.

[16] Strayhorn, T. L., Long, L. L., III, Kitchen, J. A., Williams, M. S., & Stentz, M. (2013). Academic and social barriers to Black and Latino male collegians' success in engineering and related STEM fields. Proceedings from *2013 ASEE Annual Conference and Exposition*. Atlanta, GA.

[17] Chen, X., & Soldner, M. (2013). *STEM attrition: College students' paths into and out of STEM fields*. National Center for Education Statistics, Institute of Education Sciences (NCES 2014-001).

[18] Moore, J. L., Madison-Colmore, O., & Smith, D. M. (2003). The prove-them-wrong syndrome: Voices from unheard African-American males in engineering disciplines. *The Journal of Men's Studies, 12*(1), 61-73.

[19] Strayhorn, T.L. (2012). Sense of belonging and STEM students of color. In T.L. Strayhorn (Ed.), College students' sense of belonging (pp. 61 - 76). New York, NY: Routledge

[20] Bandura, A. (1997). Self-efficacy: the exercise of control. New York: Freeman.

[21] Zimmerman, B. J. (1995). Self-efficacy and educational development. In Bandura, A. (Ed.) *Self-efficacy in changing societies* (p. 202 - 231). Cambridge University Press.

[22] Gore, P. A. (2006). Academic self-efficacy as a predictor of college outcomes: Two incremental validity studies. *Journal of Career Assessment 14*(1), 92 - 115.

[23] Lent, R. W., Brown, S. D., & Larkin, K. C. (1984). Relation of self-efficacy expectations to academic achievement and persistence. *Journal of Counseling Psychology, 31*(3), 356 - 362.

[24] Schunk, D. G. (1989). Self-efficacy and achievement behaviors. *Educational Psychology Review, 1*(3), 173 - 208.

[25] Hornish, R. (2005). Student resiliency and academic performance. *Recruitment & Retention in Higher Education, 19*(11), 1-2.

[26] Martin, A. (2013). Academic buoyancy and academic resilience: Exploring everyday and classic resilience in the face of academic adversity. *School Psychology International, 34*(5), 488-500.

[27] Martin, A. J. & Marsh, H. W. (2006). Academic resilience and its psychological and educational correlates: A construct validity approach. *Psychology in the Schools, 43*(3), 267 - 281.

[28] Martin, A. J. & Marsh, H. W. (2008). Academic buoyancy: Toward an understanding of students' everyday academic resilience. *Journal of School Psychology, 46*(1) 53 - 83.

[29] Strayhorn, T.L. (2010). Buoyant believers: Resilience, self-efficacy, and academic success of low-income African American collegians. In T.L. Strayhorn & M.C. Terrell (Eds.), Evolving challenges of black college students: New insights for policy, practice, and research (pp. 49 - 65). Sterling, VA: Stylus.

[30] Valencia, R. (Ed.). (1997). *The evolution of deficit thinking in educational thought and practice*. New York, NY: Falmer.

[31] Harper, S. R. (2010). An anti-deficit achievement framework for research on students of color in STEM. *New Directions for Institutional Research, 2010*(148), 63-74.