

## **Findings in STEM Retention at Historically Black Colleges and Universities**

**Lauretta Garrett**

**Li Huang**

**Vivian L. Carter**

Tuskegee University

### **Abstract**

*Although college retention is a complex issue, the strength of Historically Black Colleges and Universities (HBCUs) as leaders in science, technology, engineering, and mathematics (STEM) fields can be drawn upon to understand college retention in STEM fields. Focus groups were conducted with undergraduate students, graduates, faculty, administration, and staff members involved in STEM at six HBCUs. This report examines the focus group data, providing a snapshot of the experience of majoring in STEM at an HBCU using the words of those involved. Results show that HBCUs have the potential to provide every type of important psychosocial and structural support that STEM students need to be successful.*

*Keywords:* STEM retention, psychosocial factors, structural support

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I wanted an education. I think it's important because today it's almost impossible to survive in this world without one. And not just that, I don't want to settle for just like mediocrity, just settle for like a college degree, because it's almost ...you can barely get a job with just a college degree. So, I wanted to go further than that, and as far as I can go to get a decent job to support myself and, and support my family. And that definitely requires education. (Female, STEM student at a Historically Black University)

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Address correspondence concerning this article to Lauretta Garrett, Department of Mathematics, Tuskegee University, 1200 W. Montgomery Road, Tuskegee, AL 36088 or [lgarrett@tuskegee.edu](mailto:lgarrett@tuskegee.edu).

The desire of this student to be successful, and not to just “settle for mediocrity” is a desire that can be tapped to help her achieve her life goals and harnessed to help society as well. America needs strong scientific, technological, engineering, and mathematics (STEM) graduates (U.S. Department of Education, 2008). Unfortunately, the United States has recently been ranked 52nd in the quality of its mathematics and science education (Level Playing Field Institute, 2014). The majority of students entering college in the United States majoring in STEM fields switch to a non-STEM field (Task Force on the Future of American Innovation, 2006).

The percentage of Black American college freshmen intending to major in science and engineering fields (S&E) rose from 32.8% in 2008 to 40% in 2014, the same percentage as White American college freshmen (National Science Board, 2016). Nevertheless, in 2013, the percentage of total S&E degrees awarded to Black Americans was lower than the percentage of total enrollment of Black Americans (8.5% vs. 13.2%). In contrast, the percentage of total S&E degrees awarded to White Americans was higher than the percentage of total enrollment of White Americans (62.1% vs. 56.3%) (National Science Board, 2016). It is vital that Black American students majoring in STEM fields be given every opportunity to succeed. The desire of Black American freshmen to major in STEM has consistently been higher than the percentage of Black American freshmen in the larger population (Sasso, 2008). To contribute to the effort to support Black American students majoring in STEM, issues of retention in STEM fields at HBCUs will be examined.

### **Issues in Retention for Black Americans**

How can motivated Black American students be retained in the STEM pipeline? The literature and research regarding Black American college students' retention is extensive (e.g., DeNicco, Harrington, & Fogg, 2015; Maton, Hrabowski, Greif, 1998; Hrabowski & Maton, 2009; Hausmann & Schofield, 2007; Perna, Lundy-Wagner, Drezner, Gasman, Yoon, Bose, & Gary, 2009; Greif, Harbowski & Maton, 2000; Fries-Britt, 2017). Among the issues mentioned are high school grade point average (GPA), placement test scores, demographics, financial need, and remedial course work (DeNicco et al., 2015). Studies focused on the opportunities provided to gifted Black American students discuss issues in retention for Black Americans and suggest ways to address them, as do those that examine ways to support at-risk students. Following a discussion of a selection of studies, we will share ideas from the literature related to structural and psychosocial factors affecting retention.

## **Supporting Black American Students**

The recruitment and retention issues of Black American students in gifted education programs in the U.S. can provide insight into issues facing Black American students who wish to succeed in STEM (e.g., Hrabowski, 1991; Grantham, 2011; Winsler, Karkhanis, Kim, & Levitt, 2013; Ford, Moore, & Scott, 2011). Hrabowski's (1991) Meyerhoff Scholars program, designed for gifted Black American males, has produced successes in science-related disciplines at the University of Maryland Baltimore County. The achievements of the Meyerhoff students showed that a well-designed university-based intervention increased the numbers of Black American undergraduate college students who succeed in science, mathematics, and engineering. The interventions included summer bridge programs, training for students' knowledge and skill development, monitoring of students' progress, and providing support and motivation to students (Maton, Hrabowski, & Schmitt, 2000). In addition, Hrabowski (1999) emphasized the role of parents, especially mothers, who played an important role in the support of Black American male success in science fields.

Other studies (e.g., Ford, 1996; Staiger, 2004; Winsler et al., 2013; Fries-Britt, 2017) have identified reasons Black American students may not participate in gifted education programs. For example, some researchers (e.g., Ford, 1996, 2004; Staiger, 2004) showed that issues in the current school system are the main reason Black students frequently lack access to, drop out of, or choose not to participate in gifted education programs. Other factors hindering participation in gifted programs, especially for Black male students included low teacher expectations, lack of motivation to do the work, and fear of separation from their social or peer group (Ford, 1996; Staiger, 2004; Winsler et al., 2013; Fries-Britt, 2017). Some Black students felt that advanced classes belong to the white students (Ford, Grantham, & Whiting, 2008).

Others felt that schooling was not necessary for them (Ogbu, 2004). Ford et al. (2011) provided a theoretical framework to aid educators in improving retention in gifted programs for Black Americans. For example, deficit thinking may influence the behaviors of Black American students. Considering voluntary and involuntary minority group theory can allow educators to note that all minority groups have a different history, culture, and experience in the United States. Racial identity theory offers the belief that self-esteem and self-concept significantly affect students' performance and those with positive self-images or self-perceptions are more likely to do better in school than those who have negative perceptions of themselves. Stereotype threat theory reminds educators that test anxiety is a reality for some

students, especially for Black American students. The Afro-centric cultural styles model explains that spirituality, harmony, affect, movement, verve, expressive individualism, oral tradition, communalism, and social time perspective are important factors in helping educators understand Black American students' learning styles. Finally, the multicultural curriculum model explains that students' motivation and engagement increase when interest increases. This model explained four levels at which to infuse multicultural content into the curriculum (Ford et al., 2011). All of these theories and models can help educators at all levels understand the issues Black American students might deal with and the support that might work best for those students.

Palmer, Davis, and Maramba (2010) conducted interviews with 11 Black males with poor academic preparation who persisted to graduation from an HBCU. The participants had been through a six-week summer residential bridge program that targeted at-risk students as defined by their high school GPAs and standardized test performance. Challenges to retention noted by the participants were lack of sufficient financial aid, personal pride, home and local community problems, and the development of a supportive academic network. Network development was aided by participation in the bridge program. Participants noted that some of their male peers had a hard time making connections on campus and becoming involved.

The predominantly Black racial make-up at the HBCU was seen as a positive factor (Palmer et al., 2010). Such a racial mix allowed students to be with a diverse group of motivated Black males. For one student, this expanded his vision of what he could do with his life and took him beyond society's narrative about Black males. He stated that he did not like "much of society [s]" view that he was "not intelligent" (p. 93). The presence of "Black people... Trinidadian people... people from all shades of Black" who were "motivated [and] driven for success" helped him to feel more positive about his own chances for success.

Another motivator was high expectations (Palmer et al., 2010). One of the participants noted, "Black professors are usually harder, because they know that you have the potential and they'll push you, and drive you" (p. 94). He saw the presence of high standards as motivational and as reinforcing the belief that he could do hard things and be successful.

Retention is a complex issue and many factors impact Black student college retention. Examining programs to support both gifted and at-risk Black students shows the importance of psychosocial issues such as networking and social support, self-image, and deficit thinking to their academic experiences. They also show us the

impact of structural factors such as bridge programs, academic training, and financial opportunities.

### **A Structural and Psychosocial View of Retention**

Structural factors at institutions of higher education include support programs, tangible resources, people, and institutional standards. People include mentors and supportive faculty. Programs include initiatives such as tutorial centers and first-year programs. Tangible resources may include such variables as financial aid and school infrastructure. Academic monitoring, scholarship and internship opportunities, targeted programs for males and at-risk students, special services for first-generation or at-risk students, summer orientation programs, and a lending library are some of the structural measures used at a model HBCU that boasts high graduation rates (Fischer, 2007).

Social factors include social engagement, peer interactions, and family influence. Social factors impact integration into the institutional culture. A lack of cultural integration can negatively affect a student's ability to access structural resources (Ezeala-Harrison, 2014). Emotional factors include anxiety, stress, and self-efficacy. Self-efficacy is the belief in one's own ability to accomplish something challenging, and has an impact on academic achievement (Wadsworth, Husman, Duggan, & Pennington, 2007). Motivational factors include academic motivation, which has three orientations -- intrinsic motivation (inner drive), extrinsic motivation (something outside of the student), and amotivation (stop trying – believe things are out of their control) (Brouse, Basch, LeBlanc, McKnight, & Lei, 2010; Petersen, Louw, & Dumont, 2009).

Many cultural, societal, educational and personal factors affect whether or not Black American students who desire to major in STEM fields are actually retained through the STEM pipeline to productive, secure careers that add to our nation's human resources. Focusing on structural and psychosocial factors provides practical insights that can help address personal needs which impact STEM retention.

### **The Focus of The Report**

One of the purposes of our study was to improve our understanding of the interplay of psychosocial and structural factors on STEM retention at HBCUs. We wanted to know what psychosocial factors appear to impact the retention of students in STEM disciplines at HBCUs. We also wanted to know more about the impact of psychosocial factors on the effectiveness of structural factors. We will report selected

emergent ideas in the qualitative data we collected from focus group participants.

## **Method**

Our work focuses on the structural and psychosocial factors that are present once the student arrives at the institution of higher education and the ways in which these factors intersect. In seeking to gain further insight into the important psychosocial factors, we have grouped them into three areas: social factors, emotional factors, and motivational factors. Figure 1 shows the proposed theoretical relationship between psychosocial and structural factors that emerged from our initial review of the literature.

### **Design and Data Collection**

The overall study used a mixed methodological approach. We collected qualitative data in the form of focus group interviews at six HBCUs. Our goal was to understand the experiences of those in STEM fields at HBCUs and to eventually aid the institutions in developing action plans for STEM retention improvement. Four focus groups were conducted at each of the six institutions. The four groups were: 1) undergraduate students, 2) graduates, 3) faculty, and 4) administration and staff members. Totaling focus group participants at all institutions, we interviewed 52 students, 33 graduates, 44 faculty members, and 35 administration and staff members. Focus groups were conducted at the home institution of the participants by project researchers trained in educational and social science research methods. Focus groups lasted approximately 45 minutes, with a shorter group lasting about 36 minutes and a longer group lasting about 70 minutes. A liaison from each participating institution worked with us to set up the focus groups. We used semi-structured interview protocols to allow participants' thoughts to drive the data collection process while at the same time providing some structure to the sessions. A sample of focus group questions can be found in the Appendix.

### **Data Analysis**

Focus group results provide a snapshot of emergent themes in STEM retention at HBCUs and suggest further avenues for research. Data analysis of focus group transcripts was conducted using the constant comparative method with the help of qualitative data analysis software combined with handwritten coding (Chuang, 2013). The unit of analysis was one semantic paragraph (a group of sentences addressing one coherent thought or a set of coherent thoughts).

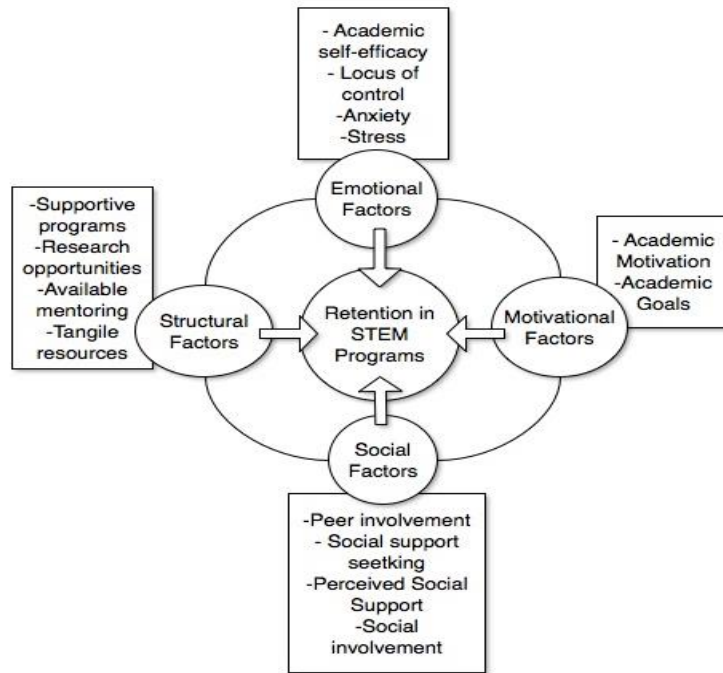


Figure 1: Theoretical relationship between psychological, sociological, and structural influences on STEM retention at HBCUs.

Constant comparative analysis allowed us to identify constructs that would accurately represent the views and experiences of the participants (Creswell, 2007; Glaser & Strauss, 1967). Open and axial coding were conducted to first note emerging ideas and then refine those ideas and sort them into categories (Creswell, 2007). We created four codebooks, one for each population, to allow for theme emergence particular to each population.

Coders met regularly to discuss definitions of codes and refine emerging codebooks and ensure that each coder understood the definitions. Codebooks described the codes as they fell into categories and included brief and longer definitions, instructions as to when to code and when not to code, and examples of coded units of text. The results of this coding process provide insight into the experiences of all populations involved.

## Findings

Overall focus group findings are shown in Figure 2. The diagram is based on our original model, with structural, social, and psychological factors broken down

into components. We discuss the components found in this model.

Focus group results are presented as they connect to the structural and psychosocial factors we sought to investigate. The emphasis is on emergent themes arising from our qualitative analysis of focus group transcriptions that connect with and add to our initial model. We begin with social factors.

## **Social Factors**

Social factors that impact student retention include the students' networks of support. Network includes supportive institutions employees, family, peers, upper-class students, and student organizations. Family, peers, and social organizations can be challenging as well as helpful. Our data produced emergent ideas regarding each of these influences.

**Supportive institution employees.** Institution employees are a part of the student's social network. Participants from each of the four groups mentioned the importance of a personal connection between institution employees and students. Emergent in this data is the feeling among employees at HBCUs that their staff "honestly care[d]" about the students.

I think one of the strengths of our university is [that] the faculty members as well as the staff members honestly care about the students. Take a student aside, 'I recognize you have had a really tough day today', something to just try to motivate them and encourage them and continue to push [and provide] encouragement . . . I think we are more of a family . . . type setting or there is a lot of support. It is built in. I think oftentimes you don't find [that] at some of the other institutions. (Female, Admin./Staff)



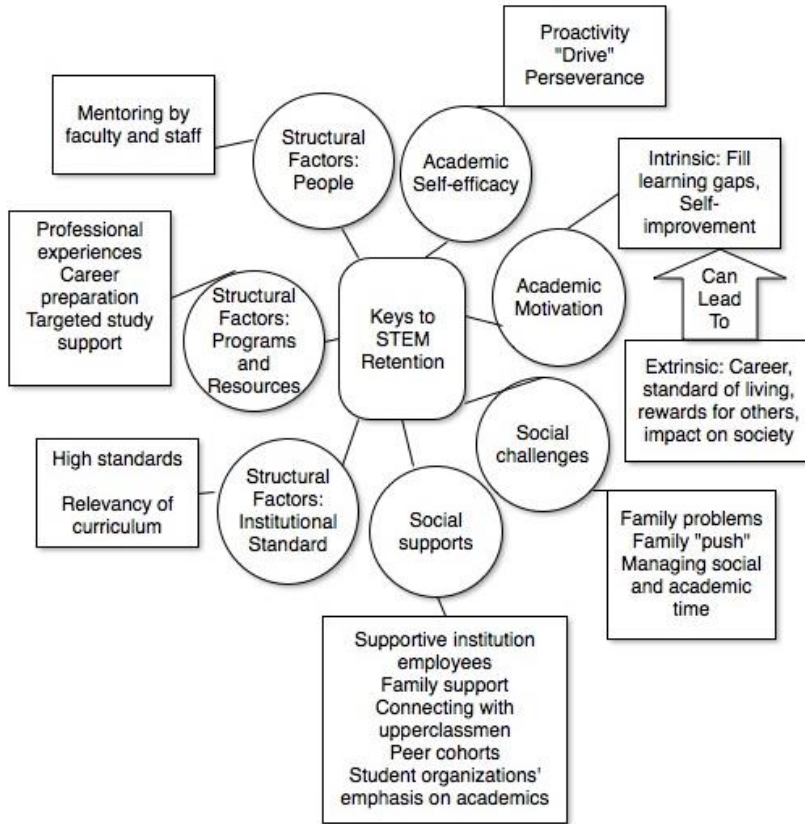


Figure 2: Components of structural, psychological, and social factors emerging from focus group analysis.

Note that this employee felt that this caring was something that set her institution above others, and that this caring was important to student success. The following quotation echoes the importance of this kind of support, where the support is evidenced by time spent with students.

If I can spend more time with them. Some of the students sign up and do research with me through whether it's Chancellor Scholars or research programs. I find that the more I spend time interacting with them, they tend to do better. During that time, besides just academic, [there's] the social interaction and there's keeping an eye on the academic performance, their career path, [and] keep[ing] them focus[ed] that we can do in the classroom as well. (Female, Faculty)

Students and graduates also noted the presence of caring and support. The

presence of this supportive employee network is thus confirmed not only by faculty and staff, but also by those supported by them.

I've gotten a lot of support here at \_\_\_\_\_. I have a lot of people that I can talk to. Especially, my professors, about life issues and school issues, and just how to become a better person and a better student. (Male, student)

I guess in general \_\_\_\_\_ has always been there, \_\_\_\_\_ now has been there to encourage me and even though I took a break between under[grad] and grad school, I stuck by her and she stuck with me and continued to encourage me through trying to figure out what I wanted to do and where I wanted to go and so forth. (Female, Graduate)

**Family support.** Family influence is another important social factor. Focus group participants saw this as both a positive and a negative, depending on circumstances. These statements from a graduate and a student indicate positive family influence. Emergent here are types of family support, including “acknowledgement” and family recognition of student effort. One female graduate stated “My family helped me the most, just with encouragement and acknowledgement.”

I got all of my support from my family, because I'm the only one that went out-of-state for school. And my family, they see me try every day, and it's hard . . . being away from home. And when it come[s] down to professors, I . . . kind of have support from them but . . . in my major it's always hard to get in contact with them. (Male, Student)

Note the importance of family to this student to supplement a lack he sees in support from faculty. A student who knows that his or her family is counting on academic success, also feels that family support, as in this next student's case.

I get support from my family because I'm the only one out of a lot of cousins and nieces and nephews that has left and gone to college. Most of them ha[ve] stayed home and have families, and I'm the only one that has really ventured off and [gone] to a four-year college. So, they're all rooting for me to graduate. (Female, Student)

**Family problems and “push.”** Although some students and graduates had positive experiences with family support, faculty, and administration members observed some challenges that arose from family associations.

[I]t's getting more and more challenging to keep them paying attention in the class. There are various reasons, most of which we could not solve ourselves. But there is an issue. He didn't have time because he's working almost full-time. And he has this problem.... Can you give me a couple dollars? We cannot solve it. But probably there is also a big factor that they cannot pay tuition. (Male, Faculty)

I think from my point of view, one thing that keeps the student from being successful is that college may not have been for them. It may have been for the parents. They want them to succeed. It may not be a point in their lives that they are ready for. You can tell they may not be ready for us but the parents are. The parent takes the role of taking care of everything for the student. (Female, Admin./Staff)

Faculty felt some pressure to make-up for difficulties in the students' personal life arising from family problems. The concern of the administration/staff member that attending the institution was "for the parents" and the student "may not be ready" might be called *family push*. This participant went so far as to say that family push "keeps the student from being successful."

**Social time and student organizations.** Like family influence, extracurricular activities and social organizations were also found to be both helpful and harmful. Student organizations might include sports, clubs, Greek organizations, and other groups. Social time may be spent in peer cohorts and making connections with upper-class students in addition to more informal activities. All of this requires students to carefully select how they will spend their time.

**Peer cohorts.** Extracurricular activities might take place in an academic cohort. Cohorts can be formal arrangements or informal networking. Cohorts were seen by administration and staff as a positive influence.

[A]s a cohort as they progress through their undergraduate career to be resources to each other, even for stuff out of the department or in their personal lives. The faculty that leads it can tell them, "These are the realistic, next steps for you, things you should be planning on" so they are not surprised or sidetracked by things .... They have positive social opportunities as opposed to being in just a social group. Some of them can have academic or even career benefits to them. (Male, Admin./Staff)

In addition to being helped by a cohort of peers in the same field of study, students

benefit from connecting with others in their field, such as upper-class students.

**Connecting with upper-class students.** Connecting for social and academic support with upper-class students is one of the types of networks that focus group participants mentioned as being important to success.

There were only . . . 2500 students. The majority of us lived on campus. The campus was kind of close . . . because a lot of the buildings that were here had been torn down and new buildings have been erected. It was so closely knit. We all knew each other. So you really had family here. For me, for instance, I came in as a freshman. All the way down from New York. \_\_\_\_\_ was the new dormitory as a freshman in '78. Because I came from so far, they gave my room away. So, I didn't end up living in the freshman dorm. I ended up in \_\_\_\_\_ Hall. [It] ended up being the best thing for me because . . . they roomed me with a freshman but I was there with all these upper-classmen. They became my big sisters. That was a plus. I ended up attending every single graduation including my own in '82 because I knew someone graduating each year. (Female, Graduate)

This graduate notes that she “was there with all [those] upper-lassmen” and that they “became [her] big sisters.” This fortuitous circumstance was seen as a positive influence on her ability to be successful. As she said, “That was a plus.”

**Emphasis on academics.** A student noted the positive influence of an extra-curricular organization that had high expectations for its members. When asked to elaborate on the support received from peers or student organizations, he said:

They support --well, of course, they tell us to maintain our focus and our priorities in our academics, but they do encourage us to be better people and to do other things. Teach us how to do other things besides how to be good students. They teach us how to be good people as well. (Male, Student)

**Managing social and academic time.** Not all students or former students felt that extracurricular activities were a positive influence. The following graduate notes the struggle he had making choices regarding extracurricular activities.

I would leave my dorm room at 7, maybe 8 o'clock in the morning. I had a routine. Go eat about 7:30, go to class, class is from 9 until about 3 o'clock. After 3 o'clock I would go to the game room and play a little Pacman. Go

eat. After that go start my student organizations, the meetings I had there and later I would study. I was back in the room at about 11:30, 12 o'clock. That was a routine. It got the best of me that semester. It came to a point where I had to tell myself, these student organizations are great, having a lot of fun, but I'm here to get my degree. I backed up a lot with the student organizations. Not as active as I was before. Various organizations, captain of different teams. I had to back up and say, you are here to get your degree and that's what I did. (Male, Graduate)

A key phrase here is the student's observation that he "had to back up and say, you are here to get your degree." He had to learn to let go of some activities and prioritize and focus on his academic work.

### **Motivational Factors**

Both extrinsic and intrinsic motivators were discussed among focus group participants. The data show what extrinsic and intrinsic motivations were present and how the two might be related to each other during students' academic experiences. Extrinsic motivators were defined as anything outside of the student that provided motivation for academic success. These included a career, an improved standard of living, rewards for other people, and the desire to have an impact on society. Intrinsic motivations include motivation that comes from within the student such as the joy of learning and the desire for self-improvement.

**Career.** Students mentioned wanting a job or career as motivation. Note that no other motivation is mentioned by this student, other than the related ideas to further or better herself.

Pursued a degree simply to obtain skills that I needed in order to obtain a career, at the time, in an area that I thought was my main interest. To further myself; to better myself. To obtain a job, a career. (Female, Graduate)

**Standard of living.** A variation on the idea of having a career was having an associated standard of living that was expected from the career. Standard of living is considered to be a separate construct from career. It is related to the everyday quality of life that the student hoped to have as the result of his or her career.

When I was nine, [there] was . . . a farm across the street from my grandma's house. And I picked stringed beans. And I worked out there for like two hours and [they] gave me \$2 [and] I was like, look -- and then I gave them

the \$2 [back] because they [were] selling soda and chips. I'm going to college.  
(Female, Graduate)

This graduate noted that childhood experiences provided impetus to have something better, to raise the standard of living she had experienced as a child by “going to college.”

**Rewards for other people.** The desire for an improved standard of living was not always a selfish one. This impact of other people in a student’s life is extrinsic motivation. The desired reward of improving other people’s lives was external to the student.

The reason I want to get an education is to better myself. And the kids that I have, they will have a stable home because I was raised in the single-parent home and I didn't get everything I wanted. And we struggled pretty much most of my life. So, I want to have an education and be able to provide for my family better than my mother was able to provide for me. (Female, Student)

This student wanted the improved standard of living for her children, so they won’t have to be raised in a family that struggled.

**Impact on society.** Another extrinsic motivation is the desire for students to make a difference in some way external to themselves and their families.

It was like, okay, there aren't a lot of Black people in chemistry, not a lot of Black women in chemistry. I'm not really interested in this program but I'm going to do it because I want to be that trail blazer and be someone my people can look up to. . . . I needed to show children who came from an environment like I did, underserved community, single parent mother who was a teenage parent. I wanted to be able to show them that you can do this no matter what you see on TV, no matter what statistics say. That was really my driving force and knowing that no one else in my family had done it before, I wanted everyone to know that it was possible. Financially, my mom, she never had to do anything except bring me to school. I literally packed up my whole room and [was] sure that I was never coming back to our house again and I never did. That was pretty much my experience. (Female, Graduate)

This graduate wanted to be a “trail blazer” and show other students what could be achieved. Wanting something external provides extrinsic motivation.

**Intrinsic motivators.** Participants also mentioned intrinsic motivators.

Intrinsic motivations come from something inside of the student apart from any other reward or impact. They are motivations that do not appear to have an external impact. The desire to learn and to improve oneself and the joy of learning are intrinsic motivations.

**Fill-in learning gaps.** Current students' desires to continue learning and fill in perceived gaps in the education they were receiving shows the intrinsic motivation of wanting to learn beyond what the school was providing.

[At] competitions . . . [I saw] that people from other schools ha[d] done different things. I don't know if it's because of the funding or, just more advanced technology that they have, but I feel like that's, that's going to push me to try to, I guess supplement what I'm learning here on my own. (Female, Student)

**Self-improvement.** The desire to better oneself and avoid failure is an intrinsic motivation describe by the following student.

I just feel like failure is inevitable for me, and in order for me not to fail as a person, I need the resources to better myself and to have a nice career and the only way for me to do that is to become knowledgeable with an education. (Male, Student).

**Extrinsic as precursor to intrinsic motivation.** In each of these examples, something extrinsic (attending a conference, having a career) is associated with an intrinsic motivation (filling in learning gaps, self-improvement.) Wanting to please someone else was an extrinsic motivation that led to intrinsic motivation for this graduate.

My purpose for obtaining an education was, honestly, to please my parents. To go to school, because both of my parents did not obtain their degree until after they were adults. And, so they stressed importance of education. So that was the only reason why I came to college. Then once I got here, I saw the benefits and used it to my advantage. (Female, Graduate)

This graduate saw additional benefits aside from those that provided her original motivation. Another comment she made provides insight into what she gained. When asked what was helpful to her major field studies, she said

It was -- for me, it was my peers . . . . We'd get together and study so, that made it a lot easier. And it made it fun. I really enjoyed it. I enjoyed psychology. The instructors made it fun.

Note that she said "I enjoyed it. I enjoyed psychology." Her original motivation to attend college was extrinsic (pleasing her parents). Once she got there, support systems present at the institution helped her learn to enjoy the field of study she had chosen and to gain that intrinsic motivation.

### **Emotional Factors**

Emotional factors may have a positive or a negative influence. Among the emotional factors that we found in our focus group data were those that have the potential to positively impact students' work habits and chances of success, including students' feelings of academic self-efficacy. Feelings of self-efficacy can take different forms, such as proactivity, "drive," and perseverance.

**Student "drive" and perseverance.** We define *drive* as the inner will that pushes students to persevere, the emotional strength that allows perseverance. Evidence of drive and the importance of the perseverance that result from this drive can be seen in this successful graduate's statement.

The real reason I wanted an education is because they said I couldn't do it. That's just plain and blunt, simple. They said because I had so much trouble they said that you are going to repeat this grade. You are not going to make it. You need to just stop and go get a job. But I didn't want a job. (Laughter) So, I picked the hardest thing that I thought I could pick, which was definitely biology. And everybody around me used to say, "Why did you pick that?" "Pick something else like mass communications." Well, maybe I don't want to be a mass communicator. Maybe. . . I want to be a scientist. Maybe I want to be a doctor. I want to be something special. Like, something that I thought was worthwhile, and [here] I am today, with my BS and I graduated. And they all -- like, I see them every day, too. I made sure . . . to see them every day after I graduated. Every day I [say] -- "Hey, how are you doing?" Ching! Just rub it in their face. (Female, Graduate)

**Proactivity.** Proactivity provides evidence of a certain degree of self-efficacy. Proactive students actively seek support rather than just waiting for support to be given.



As far as the professors are concerned . . . from the ones that I have interacted with, I felt like if [I] needed support, I could get support. I tried to maintain [a] good [rapport] . . . with them. Just in case I need, you know, some additional support or assistance I could get it. My support also comes from my mother and my family, friends and as well as professionals out in the community. I seek them for support as well, so I have support coming from a lot of different areas that help me, you know, to stay focused. (Female, student)

Evidence of proactivity is found in the statements “I seek them for support” and “I could get support,” implying that the support was sought.

### **Interactions: Social, Emotional, and Motivational Factors**

Family is a setting in which social, emotional, and motivational factors intersect. The love of family is a motivation situated within a social network. Love of family was seen in the statement of the female student who noted that she was motivated to get her education so that "the kids that I have . . . will have a stable home." Another female student noted "I wanted to go . . . as far as I can go to get a decent job to support myself and, and support my family." The students were motivated by a love of family. The family provides emotional support, as noted by the female student who said, "they're all rooting for me to graduate." The connection between family, emotion, and motivation is shown in figure 3.

### **Structural Factors**

Structural factors include such things as tutorial centers, curriculums, infrastructure, and financial resources. They are the facilities, organizations, and structures that are in place at the institution to allow the mission of the institution to be fulfilled. Structural factors mentioned in focus groups as impacting STEM retention fell into three categories: people, programs and resources, and institutional standards.

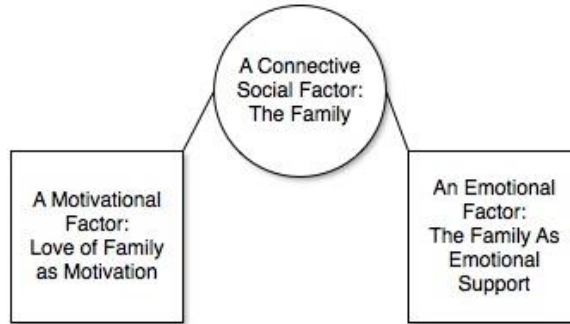


Figure 3: Connections noted in focus group data between psychosocial factors that are rooted in family relationships.

**People.** As has been noted, the faculty and staff can provide an important social support network for students.

I found support in some of my professors. Like, I've had a professor that I go to and get mentored from since freshman year. My advisors are really good. They keep it real with me. (Female, student)

**Programs and Resources.** Among the important resources mentioned by participants were common issues such as college infrastructure and financial aid. In addition, there were two key types of programs discussed for supporting college student success. First, there was the value of support programs that provide professional experiences and professional growth. The other need mentioned was support targeted to students' specific individual needs.

**Professional experiences.** Students wanted relevant, hands-on activities. Faculty, administration, and staff mentioned the effectiveness of programs for students that provide them with professional experiences. Students, faculty, and staff saw the need for ample exposure to professional level work and professional interactions. This statement from a staff member who worked with interns at the institution is one example.

Some of the interns, I take them in the server room and show them, this is reality, what you really need to know. . . . A lot of [what students are learning] is theory. There are some application but real world, I tell students, this is real world. Let me break down real world for you. The stuff they are teaching, it's theory, liberal arts. That's what you learn is the theory. You need to know that but in the real world, they are not going to ask you about

your theory. They are going ask you, I need you to knock this out. That's nice [that] you know the theory and all, but I need you to knock this out. (Male, Admin./Staff)

**Targeted support.** Participants also discussed targeted support. We define *targeted support* to include support for a specific area of student need, academic, social, emotional, or other. This might include specific areas of academic study such as mathematics or reading. It might also include support for the adjustment to college level work, and help understanding the college curriculum sequence.

**Targeted study support.** Students expressed a desire for help studying different types of subjects. This statement indicates the challenge some students face and the hindrance that not having such support can be to their education.

A few things that have hindered me is like, not knowing how to study for certain classes like - - you studied a different way for math but studying for English is totally different. Like you have to do different techniques. I really slacked off on like determining the difference for each class. (Female, Student)

**Adjustment to college level study.** This graduate expressed the challenge of being unprepared for the studying needed at the college level.

I would probably also have to say [a hindrance was] the social life early on. And also, the transitioning from high school to college. My freshman year, just having to have that discipline to study continuously because of it. Which, like, in high school, you didn't really have to study that much, but you have to study in college. So just getting over that transition hurdle brought a hindrance early on.

(Female, Graduate)

**Understanding the College Curriculum Sequence.** Students noted the importance of understanding the college curriculum sequence – the way later courses build on earlier courses.

So you're a senior and you - - they'll bring up something that you learned your first semester in college so you have to remember everything you're taught, being a biology major, because everything is just added on and added on so. (Female, Student)

**Institutional Standards.** Institutional standards refers to the academic standards present at the institution. Institution personnel noted their desire that their school maintain high academic standards. Institution personnel were invested in the high standards and the reputation of their institution.

We both have very big roles that I would say, we play behind the scenes to help ensure students graduate and it means something to graduate, that our programs remain accredited, remain in good standing. That's the role I serve.  
(Female, Admin./Staff)

Institution personnel also felt that holding students to high standards was important for the success of their students in STEM fields.

We see it all the time over there in my world. They come over there and they have -- you are sitting there and let's come up with what is your topic, diabetes. You are going to look at an aspect of diabetes. You can't possibl[y] do a paper on diabetes. Okay. Let's sit down and go and work on this. The paper is due at 10 o'clock. It's 8:45. What do you want me to do? It happens over and over. You have all this stuff [you're] trying to do with them and they get all upset. You finally have -- I didn't wait two hours before the paper was due. Now that you have put yourself in this position, what can you do? It's amazing. You would expect [it from] freshmen but you would be amazed how many Juniors and Seniors do the same thing. At some point this has worked. You have to realize that that's why they keep doing it because at some level it worked and [they] got a decent grade and [so they] continue to do the same thing until they get that one person that this is not acceptable for. For most of them, I would love to be a fly on the wall [to see] who did get into a graduate program. I think they are just probably going to be overwhelmed. They are just not prepared. You would not believe when they come up there wanting help with this paper and . . . it's due at 10. You are like, there's not a whole lot I can do. Pray. There's not a whole lot you can do at that point. We are not talking Freshmen and Sophomores. It's juniors and seniors that have the same problem. (Male, Admin./Staff)

This staff member makes the point that high standards early in student programs prepare them for later success and are, therefore, important to eventual retention and graduation.

## **HBCU Strengths**

HBCUs have the power to bring together psychosocial and structural factors for positive effect. Invested faculty can tap into student drive and the desire students have to “make a difference.” The following graduate student noted the change in atmosphere that he felt when he switched from a Predominantly White Institution (PWI) graduate school to an HBCU graduate school.

I made a call to my old professors and mentors from \_\_\_\_\_ and knew about the graduate program starting up here in the area that I got my degree in. So, I stopped my graduate studies at the PWI and came to \_\_\_\_\_ and it was a total 180. The classmates were more supportive. We were supportive of each other, just encouraging one another to make it through because the program was just as intense as any other school. The professors and the staff, they were more supportive. As I mentioned before, I received assistantships. Not only did they encourage us academically but they put us out of there to present in different programs, give little seminars on our own, not necessarily specifically on our academic program. But just talking about grad school in general, the support system was so much better once I came back to [an HBCU].” (Male, graduate)

This graduate mentions several of the ideas that have emerged in our focus group data: supportive peers, supportive faculty, supportive staff, an intense program with high standards, and the opportunity to have professional experiences. This student had experienced both a PWI and an HBCU and considered the HBCU experience to be “so much better.”

## **Implications**

Our work not only supports existing research regarding retention, it also adds to an understanding of key psychosocial factors. An emotional factor seen was drive, which we defined as an emotional underpinning that provides the strength to persevere. Student drive was a psychosocial factor that aided students in benefiting from institution programs and resources. This supports the importance of psychosocial factors as influences on the effectiveness of structural factors.

Connecting with upperclassmen in the same field of study positively impacted one graduates’ experience and changed her motivation from fulfilling her parents point of view to having fun and enjoying her work. The data indicate the importance to students of a multi-faceted network of supportive connections that

includes organizations, field of study cohorts, upperclassmen, faculty members, and staff. The “honest car[ing]” present at HBCUs that was expressed by one staff member was also supported by other comments indicating the extra time faculty members spent with students. Time spent expressing concern and listening to students can be a way that faculty and staff members gain awareness of influences in Black students’ lives and help Black students feel a connection to the campus community. As one graduate noted, he talked to faculty and staff at his institution about “life issues and school issues and just how to become a better person and a better student,” indicating the level of involvement on the part of faculty and staff that helped him to succeed.

As faculty and staff members at HBCUs seek to help students, they may require training as to how to appropriately support students’ diverse needs. One such need that emerged in our data was the need to help students who may have come to school because they were pushed by their parents to attend. Although love of family was a positive motivator for some, when pushed some students were having trouble finding their way. Resources may be needed that help faculty and staff to aid students in learning to make their own choices about their futures. Faculty and staff also can be made aware of the importance of field of study peer and upperclassmen connections in helping students in such situations to find intrinsic motivation.

Our work also points out the importance of targeting student support efforts to student needs. Part of that effort includes helping students navigate college and career paths and understand the reasons for their curriculum. Our work reinforces the importance of helping the individual student to find resources, motivation, and support. HBCUs show us models of how to provide that kind of help.

### **Conclusion**

The HBCU experience has the potential to bring together the best of the psychosocial factors that can support Black American students in STEM success. Evidence in the work of (Palmer et al., 2010) supports these findings. They noted that “[M]any of the factors that participants . . . identified as contributors to their success . . . are the very same factors that are absent for Black students at PWIs who have less favorable experiences and outcomes” (p. 98). College retention is complex issue (Credé & Niehorster, 2012), but as the findings suggest, HBCUs often provide for vital factors influencing retention to be positively addressed. Further research into different methods of implementation can examine how such factors can be tapped into at all HBCUs and how other institutions can learn from what happens in the lives of successful STEM HBCU students.

For example, mentoring is a common theme in the general college retention literature as seen in the work of Carpi, Ronan, Falconer, Boyd, and Lents (2013) and Kendricks, Nedunuri, and Arment (2013). HBCUs can ensure that all personnel at the institution, as well as upper-class students, are considered to be mentors and are trained in the mentoring process. Mentoring programs take a variety of approaches, both academic and non-academic. Students in our study felt the effects of the embedded mentoring and support that was present at the HBCU they attended. Institutions can ensure that there will be a culture of mentoring by providing new employees with clear expectations as to their mentoring responsibilities, as well as training, time, and resources. Palmer et al. (2010), confirmed that faculty and staff who envision themselves as an important part of the student support network are vital resources for underprepared students.

Strategies for improving the retention of Black American STEM students must strike a balance between providing strong support and holding students to high expectations. Mentors who have high expectations for students and who strive to support as well as motivate them can provide such balance. Hrabowski (2004) has noted that high expectations are an important part of the support needed by Black American students. The equity principle of the National Council of Teachers of Mathematics (NCTM) (2000) states that, "Excellence in mathematics education requires equity – High expectations and strong support for all students" (p. 11). The same is true for all STEM fields. When Black American students know that someone will encourage them, hold them to the high standards that success requires, ensure that they have the resources that they need, and aid them in making the transition to professionalism, then they will be able to enter STEM professions as they desire and help fill the United States' STEM needs.

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## Appendix

### Selected Questions from Student Focus Group Protocol

#### Questions and prompts (see additional possible questions listed below).

1. Let's start by having each of you tell us something about your educational experiences.
2. How have you been supported in your pursuit of an education?
3. Is there anything that has interfered with your pursuit of an education?

#### The following questions may also be asked used to narrow the focus of the conversation to science, technology, engineering, and mathematics, if needed.

4. What about your experiences in science and math?
  - a. Is anyone majoring in those fields?
  - b. Is anybody studying engineering?
  - c. Is anybody majoring in computer science?
5. What has helped you the most in your study of (*choose from the following as applicable to the participant judging by their responses, or refer to other courses of study if the participants mention them.*)
  - a. science?
  - b. mathematics?
  - c. engineering?
  - d. computer science?
6. What has helped you the most to make good use of technology for learning?
7. What use of technology for studying (*science, mathematics, engineering or other course of study mentioned*) has helped you the most?

## Contributors

**Megan Glover Adams, Ph.D.**, is an Assistant Professor of Reading Education in the Department of Secondary and Middle Grades Education at Kennesaw State University in Kennesaw, Georgia.

**Vivian L. Carter, Ph.D., MHR**, is the Chair of the Department of Psychology and Sociology at Tuskegee University in Tuskegee, Alabama.

**Cassandra R. Davis, Ph.D.**, is a Research Assistant Professor in the Department of Public Policy at the University of North Carolina at Chapel Hill in Chapel Hill, North Carolina.

**Lauretta Garrett** is an Associate Professor in the Department of Mathematics at Tuskegee University in Tuskegee, Alabama.

**Rodney D. Green, Ph.D.**, is a Professor in the Department of Economics at Howard University in Washington, DC.

**DeBorah Gilbert White, Ph.D.**, is the Founder and Coordinator of HerStory Ensemble, a community-based advocacy, artistic, economic development and empowerment organization, in Wilmington, Delaware.

**Li Huang, Ph.D.**, is an Assistant Professor in the Department of Psychology and Sociology at Tuskegee University in Tuskegee, Alabama.

**Rhonda Jeffries, Ph.D.**, is an Associate Professor of Curriculum Studies in the Department of Instruction and Teacher Education at the University of South Carolina in Columbia, South Carolina.

**LaDelle Olion, Ph.D.**, is a Professor of Education in the College of Education at Fayetteville State University in Fayetteville, North Carolina. He also is the Editor-in-Chief of *The Negro Educational Review*.

**Linda Silvernail, Ed.D.**, is the Assistant Principal for Curriculum and Instruction at Spring Valley High School in Columbia, South Carolina.

**Aisha Thompson, M.A., M.B.A.**, is a Research Fellow in the Department of Economics-Center for Urban Progress at Howard University in Washington, DC.

**Majorie Williams-Cooper, M.A., DLitt.**, is the Founder and resident of Sophia Collective, Inc., in Rahway, New Jersey.

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