



African American Undergraduate Success in Engineering: "Proving them

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Black Undergraduate Success in Engineering: The “Prove Them Wrong Syndrome” or Social Responsibility

Introduction

One of the most studied issues in education research over the past several decades in the United States has been the achievement gap between Black and White American students¹. One of the primary goals of this research is to increase the number of Blacks attaining college degrees. While there has been a steady increase of Black students attaining college degrees since the 1980s, the vast majority of these students have received degrees in the social sciences and the humanities, with an underrepresentation of Blacks in the science, technology, engineering, and mathematics (STEM) disciplines². This disparity is important to note, not only because the STEM disciplines tend to offer higher incomes and a more stable workforce, but also because the United States is currently experiencing an increase in jobs in STEM disciplines that is not being matched by job-seeking graduates³. These findings are seen across race, meaning that while there are many minority students who could greatly benefit from jobs in STEM, the United States STEM workforce could also greatly benefit from an increase in STEM graduates of all backgrounds. Not only are STEM educators, policymakers, and employers interested in increasing STEM graduates, but increasing minority STEM graduates would contribute to the long time goal of education researchers and policymakers to decrease the achievement gap between White and Black students. An investigation of what factors motivate those Black students who persist in STEM majors is needed to replicate these factors for other students and as a result retain Black students in STEM.

The achievement gap in the United States is due, in part, to a history of prejudice and discrimination towards Blacks attaining education. This prejudice has had a two-fold effect: first, the denial of access to post-secondary education, and second, a lack of self-efficacy in Black students regarding educational attainment because of the prolificacy of negative stereotypes about their achievement⁴. Steele and Aronson's⁵ work on stereotype threat supports the notion that knowledge of negative stereotypes about the achievement of Blacks can, in turn, lower that achievement. Steele and Aronson found that when Black students were tasked with completing a standardized test that they were told measured intelligence, they consistently scored significantly lower than their White American counterparts. When they were instead given a standardized test and were told that the test did *not* measure intelligence, Black students did not score significantly differently from their White counterparts. Steele and Aronson posited that awareness of the stereotype that Blacks are low academic achievers distracted and caused anxiety for Black students which led to a self-fulfilling prophesy – poor test performance. Across several replications, using Black students, women, and athletes, it has been found that stereotype threat does decrease academic achievement for those negatively stereotyped populations^{6,7}. Stereotype threat then demonstrates a cycle began by racial prejudice in the United States regarding Blacks and educational attainment and how even high achieving Black students might be impacted by that racial prejudice. In response to stereotype threat, high achieving Black students may become motivated to achieve by proving negative stereotypes wrong, which may lead to higher achievement, but may also bring about the distress similar to that caused by stereotype threat. While “proving them wrong” may appear to successfully motivate Black students, other pathways are likely to lead to less psychological distress and equal if not more academic success

for Black students. This paper will address the pathways that Black engineering undergraduates take to successfully persist in their engineering programs, specifically examining the effects of the “prove them wrong syndrome” and social responsibility on Black engineering undergraduates’ academic success.

The “Prove them Wrong Syndrome”

It can be argued that stereotype threat supports the notion that successful Black students might be afflicted with the “prove them wrong syndrome”, in other words, the need to disprove negative stereotypes about Blacks’ academic achievement with their own success⁸. When Moore, Madison-Colmore and Smith asked several Black male engineering undergraduates about their experiences at a predominantly white university (PWI), they were consistently told that these students felt that they were ignored by their White peers and professors. These peers and professors had lowered expectations for Blacks, and therefore, the Black males felt that they had to prove themselves to their White professors and fellow students. Moore, Madison-Colmore & Smith concluded that these students were transforming their negative experiences as Black students at a PWI into motivation to persist in their majors. While students did persist, despite these negative experiences, the phenomenon of stereotype threat suggests that this persistence was not without a price. It is likely that the distraction and anxiety brought about by negative stereotypes of Blacks and academic achievement resulted in poorer academic performance for these students due to the negative expectations of White professors and students. Although students were able to “prove them wrong,” is it likely doing so caused a decrease academic performance and as well as decrease in psychological wellness.

Social Responsibility

As previously stated, it is important for education researchers to understand what factors serve as motivation for Black students to persist in STEM majors, and equally important is understanding what factors increase motivation to persist without possibly causing psychological distress, with the ultimate goal being replication of these factors. While the “prove them wrong syndrome” may explain one possible way for Black students to persist in STEM majors, this is not the type of motivation educators would seek to replicate. DuBois^{9,10} proposed that it is the responsibility of the successful ten percent of Blacks, the “Talented Tenth”, to assist the remaining ninety percent in becoming successful. The concept of social responsibility is not novel; however, DuBois spoke specifically of college educated Blacks’ responsibility towards those with fewer resources, which has not been often empirically studied regarding the motivations of Black undergraduates to persist in STEM majors. Although there has been some debate about whom DuBois regarded as the Talented Tenth and exactly what he charged them with, DuBois spoke of educated Blacks sacrificing their personal desires in order to increase the overall well-being of their entire race in the United States. In the simplest terms, this charge is now antiquated; however, Blacks are still less likely to attend and graduate from a college or university and are less likely to obtain financially stable careers than their White counterparts. The need for leadership to guide Blacks in the direction of educational attainment and financial stability is not antiquated. It is possible that this need can serve as a motivating factor for students to persist in STEM majors.

Past research has found that Black students are more likely to enroll in historically Black colleges and universities and are more likely to successfully obtain undergraduate and graduate degrees from these institutions^{11,12}. Not only are students' peers much more likely to share their racial and cultural heritage, but they are also more likely to have Black professors and professors of African descent. Students are exposed to many more organizations with missions regarding Black culture as well as events and programs geared toward Black culture¹³. It may be intuitive that Black students at HBCUs are less likely to rely on the "prove them wrong syndrome" when they are not in proximity to individuals who may hold negative stereotypes about them; however, stereotype threat theory suggests that even these students are aware of negative stereotypes about Blacks and academic achievement and might therefore be afflicted with the "prove them wrong syndrome." It is also possible that attending an HBCU might make students aware of the value of social responsibility towards the Black community and that this notion may supersede that of "proving them wrong".

Purpose

The purpose of this study was to explore the pathways undergraduate engineering students took to persist in their major in order to determine what factors lead to greater persistence of minority engineering majors at institutions where they are the majority. For the purpose of this paper, two research questions will be addressed: 1) What influence does the "prove them wrong syndrome" have on the persistence of Black engineering undergraduates attending a historically Black university? and 2) What influence does social responsibility towards the Black community have on the persistence of Black engineering undergraduates attending a historically Black university? While the research questions specifically address the "prove them wrong syndrome" and social responsibility, these are not the only factors that influence the integration and persistence of Black students in engineering majors. However; this paper seeks to fill a gap in the literature regarding these particular factors. Tinto's¹⁴ integration model serves as the theoretical framework for this study. Tinto suggested a twice revised theoretical model that described how students make decisions about remaining in higher education. Through all iterations of the model, the idea of integration and the nature of interactions between students and members of the institution remained. To put it simply, students' choices concerning remaining at an institution are a function of their academic and social integration within their institutions. While students' characteristics upon entering influence their initial commitment to the institution, subsequent social and academic integration alters their levels of institutional commitment. Hence, their levels of academic integration should have an influence on students' goal commitment to graduation.

Methodology

The data from this study were collected during the first year of a three-year longitudinal NSF-funded study. The research methods are described below.

Participants/Institution Profiles

Data were collected from two HBCUs in the United States. HBCU1 ranks nationally among the highest producers of African-American undergraduates with science and engineering degrees who go on to earn doctoral degrees¹⁵. HBCU2, a public, urban institution, is the top producer of

African-American undergraduates with engineering degrees as well as a top producer of female engineers. All of the engineering programs at these institutions are ABET accredited. A sample of 36 Black engineering students in their sophomore and junior years participated in the study using convenience sampling. The participants were recruited using email invitations, promotional materials posted in the engineering departments, as well as informational sessions. Male and female students from each major offered on each campus were included.

Instruments

The study used a mixed methods approach to collect qualitative and quantitative data. For the purpose of this paper, only the qualitative data will be addressed.

Semi-structured interviews. The one-on-one semi-structured interview design was a standardized list of questions that allowed for additional probing when deemed necessary. The semi-structured interviews allowed for the collection of specific information related to engineering education. The researchers were aware of the participants' perspective and oftentimes adjusted the narrative of the structured questions and used unscheduled probes. These probes provided interviewers with a way to draw out more complete stories from the participants.

Focus groups. Focus groups were used to complement the interview data, allowing the researchers to better interpret the results. Three focus group sessions per campus with 7-10 participants each were conducted during the latter part of the spring semester of year 1 and year 2. There was one all-male focus group, one all-female focus group, and one co-educational focus group per year per campus. This arrangement allowed for opportunities for the male and female student groups to be comfortable and candid in their responses. The group setting and the phenomenon of group dynamics solicited rich information from interviewees and assisted in the interpretation of the previously obtained results.

Data Analysis

Open coding was conducted in multiple rounds by two researchers. Coding involved interpreting participants' responses and assigning these responses to categories. The consensus method was used when coding data. Two researchers coded five interviews together, agreed upon each code, then met after intervals of coding ten interviews and three focus groups each to discuss the coding that had taken place. From the codes that were created, they found and agreed upon several themes, then merged these themes into overarching themes.

Results

Overarching themes that emerged from the data included *The Proving Them Wrong Syndrome: Evidenced at HBCUs*, *Social Responsibility: Responsibility toward the Black Community*, and *Social Responsibility: Mentoring*.

The “Prove Them Wrong Syndrome”: Evidenced at HBCUs. In response to questions regarding how students' believed their race and gender impacted becoming engineers and experiences that had been helpful in attaining their career goals, students provided a number of answers, but mentioned either proving themselves or proving “them” wrong seventeen times

across two years, and two campuses, and in interviews and focus groups. It was evident to students that even though they did not have professors or peers they had to prove their worth to as Blacks, they felt they had to prove themselves at their internships, in their future workplaces, and even hypothetically.

A student in the all-female focus group at HBCU1 stated (emphasis added):

And also ... I like to *prove people wrong* ... the negative type of stuff ... I feel a lot of ... White people ... think, "Oh, Black people aren't smart," or that we can't do something ... I've had white people say ... "Oh, no, you all can't do that." [My response to that is] "Are you serious because I think we have the same type of brain the last time I checked!" ... I just like to [put] that in people's face[s], so when I graduate and have that degree, I'm [going to] have it on my wall. I'm [going to] have a picture on Facebook. I'm [going to] throw that everywhere just so I can [say] ... "So now what, because obviously, we're working in the same office and I'm making more than you!" ... I want *to prove people wrong* because so many people [think] Black people can't do [engineering].

A female student in the coed focus group at HBCU2 spoke about her future workplace (emphasis added):

... I know there are still people who have ... that stereotypical ... attitude towards [Blacks in engineering]. So I know I feel like they're [going to] be a little hostile and I know there are some people who'll [say,] "Oh, well, she just got the job because ... they're just filling ... [a] quota. But ... I [want to] be able to *prove [to] people*, [to make them say], "Oh, that girl is good!" And that's ... what I want them to [see]. I don't want them to see what they see on the outside ... I want them to see ... when [they] have to actually read ... out what I can do, I want it to look amazing.

Others in the focus groups tended to agree with the previous two speakers; however, a student in the all-male focus group at HBCU1, while recognizing that non-Blacks may not expect Blacks to succeed in engineering, disagreed with his counterparts, stating:

... I don't ... agree ... with ... what he was saying earlier about ... almost beating the odds ... [of] the expectations are as far as being an African-American male ... [B]eing able to succeed and to get to that point where you could say that you're an African-American male and an engineer ... defies a lot of people in general throughout the world [regarding] their expectations. And ... personally, I don't do this because I feel like I have something to prove to anybody. I do it out of my own personal passion and ... my own personal love for the major and ... the field.

In an interview a student at HBCU1 echoed the sentiment that Blacks have to prove themselves in the workforce when asked if she felt her race would impact her becoming an engineer (emphasis added):

Yes, because even though ... when the companies bring people here they might send Black people ... you know that Black people don't make up the majority of actual work force. So ...even though we're at [this university] and most people here look like us, we know that when we get out it won't actually be like that ... *I feel like having to prove that you can do it and as a Black person it's just something that you'll have to deal with.*

These were sentiments students repeated, using the specific words “prove myself” or “prove them wrong”. And yet, across two years, a total of eight focus groups, and sixty-seven interviews, students only mentioned “proving them wrong” seventeen times, nine times in year one and eight in year two. Although, students appeared to be well aware that they would not be in a racially homogenous environment in the workplace (they themselves would most likely represent whatever “diversity” their company may boast), this supposition can be seen as likely to be true considering the focus group data. Although there are only three quotes listed from focus groups, in each focus group, when the topic arose, no student seemed surprised by the idea of Blacks having to prove themselves to their non-Black peers. However, as our male student in the HBCU1 male focus group demonstrated, “proving them wrong” was not necessarily the *only* or even a top motivator for students in this study.

Social Responsibility. When in interviews and focus groups, students spoke of social responsibility a total of thirty times, almost twice that of proving themselves or proving others wrong. Students spoke about social responsibility twenty-six times during the year two interviews and focus groups, and only four times during year one. Again, this was in response to questions about the impact they believed their race or gender had on becoming engineers and experiences that were helpful in attaining their career goals. Not only did participants in this study appear to be more motivated by the notion of social responsibility, but this motivation seemed to grow as they moved toward graduation. Students spoke of social responsibility in two ways, responsibility towards the Black community and mentoring. This is important to note because when students spoke about responsibility towards the Black community, it was usually in the abstract; students were more likely to report a desire that their success be recognized by others as a model for what they themselves could do. When students spoke of mentoring, they spoke of direct action with their underclassmen peers or younger students ranging from elementary to high school. Students were more likely to participate in mentoring during the second year of the study. This can be seen as intuitive, students may be more equipped to be mentors during their junior year in college, but conversely, many students spoke of their junior year curriculum as much more challenging than the previous year. Students’ junior year is typically when engineering majors, across universities, have more discipline specific courses. With much more challenging classes, and possibly much less time on their hands, it is likely that mentoring was of high importance to these students.

Social Responsibility: Responsibility toward the Black Community. When students spoke of their responsibility towards the Black community, they either spoke of the Black community in general, younger children in need of role models, or underclassmen peers. A student at HBCU2 spoke of her passion toward uplifting the Black community:

I'm very passionate about the condition of the Black community, and anything

that I can do to help to elevate our status right now, whether it be reaching back or doing the best that I can, or raising a family that will do the best that they can, I want to do it. In engineering, we're very, very slim to none in the engineering field. So I was definitely more motivated when I found out -- I mean, you rarely find Black engineers. When I tell people, whether it's somebody that's White or Black, they're like, oh, you're an engineer. You'll have no problem finding a job. You're a woman and you're an African-American. ... [T]hat definitely motivates me ... to have a positive effect on the Black community.

Another student at HBCU2 reported very similar thoughts when asked if she felt her race impacted her becoming an engineer:

... [I]t gives that [model] of ... intelligence to Black people ... because ... we have ... that stereotype where, "Oh, Black people ... are [going to] stay where they are." But no ... I feel like because I'm striving as a Black woman to become an engineer, that I support my race, because, basically, that's bringing up every young person behind me. I'm showing them that you can do this the best way you know how. Basically, Obama becoming President, us becoming engineers, and putting forth our future, as everybody's seeing that, they know that the generation is constantly [going to] grow instead of coming down.

A student at HBCU1 speaks of being a role model just by being a Black engineer:

I always wanted to do something that other people didn't, and Black females are so underrepresented even just in the STEM fields alone, and especially in chemical engineering the number gets even smaller. So I know that me being not only an engineering major, [but also] a Black female engineering major makes me ... that much more unique ... [P]artially the reason ... I'm sticking through [is because] I know I'm helping that number [of Black female engineers] go up, and I'm [going to] help future Black female engineers.

Another student echoed this sentiment when he said that he hoped as an entrepreneur he would be able to give back to the Black community. On a slightly different note, one student in the coed HBUC1 focus group noted the importance of a Black student performing well at an internship, in that that performance was likely to influence whether other Black students would be hired in the future:

... [W]e're very ... un[der]represented ... [W]hat you do will not just be a reflection on you. It will be a reflection on Black students in general. ... [I]f you go and you excel, then they'll think okay ... they excel. If you go and fail ... [or] ... you don't live up to the same [standard] as the White students, then they'll [think], "Okay, maybe I ... should be leery of hiring Black students ... I should be more strict on who I accept." So you ... have to really push yourself when you go to internships to be the best of the best, and ... set a good example, especially if you go to a place where ... you're the only [Black intern] there.

These students demonstrate that uplifting the Black community serves as motivator for them to do their best at internships, to graduate with a degree in engineering and to achieve their career goals. The idea that their success is not just their own, but a catalyst for the Black community to move forward speaks to DuBois' idea of the responsibility of the Talented Tenth; however, DuBois' insisted the Talented Tenth take action, and that is also what these students have done.

Social Responsibility: Mentoring. Students reporting mentoring in many capacities from the more traditional one-on-one kind to teaching young students for an extended period of time to speaking with students for just a few hours. In most cases, students reported that mentoring motivated them to pursue their chosen careers. In no case were students mandated by their professors, engineering program, or university to be mentors, each student chose to do so.

Students in the female HBCU1 focus group spoke about mentoring underclassmen, one student stated:

... [H]elping the underclassmen ... really boosts you and ... reawakens the passion [for engineering] ... You're supposed to be helping them ... and if you're ... at the end of it and ... you don't want to do it, then that's not very motivating for the younger ones. So ... keeping them in [has helped move me towards my career goals.]

Two students in the HBCU1 focus groups stated the importance of mentoring students as both an Black and a woman:

... [B]eing Black you already are unrepresented. Being a woman, it ... has an impact ... I went to Memphis during spring break ... and I helped tutor and mentor young people ... elementary through high school students. ... [W]e held this ... summit for juniors and seniors about college ... choosing their majors and things like that. And I spoke to a lot of the girls and they said, "Okay, I am smart in math but I don't know what to do with it." ... I was [said], "Oh, you need to be ... an engineer." [They said], "We've never even met [a Black female engineer]." ... So I feel ... gender does play a role because [they] may have seen ... Black male ... scientists and engineers, but none of them had ever seen, or talked to, or heard of any ... Black female scientists or engineers.

I get really excited for things like Introduce a Girl to Engineering Day. That's probably ... my favorite day of the entire semester 'cause I get to [be] with girls who ... like to do technology stuff. ... [H]ow fun is that, right? So you get to share with the younger generation those things that you're already passionate about and ... try and get them going in this direction so that in 20 years or so ... you could walk around your office and there'd be like a sundry of women just walking around the office handling business, looking nice, professional as they should.

Another student spoke of her time mentoring young children:

When I went to alternative spring break last year in Chicago [it] really showed me that I wanted to work with the youth more than anything ... I went to Chicago to do community service and we focused on gun violence. I was in the education group, so I got to go into the schools and speak with the students, just interact with them, and they really showed me that these students want to go to school like me but they don't always have the option per se ... I don't want that to be the case anymore. I want them to have that option so they can one day come to school like me and possibly become future engineers or doctors or anything. I'd rather make 100 engineers than make myself one engineer.

This student demonstrated that mentoring deeply inspired her career goals. Yet more students spoke of mentoring underclassmen, many as a result of appreciating the benefits they received from their mentors when they began their college careers at both HBCU1 and HBCU2. Mentoring students during Alternative Spring Break at HBCU1 was mentioned three times, a program in which students commit their spring break to community service in impoverished areas in the United States. HBCU1's Introduce a Girl to Engineering Day was also mentioned three times. Both HBCU1 and HBCU2 male students were involved in male centered student organization that allowed male college students to serve as mentors to underclassmen and to be a support group for their peers.

Discussion

Previous research has shown that Black males at a PWI were able to take the stigma of negative stereotypes about Black academic achievement and turn it into a motivator to persist to graduation in their engineering majors. In essence, these Black males demonstrated the “prove them wrong syndrome”, doing their best in their majors to disprove the negative stereotypes about Black academic achievement. Steel and Aronson⁵ found that the awareness of negative stereotypes about Black academic achievement typically has a negative impact on Black students' academic performance, making the positive outcome of persistence in engineering majors counterintuitive. This begs the question of whether there is still a negative impact on academic achievement in some measure. In addition to this, while it is important to understand what factors motivate persistence, it is even more important to be able to replicate these factors across institutions and students, ideally focusing on positive experiences rather than negative.

Over one hundred years ago, W.E.B. DuBois^{10, 11} suggested that it was the responsibility of the educated 10 percent of Blacks, the “Talented Tenth”, to use their resources to help to improve the livelihood of Blacks in the United States. Though there are some antiquated aspects of this argument, instilling the notion of social responsibility into any group of privileged individuals has positive consequences for society at large. That being said, it can be hypothesized that adopting the value of social responsibility may increase motivation for Black college students to persist in their majors. This study addressed the research questions: 1) “What influence does the “prove them wrong syndrome” have on the persistence of Black engineering undergraduates attending a historically Black university?” and 2) “What influence does social responsibility towards the Black community have on the persistence of Black engineering undergraduates attending a historically Black university?” Evidence of both the “prove them wrong syndrome” and attitudes and behaviors that endorsed social responsibility were found.

This study supported the finding that Black students were motivated by the “prove them wrong syndrome” even while attending HBCUs; however, as stereotype threat suggests, students may be *victims* of the “prove them wrong syndrome,” and when proving them wrong becomes salient, academic achievement may decrease. What this study demonstrated was that attendance at an HBCU might serve as a mediator that lessens the impact of the “prove them wrong syndrome” on Black students’ academic achievement. This finding stems from the frequency with which students mentioned “proving them wrong.” In addition to that lessened impact, attending HBCUs might also increase Black students’ attitudes toward and participation in activities that help to improve the academic outcomes for other Black students, whether they are in college, high school, or elementary school. DuBois suggested that the Talented Tenth were responsible for helping to improve the lives of the Blacks in the United States. This study demonstrated that it was of high importance to Black students to mentor others, and these students were willing to use their personal time, even including their spring breaks to do so.

Tinto’s¹⁵ model of integration postulates that the more integrated students are into their university and academic program, the more likely they are to persist in their majors. Students’ endorsement of attitudes toward and behaviors of social responsibility may indicate greater integration into their institutions in that HBCUs have a history of social responsibility towards Blacks and women. Along with any positive psychological or academic consequences of the endorsement of attitudes toward and behaviors of social responsibility, students may be more likely to persist as it is related to social responsibility due to their integration into their institution.

Implications

Interestingly, Blacks attending HBCUs still felt they had to “prove them wrong”, with female students’ double minority status playing a part in this phenomenon as well. However, there was a greater frequency in which students reported that they were motivated by helping people versus motivated by proving people wrong. The assumption can be made that the desire to help others brings more psychological, and therefore behavioral (in this case academic), benefits than the need to prove them (people or stereotypes) wrong; however this is not certain. Further research must be employed in order to determine whether:

- The “prove them wrong syndrome” lowers academic performance in the same manner as stereotype threat;
- There are measures that can be taken to reduce the negative effects of the “prove them wrong syndrome” across institutions;
- Positive attitudes and behaviors regarding social responsibility increase academic performance;
- Attendance at an HBCU increases attitudes and behaviors regarding social responsibility; and
- There are measures that can be taken to increase attitudes and behaviors regarding social responsibility across institutions.

Conclusion

For many educators, education researchers, and policy makers, the goal is to deliver an education to students that is of the highest quality while making this education available to all students. An

inherent result of this goal is decreasing the achievement gap between Black and White students from their high school math test scores to their attainment of bachelor's degrees. One strategy to lower the achievement gap between White and Black students, especially in the STEM fields, is to understand what experiences are more likely to increase persistence of Blacks in STEM majors and how to replicate these experiences in order to benefit Black students across institutions. This study investigated students' experiences to retain Black students in engineering majors, and eliminate the achievement gap between Black and White students across the United States.

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