

Post Baccalaureate Decisions of High Achieving Black STEM Students: Exploring the What, When and Why

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Context

The literature indicates that the representation of minority science, technology, engineering, and mathematics (STEM) professionals is significantly disproportionate to minority representation in the U.S. general population and workforce. This under representation impacts the ability of the current pool of primarily White male STEM professionals to meet the rapidly changing demands facing the engineering industry. To address this concern, the U.S. must increase the numbers of women and minorities (defined for the purpose of this study as African Americans, Hispanics, and Native Americans) that earn degrees in STEM fields not just at the baccalaureate level, but at all levels (U.S. Census Bureau, 2006). Minorities, particularly African Americans, are showing an increase in enrollment and subsequent degree attainment in science and engineering in general (S&E) (US Census Bureau, 2006). However, most of the increase is in psychology and social science, while the natural sciences, mathematics and engineering show little to no increase. Furthermore, little increase is seen at the master's and doctoral levels. The disparity is particularly evident in graduate degree attainment where in 1996 African Americans earned only 674 masters degrees in engineering as compared to 13,573 earned by Whites (US Census Bureau, 2006).

Research Questions

This paper examines the factors influencing the post baccalaureate decisions of high achieving Black STEM students with a focus on understanding what leads them to graduate school in STEM disciplines. We used Social Cognitive Career Theory (SCCT) as a theoretical framework to provide insight regarding these factors. The following research questions were examined:

1. Are there differences in coping efficacy based on academic discipline (Engineering and Computer Science versus Science and Mathematics) or gender?
2. What are the common traits and characteristics of a senior student intending to enter graduate school, professional school or industry?

This study is significant because it enables academicians to better understand how STEM students navigate their post-BS career choices, identify the conceptual foundations students need in order to choose to pursue graduate STEM education, understand this transitional experience across gender lines and discipline, and transform the findings and insights gained from this research to inform practice. Most importantly, however, we aim to contribute to the literature by expanding the knowledge base of this understudied population (i.e. Black students at a historically Black university) which will allow the STEM community to identify where additional research work is needed and what “the vision of the possible” for intervention programs may look like.

Theoretical Framework

The theoretical framework guiding this study is Social Cognitive Career Theory. An extension of Bandura's general social cognitive theory (Bandura, 1986), this theory postulates that three social cognitive mechanisms are essential to career development: self efficacy beliefs, outcome expectations, and goal mechanisms (Lent, Brown, & Hackett, 1994). The quantitative portion of this paper examines goal mechanisms while the qualitative portion examines self efficacy beliefs and outcome expectations. Bandura asserts that self efficacy beliefs are "concerned not with the skills one has but with the judgments of what one can do with whatever skills one possess" (Bandura, 1986; Albert & Luzzo, 1999). Thus, among the sample in this study, self efficacy plays a crucial role in one's confidence in his/her ability to pursue a post baccalaureate degree, despite the various barriers and obstacles. Focus group data as well as data from the semi-structured interviews examined the role of self efficacy by exploring the impact of a variety of internal and external factors on the study participants' post baccalaureate plans. Outcome expectations refer to beliefs regarding the long term consequences of success in specific educational or career decision making behaviors (Betz & Voyten, 1997; Ochs & Roessler, 2004). Outcome expectations for pursuing a career in industry or completing a graduate or professional degree were explored during the focus groups. Finally, goal mechanisms refer to the determination to engage in a particular behavior or activity or to affect a particular future outcome (Albert & Luzzo, 1999). For the purpose of this study, goal mechanism is the post baccalaureate plan of either pursuing a career in industry or obtaining a graduate or professional degree. This paper will discuss the impact of STEM discipline on post baccalaureate educational and career plans.

Methodology

This paper shares data from the first phase of a multi method National Science Foundation (NSF) funded longitudinal study conducted at a historically Black university (HBCU) in fall 2006 and spring 2007 using a sample of 51 high achieving Black STEM senior students. A stratified random sampling technique was utilized to select the study sample which were divided into three subgroups based on majors—(1) physical sciences and mathematics, (2) engineering and computer science, and (3) biological sciences. The sample consisted of 51 students (61% female and 39% male) and was then divided into 2 groups: Engineering and Computer Science (ECS) (31%) and Science and Mathematics (SM) (69%). Fifty-five percent were United States citizens and 45% were international students. More than half were African American (55%), 33% were Afro-Caribbean, 4% were African, 2% were Asian, and 6% classified themselves as Other. The age of the participants ranged from 19 to 28 and the mean age was 22. Finally, in regards to the specific STEM discipline, more than half were from the biological sciences (51%), 3.9% were from physics and mathematics, respectively, 9.8% were chemistry, 2% were computer science, 2% were chemical engineering, 6% were civil engineering, 12% were electrical engineering, and 9.8% were Mechanical Engineering.

Data for the first phase of this study were collected during three occasions in the fall of 2006 and spring of 2007 via an electronically administered survey, semi-structured interviews and focus groups. These sources of data collection allowed us to ascertain what career decisions these students were making immediately upon graduation, why they made that decision, and when in their academic pipeline did they make this decision. The electronically administered survey was quantitative and sought to obtain information regarding participants' post

baccalaureate decisions. The semi-structured interviews consisted of a standardized list of questions asked the same way to each student, but also allowed flexibility for probing when needed. Finally, focus groups were used to complement the surveys and interviews allowing the researchers to better interpret and corroborate the results. The focus groups (with 7-10 students each) were divided into 2 distinct groups: one for students pursuing a graduate or professional degree and one for students pursuing industry.

Data was analyzed using a variety of methods. Quantitative data was analyzed using both descriptive and inferential statistics. Descriptive statistics was used to describe the sample population as well as to determine the post baccalaureate decisions of students (i.e. the percentage of students pursuing graduate school, professional school or industry). Inferential statistics (Independent t test) was utilized to make inferences about the sample as well as to answer research question 1. Qualitative data from the structured interviews and focus groups were recorded and transcribed. The data was then transported into NVIVO Qualitative software and analyzed to determine themes and patterns. This approach was used to answer research question 2.

Findings and Conclusions

Coping Efficacy based on Discipline and Gender

Findings revealed that STEM discipline has a greater impact on one's confidence in one's ability to cope with the barriers and problems associated with pursuing a professional or graduate degree than gender. Science and Mathematics students have greater levels of coping efficacy than Engineering and Computer Science students. This is also the case when comparing coping efficacy for both STEM disciplines within each gender. Women Science and Mathematics students have higher levels of coping efficacy than women Engineering and Computer Science students. Similar findings were found by men. These findings provide motivation for further inquiry within Engineering and Computer Science programs, since each analysis continued to point in the direction of lower coping efficacies for students within these majors. The subsequent parts of this section of this paper will seek to provide qualitative information regarding factors influencing students' post baccalaureate decisions.

Common Traits and Characteristics of Students Based on Post BS Decision

An understanding of the common traits and characteristics of students for each post baccalaureate decision group (i.e. graduate school, professional school or industry) shed light on the following questions:

1. What is the Post Baccalaureate decision (i.e. graduate school, professional school or industry)?
2. Why did students make the decision (i.e. what are the significant influences)?
3. When did the students make the decision (i.e. before freshmen year, during sophomore year, during junior year, during senior year)?

The data included in this section is based on the in depth interviews and focus groups conducted with students during the spring 2007. Findings were disaggregated by 3 distinct categories based on the post baccalaureate decision: graduate school, professional school or industry. A small sample of the population (14%) selected other as their post baccalaureate decision. These students reported they would be pursuing industry or a post baccalaureate

internship after graduation and then pursue graduate or professional school within 1 or 2 years.

Graduate School

Based on the data from the semi-structured interviews (collected in spring 2007) 26% of students reported they would be attending graduate school in the fall of 2007. Of that sample, eighty-two percent (82%) reported they would be pursuing a master's degree or Ph.D. in a STEM area while the remaining students selected a master's degree in a social science or business administration. Among those pursuing a master's or Ph.D. in a STEM field, common reasons included mentorship experiences (both formal and informal), undergraduate research experiences, research intensive internship experience and encouragement from faculty. Overwhelmingly, the students reported graduate school will increase their opportunities for advancement in their careers as well as increase their financial stability.

Engineering and Computer Science students represented 27% of the sample pursuing graduate school. Of that number, 33% are pursuing an MBA while the remaining students are pursuing a graduate degree in a STEM discipline. Among engineering students, the decision to pursue graduate school directly after undergraduate is largely based on a substantive understanding of one's specific career goal. Further, many reported an internship was crucial in making their decision. In terms of the time in which students made their decision to pursue graduate school, 36% selected it during their senior year, 46% during their junior year and 18% before entering their freshman year. Many students reported they came into college with a preconceived notion of their post baccalaureate plan and then changed their decision after consultation from a faculty member or participation in a research intensive program.

Professional School

Approximately 19% of the overall sample reported they would be attending professional school in the fall 2007. Professional school is categorized as dental school, medical school, law school, or pharmacy school. Similar to students pursuing graduate school, those pursuing professional school indicated their decision was impacted by mentorship and externship experiences. These students did not deny the impact of a research intensive degree; however, many reported they would rather have more face-to-face interaction with clients. Also, students often volunteered at hospitals and medical facilities as well as participated in study abroad programs. Overall, it appears to be a decision based on one's preference for more in depth interaction with clients. Further, the decision to pursue a professional degree was often greatly influenced by family and was made before entering college. In fact, of the students pursuing professional school, 88% made their decision prior to entering college. The remaining 12% made the decision during the sophomore year.

Industry

About 40% of the sample reported they would pursue a career in industry upon graduation. Not surprisingly, the majority of these students (59%) were engineering students. A large percentage of the students reported internship experience was influential in their decision. In fact, one student interned at a large computer company for 2 summers and subsequently obtained a job after graduation. Some reported they would like to pursue graduate school in

the future; however, they believe that work experience will allow them to better assess the type of graduate degree to pursue. The decision to pursue industry after graduation was often made during students' junior and/or senior year. In fact, 18% made their decision during their junior year while 70% made their decision during their senior year. Thus, the point at which these students make their decision to pursue industry is similar to those pursuing graduate school. While those pursuing professional school, make their decision much earlier (before entering college).

Recommendations

Overall, findings from this study shall serve to inform academicians in STEM areas about how the various extra curricular and co-curricular activities (i.e. mentorship, summer research and internship experiences) can influence the pipeline of the engineers and scientists that pursue advanced degrees. As articulated through the Social Cognitive Career Theory, an evolutionary process beginning in early childhood and continuing throughout adulthood narrows the scope to successful endeavors to focus on and form a career goal/choice. The contextual factors come into play by influencing the individual's perception of the probability of success. We are reminded of the importance of the impact of undergraduate experiences outside of the classroom to the pathways that our students pursue. More than likely if students are exposed to research in their undergraduate careers, there becomes an interest in the pursuit of graduate school. Conversely, if students participate in summer internships or cooperative experiences, they are more likely to pursue a career within the industry immediately after graduation. This data serves as the first phase of a two year longitudinal study. Data from the second year is in the process of being collected and analyzed. This research will seek to answer research questions not answered during the first phase of data collection as well as provide rich information regarding the experience of students pursuing graduate school in STEM disciplines.

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