

# An Examination of the Paths Influencing the Post Baccalaureate Decisions of High Achieving Black Engineering Students

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***Abstract:** The disproportionate representation of Blacks in STEM fields suggests a need for more STEM degrees at the baccalaureate level and beyond. Additional research is needed to examine what minority STEM students are doing after completing the baccalaureate degree and why are they making those decisions. Utilizing Social Cognitive Career Theory, this National Science Foundation funded longitudinal study employs a mixed methods approach to answer this research question. Our data revealed three immediate paths high achieving engineering students take upon graduation: (1) pursuit of graduate school; (2) graduate school + industry; and (3) working in industry with a delayed pursuit of graduate school. Findings revealed access to mentorship, opportunity to pursue graduate school while working and a desire for an immediate lucrative salary significantly impacted the post baccalaureate paths of high achieving Black engineering students. Engineering education implications are addressed.*

## Context

The literature suggests there is a need to increase the numbers of minorities in STEM at all educational levels; however, this need is particularly acute at the graduate level. The attainment of masters and/or doctorate degrees provides different career path opportunities for minority engineers, which include leadership positions in industry and academic careers. This will subsequently increase the diversity of STEM faculty who can serve as role models for future minority BS degree recipients. Although many researchers in engineering education may present data on the paths towards pursuing an engineering degree as well as factors concerning recruitment and retention of minority engineering students, there are very few studies that examine the paths influencing the post baccalaureate decisions of these students. This is a critical area for engineering education as engineering educators must be aware of the student experiences that lead students to a particular choice. Therefore, an understanding of the “what is” regarding the experiences of students who successfully transition from baccalaureate education to STEM graduate education is crucial to developing successful interventions for those students that may choose to forego or delay graduate education for immediate entrée to industry.

## Research Questions

The path taken towards a post baccalaureate degree for engineering students was of particular interest. This paper will utilize a case study approach to examine the post baccalaureate paths taken by 12 engineering students in the sample of 50 STEM students. Due to attrition, there were 12 remaining engineering students that were available during year 2 of the study. This study found that all engineering students included in the sample have an interest in graduate education. However, within

that sample are 3 paths that engineering students take: (1) immediate pursuit of graduate school; (2) pursuit of graduate school immediately while simultaneously working full-time in industry; and (3) working in industry directly after graduation, with plans to pursue graduate school in the future. As common in 'within analysis case studies', this paper will answer one major research question regarding the sample: What are the internal and external factors influencing the post baccalaureate path of high achieving Black engineering students?

## Theoretical Framework

The theoretical framework guiding this study is Social Cognitive Career Theory. An extension of Bandura's general social cognitive theory (Bandura, 1986), postulates that three social cognitive mechanisms are essential to career development: self efficacy beliefs, outcome expectations, and goal mechanisms (Lent et al., 1994). 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 possesses (Bandura, 1986). 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. Outcome expectations refer to beliefs regarding the long term consequences of success in specific educational or career decision making behaviors (Betz & Vuyten, 1997; Ochs & Roessler, 2004). For the purpose of this study, outcome expectations refer to one's belief in the benefits of obtaining a post baccalaureate degree. For example, one may purport that pursuing a post baccalaureate degree will seek to increase earning potential. Finally, goal mechanisms refer to the determination to engage in a particular behavior or activity or to affect a particular future outcome. 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.

## Methodology

This paper presents data from a National Science Foundation funded mixed method study conducted at a Historically Black College (HBCU) during the fall 2006 to the spring 2008 academic years at a university on the east coast in the United States. (Please note Historically Black Colleges and Universities were established by the United States government to educate African Americans post the Civil War). The study sample was limited to high achieving Black STEM students. Criteria for participation in this study included:

1. Grade point average >3.0 on a 4.0 scale (High Achieving)
2. Senior status
3. STEM major (Biology, Chemistry, Physics, Mathematics, Chemical Engineering, Electrical Engineering, Civil Engineering, Mechanical Engineering, and Computer Science); and
4. Black (African American, African, Afro-Caribbean and Indo-Caribbean and Other)

Data was collected via electronically administered surveys, focus group interviews, and semi-structured one-to-one interviews. During the first year, 51 participants were included in the sample (this includes all of the STEM majors). Due to attrition, the sample size decreased to 40 participants by year 2. Data was collected during the students' senior year and the year following the attainment of the BS degree. This paper will present data from the 12 engineering students that participated during the second year of the study. The specific engineering majors represented in this study consisted of chemical, mechanical, civil, and electrical engineering as well as computer science.

This paper will present both limited quantitative (via electronically administered surveys from year 2) and qualitative findings (via the semi-structured one-to-one interviews from year 2). Due to the small sample size, quantitative data analysis was limited to descriptive statistics. Qualitative data was

analyzed utilizing NVIVO 8 software, which allowed the researchers to classify, sort and arrange interview data in order to identify, examine, and combine complex relationships.

Participant responses were coded to identify recurring themes including methods such as keywords-in-context, taxonomic analysis and content analysis. This was useful in understanding knowledge creation and utilization, and the knowledge needs of the individual within their respective groups. Following the identification of themes, text was interpreted and coded into themes through independent and collaborative analysis.

## Major Findings and Conclusion

The choices students make after completing their undergraduate degree is often shaped by their undergraduate experience. Although all of the engineering students in this study reported they would attend graduate school in the future, study findings outlined three distinct post baccalaureate paths: (1) immediate pursuit of graduate school; (2) pursuit of graduate school immediately while simultaneously working full-time in industry; and (3) working in industry directly after graduation, with plans to pursue graduate school in the future (see Table 1). The findings will be presented around these three areas, beginning with a discussion regarding students' perceptions of the value of graduate school since all of the students reported that they would attend graduate school in the future.

Major	Graduate School	Graduate School/Industry	Industry
Electrical Engineering	3(25%)		1(8%)
Civil Engineering		2(17%)	1(8%)
Mechanical Engineering		2(17%)	2(17%)
Chemical Engineering	1(8%)		
<b>TOTAL</b>	<b>4</b>	<b>4</b>	<b>4</b>

Table 1: A Description of the Post Baccalaureate Paths of the Sample (n=12)

### The Value of a Graduate Education (Outcome Expectations)

All of the engineering students demonstrated an understanding of the benefits of a graduate degree. For example, several students reported that a graduate degree “will make them more competitive” and it will “help them to move up the corporate ladder”. This notion was vehemently expressed by a mechanical engineering major. This student stated, “Along with the specialized knowledge, you will get qualified for more managerial positions with a graduate degree.” Another student stated, “Well the thing is that in engineering you find that companies are looking more and more into employees with a graduate degree.” Modeling has also been influential in engineering students earning a graduate degree. One student reported, “I recognize that all my bosses have it and maybe I should”. Peer influence was not significant during the decision making process.

### Immediate Pursuit of Graduate School

Students that immediately pursued graduate school directly after completing a BS degree reported a graduate degree is crucial to obtaining better advancement opportunities. Some applied to both graduate schools while simultaneously applying for industry jobs. If accepted, they pursued graduate school full-time (although some pursued part-time employment in the field for the purpose of supplementing their income). Further, students that pursued graduate school immediately after completing their undergraduate degree were often influenced by mentors and professors in their

department. For example, a female electrical engineering student that is pursuing a master's degree in engineering stated: "A female faculty member in my department (that serves as my mentor) influenced my post baccalaureate decision because she encouraged me to go to grad school and when I got job offers we sat and talked about it".

Faculty mentorship is crucial in the decision to pursue graduate education. These students often obtained this mentorship from participation in undergraduate research programs. Further, several international students reported they would apply for jobs while applying for graduate schools simultaneously. Some reported the decision to pursue graduate school was based on the difficulty in obtaining a work visa. Thus, pursuing a graduate degree gave these students an opportunity to continue living in the United States. Overall, it appears that the one-on-one contact with faculty members greatly impacted students' decisions to pursue graduate school while for international students, this decision was greatly influenced by the opportunity to extend the student visa.

### **Graduate School + Industry Full-Time**

The decision to pursue graduate school while pursuing industry was often based on opportunity. For example, several students reported that after two to six months of working, the companies paid for their graduate studies. An electrical engineering student stated, "They pay for your school after two-months of working. I guess that's the probation period but people that have been working there encourage you to get your Masters and they help." Another student report "I work full-time while doing my Masters. The company pays for school and I can get the experience and when I'm done it's easier to get a management position."

Therefore, the decision to pursue industry full-time while pursuing graduate school was often greatly influenced by the students' employer. This was often an ideal situation for students because it allowed them to continue to gain work experience while pursuing an advanced degree. Further, this was deemed to be crucial when pursuing a managerial position.

### **Industry with Delayed Graduate School Pursuit**

The decision to pursue industry after graduation was often influenced by a student's need to gain more work experience prior to enrolling in graduate school. Some were torn between pursuing an MBA or a MS in engineering. Gaining work experience would help them to narrow their decision. Another significant issue is the view of the BS degree in engineering as the professional degree for entering industry.

A chemical engineering major stated: "I started as a chemical engineering major and wanted a career as an engineer, and was open to graduate school. I had two summer internships and found out how much money I could make without going to grad school and decided that I didn't need to go. So, I'm going straight into industry."

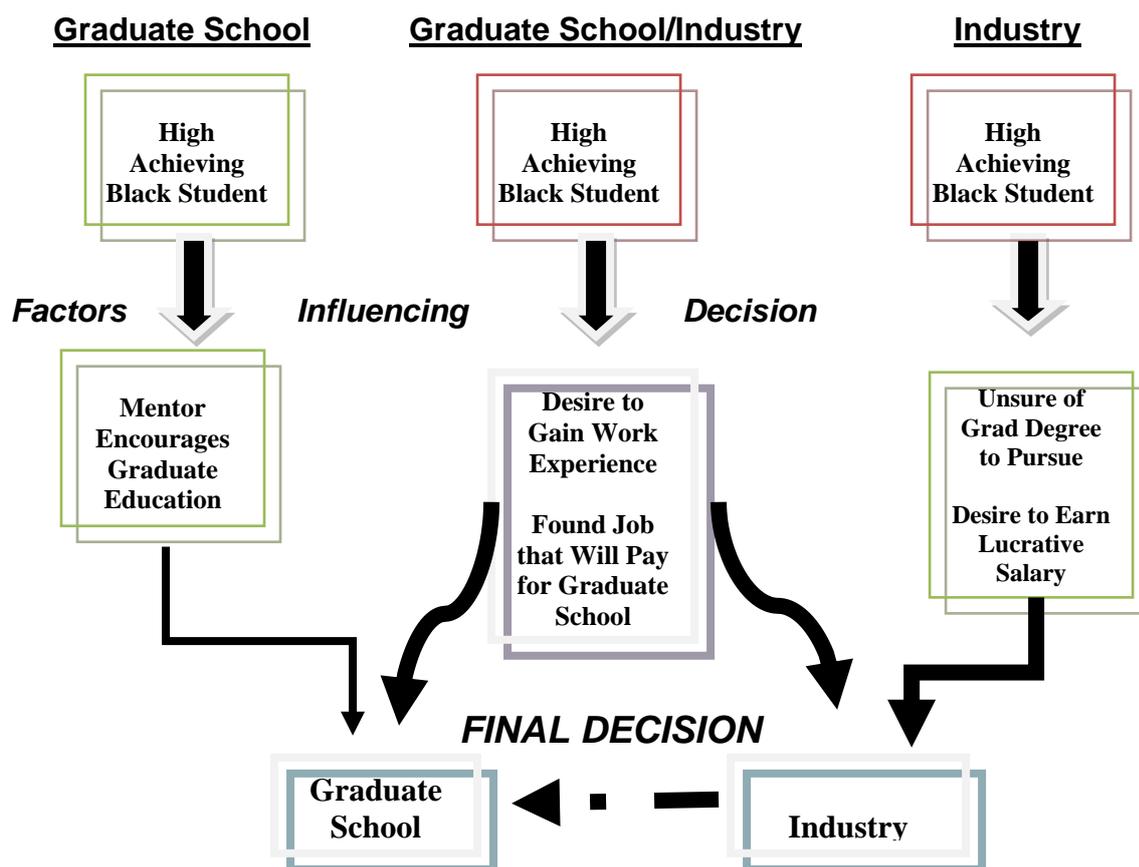
Therefore, the decision to pursue industry immediately was based on the fact that an engineering degree (at the baccalaureate level) serves as the minimum requirement for entering industry. Nonetheless, although some students pursued industry due to their desire to gain more work experience prior to selecting a graduate degree program, others viewed the baccalaureate degree as being sufficient for earning a lucrative salary in engineering.

## **Recommendations for Engineering Education**

This research uncovered many fundamental differences and similarities among these students in terms of the factors that influenced their decision. One of the most significant findings is the impact of faculty mentorship on the student's decision to pursue graduate school. In addition to contributing to the literature with this under researched area and population, this study has attempted to develop a

trajectory for understanding the path taken by high achieving Black engineering students that pursue graduate school and/or industry (see figure 1).

Figure 1 denotes 3 different post baccalaureate decisions: graduate school only, graduate school while simultaneously pursuing industry, and industry only (and then pursue graduate school at a later date). The first path shows the process from undergraduate to graduate school. These students were influenced by mentorship within their department. This mentorship experience was crucial in their decision to pursue graduate school. The second path denotes the student that pursues graduate school while working in industry full-time. These students selected this path due to their desire to gain work experience as well as having an opportunity to have their graduate education financed by their employer. The final path denotes the path taken by students that planned to go directly into industry. These students selected this path because they wanted to gain work experience because they were not sure which graduate degree to pursue; or they expressed a desire to earn a lucrative salary directly after completing their undergraduate degree. The broken arrow for this path denotes the intention to pursue graduate school in the future.



**Figure 1: Path to Graduate School and/or Industry**

Overall, this study is unique because it includes a minority population of high achieving STEM students and it utilizes multiple data collection methods to examine these students over the course of two years—during students’ senior year and their first year post graduation. Further, 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 group (i.e. African Americans 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. This study’s findings have significant educational and scientific importance.

There are significant international implications. This study emphasizes the importance of understanding the variations in the minority experience for different types of institutions of higher education. Research suggests there are differences in the social and academic experience for minorities at majority Black institutions (HBCUs), minorities at majority White institutions, and Whites at minority institutions (i.e. HBCUs and Hispanic Serving Institutions). This phenomenon must continue to be studied.

Findings from this study shall serve to inform academicians in STEM areas about how the various activities (i.e. mentorship, summer research and internship experiences) can influence the pipeline of STEM students 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. The contextual factors influence 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 our students pursue. 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, they are more likely to pursue a career within the industry immediately after graduation. Adopting a developmental democracy model, introduced by John Dewey, would allow for a wider exploration of interests during this very vulnerable stage of their education (Hickman, 1998). Dewey’s pragmatic approach to education promoted learning by doing. Very few educators would disagree with this approach. However, before one can learn through those experiences, there must first be exposure and access to those experiences. The fundamental question becomes, are students choosing their career paths based on an inherent or intrinsic interest or solely from indiscriminate exposure?

## References

- Albert, K.A. & Luzzo, D.A. (1999). The role of perceived barriers in career development: A social cognitive perspective. *Journal of Counseling and Development*, 77, 431-436.
- Bandura, A. (1986). *Social foundations of thoughts and actions: A social cognitive approach*. Englewood Cliffs, NJ: Prentice Hall.
- Betz, N.E. & Vuyten, K.K. (1997). Efficacy and outcome expectations influence career exploration and decision. *Career Development Quarterly*, 46, 179-189.
- Hickman, L., (Ed). Alexander, T. & Dewey, J. (1998). *The Essential Dewey, Volume 1: Pragmatism, Education, Democracy*. Bloomington, IN: Indiana University Press.
- Lent, R. W., Brown, S. D., Schmidt, J., Brenner, B., Lyons, H. & Treistman, D. (2003). Relation of contextual supports and barriers to choice behavior in engineering majors: Test of alternative social cognitive models. *Journal of Counseling Psychology*, 50, 458-465.
- Lent, R. W., Brown, S. D., Brenner, B., Chopra, S. B., Davis, T., Talleyrand, R. & Suthakaran, V. (2001). The role of contextual supports and barriers in the choice of math/science educational options: A test of social cognitive hypotheses. *Journal of Counseling Psychology*, 48, 474-483.
- Lent, R.W., Brown, S.D., & Hackett, G. (1994). Toward a unified social cognitive theory of career/academic interest, choice, and performance. *Journal of Vocational Behavior*, 45, 79-122.
- National Science Foundation Division of Science Resources Statistics (2006). *S&E Degrees, by Race/Ethnicity of Recipients: 1995–2004*. Arlington, VA.
- Ochs, L.A. & Roessler, R.T. (2004). Predictors of career exploration intentions: A social

cognitive theory perspective. *Rehabilitation Counseling Bulletin*, 47(4), 224-233.

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