Engineering Success: The Role of Faculty Relationships With African American Undergraduates

Christopher B. Newman, University of San Diego

Available at: https://works.bepress.com/christopher_b_newman/1/
ENGINEERING SUCCESS: THE ROLE OF FACULTY RELATIONSHIPS WITH AFRICAN AMERICAN UNDERGRADUATES

Christopher B. Newman

University of California, Los Angeles, 3005 Moore Hall, Box 951521, Los Angeles, California 90095, USA  E-mail: christopher.newman@ucla.edu

Previous research has found that faculty–student relationships are a contributing factor to the retention of students at four-year institutions. In this study, the experiences of twelve African American engineers are explored through the lens of Fiske's (Structures of Social Life: The Four Elementary Forms of Human Relations, Free Press, New York, 1991) social-relational models theory. The overall findings of this study suggest that faculty play an important role in encouraging or dissuading the African American engineers in this study to persist in their respective majors. Additionally, the involvement in faculty research laboratories and the referral by faculty to other opportunities and internships relevant to careers in engineering gave participants a much-needed practical application of their coursework. However, faculty can also have an equally paralyzing impact on students' academic and subsequent career goals through a hierarchical authoritarian disposition. The African American engineers in this study cited examples of both faculty members who were inspiring and those who were barriers to participants’ academic and career goals. Three themes emerged in analyzing participants’ relationships with faculty members: lone wolf supportive faculty, low expectations of faculty, and a lack of same-race faculty role models.

KEY WORDS: African American college students, higher education, engineering, STEM, faculty relationships, student success, relational model, anti-deficit

1. INTRODUCTION

The 2007 report Rising Above the Gathering Storm focuses on a number of national and international indicators, suggesting that the United States is falling behind other countries in science, technology, engineering, and mathematics (STEM) academic preparation and subsequent knowledge production. For example, countries around the world are producing a higher percentage of their undergraduate students with natural science and engineering degrees: 67% in Singapore, 50% in China, 47% in France, and 38% in South Korea. On the other hand, institutions of higher education in the US confer only 15% of its students with natural science and engineering degrees. Lastly, this report points out that about one-third of US students intending to major in an engineering field switch majors before graduation.

More specifically, the National Science Foundation (NSF) (2007) reported that 22.8% of African Americans entered college with the intention of majoring in a STEM field, which is slightly higher than their white American (21%) counterparts. Researchers have found a number of African American undergraduates enter college with strong SAT scores, high grade point averages, and previous success in science and mathematics courses, but disproportionate numbers of underrepresented racial minorities (URMs) leave the STEM pipeline (Seymour and Hewitt, 1997). The ramifications of these findings are displayed in the disproportionate employment rates in the engineering field. The NSF’s most recent report on engineering employment reveals African Americans account for only 3.4% of all
careers in engineering. These data are particularly troubling because African Americans make up approximately 12% of the United States population (Humes, Jones, and Ramirez, 2011). In comparison, white Americans account for 77% of engineer positions while making up 57% of the US population; Asian Americans account for just over 12% of the engineering profession while constituting 5% of the US population. These statistics suggest that engineering talent is disproportionately underdeveloped for African Americans and that highly interested students are being lost in the higher education pipeline.

Major employers of individuals with STEM degrees in the US have affirmed the value of a diverse workforce in the drive for innovation. For instance, as Bill Gates, Chairman of Microsoft, stated, “At Microsoft, we recognize that a workforce made up of smart people from different backgrounds and with different perspective is what drives innovation.” Additionally General Electric (GE), the world’s third largest publicly traded company, placed an advertisement, which states:

*The more perspectives we have, the clearer the picture. GE employees are as diverse as our products and services. That’s because we bring together the best imaginations from diverse people. We’re 315,000 minds operating in 100 countries, making over 25,000 products. Without diversity, we just wouldn’t be GE.* (General Electric)

This GE example suggests a sustained effort in developing a more racially diverse pool of engineering talent may help the US compete in an increasingly global economy where different perspectives are vital for success and innovation. Consequently, identifying factors leading to African American student’s successful navigation of the engineering pipeline may increase the retention rates and as a result, fuel a more racially diverse workforce.

This inquiry is part of a larger study exploring the experiences of successful African American engineering undergraduate students’ journey to and through the engineering pipeline. The research I present herein focuses specifically on these African American engineering students’ experiences with university faculty members across three different institutional contexts (i.e., private research, public research, and comprehensive state university).

### 2. LITERATURE REVIEW

A number of studies on the impact colleges have on student outcomes suggest faculty interactions play an important role in undergraduate students’ academic success (e.g., Astin, 1993; Kuh and Hu, 2001; Pascarella and Terenzini, 2005). Some of the outcomes of faculty interaction include increased levels of satisfaction in coursework, cognitive development, and persistence through graduation. However, recent research has started to differentiate students’ experience with part-time versus full-time faculty members (Eagan and Jaeger, 2008). In a study of four universities in the southeastern US, Eagan and Jaeger found that increased exposure to part-time faculty members decreased the likelihood of students persisting to their second year. More specifically, students at doctoral-granting institutions were 20% less likely and students at master’s comprehensive institutions were 37% less likely to continue to their second year “for every percentage point increase in exposure to part-time faulty in gatekeeper courses”. These findings indicate that although it is important for students to be exposed to faculty members, the type of faculty members may make a difference in the impact on student retention.

Although not focusing specifically on students with STEM majors, Cole (2007) and Lundberg and Schreiner (2004) focused on faculty–student interactions. After controlling for background characteristics, Cole (2007) found students who indicated they challenged a professor’s idea in the classroom had increased and positive faculty contact. Also, Cole found that “faculty not taking students’ comments seriously” had a negative impact on faculty–student interactions. Lundberg and Schreiner (2004) disaggregated faculty–student interactions by race and ethnicity and they found “working harder due to instructor’s feedback” was a very strong predictor for African American students’ faculty interaction. In Lundberg and Schreiner’s (2004) study, African Americans had the highest faculty
interaction score but the lowest perception of faculty relationships. These two studies indicate faculty play a key role in engaging students in the learning process, whether it is through encouraging critical thinking or giving constructive feedback to students.

Further differentiation is needed to understand the experiences of African Americans in engineering and other science and mathematics fields. A number of studies have found the role of faculty interaction and pedagogical practices play an important role in the persistence of students of color. More specifically, Seymour and Hewitt (1997) revealed that student perceptions of faculty as “approachable” or “intimidating” and experiences and grading in gatekeeper or “weed-out” courses played an important role in student decisions of nearly 25% of nonpersisters to leave a STEM major. Moreover, there is an inextricable link to the gatekeeper function of introductory courses and the perception of faculty as “intimidating.” Hurtado et al. (2009) found these introductory gatekeeper courses tend to give too much attention to the “acquisition of knowledge” and less on critical thinking skills. Therefore, grading systems may more accurately evaluate a student’s ability to “cram for an exam” than their ability to “think like a scientist” or engineer.

Other studies have found faculty support and encouragement (Cole and Espinoza, 2008) and opportunities to engage in research with faculty members (Espinosa, 2008) provided an increase in GPA and academic self-concept for students of color. These findings show the important association between faculty support and encouragement and measures of academic performance. Carlone and Johnson (2007) developed a theoretical model of science identity that emphasizes the importance of faculty recognition of a student’s abilities as a “science person” and not just a student in a science course. Hurtado et al. (in press) found students received positive outcomes not only when faculty recognized a student’s promise as a future scientist, but also when faculty members expressed interest in a student’s academic and personal well-being. This interest in the “whole person” broke down barriers and softened the perception that faculty were unapproachable.

Additional bodies of literature stress the importance of same-race and gender faculty role models in engineering (Slaughter, 2009; Leggon, 2010). However, African Americans make up only 2% of the engineering faculties at top research universities in the US (Slaughter, 2009). Slaughter and Leggon point out the lack of African American faculty is connected to paltry participation rates of African Americans in STEM doctoral degree programs. Even when racial minorities make it to the professoriate, Allen et al. (2002) found faculty of color typically carry the burden of counseling and mentoring students of color. Although faculty may be motivated to help students of color succeed, “these advisory activities can be very consuming, draining time and energy away from research and writing” (Allen et al., 2002). In addition to mentoring responsibilities, these faculty members often devote substantial time to university service through committees on “issues of color and gender, campus security, race relations, recruiting faculty/students of color, university relations, and community outreach” (Allen et al., 2002). All these nonacademic responsibilities may lead to faculty of color not receiving tenure or promotion, which creates a cycle of underrepresentation. Although African American faculty members may positively influence African American undergraduates to persist in engineering, they may be doing so at the expense of their own career.

Although relationships with faculty are important, students also have to deal with a number of other issues impacting their academic and career strivings. For example, research has indicated that environmental factors, and not solely academic preparation and interest, have an impact on African American students’ persistence in STEM majors. Seymour and Hewitt (1997) controlled for academic preparation by including only study participants who scored at least 650 on the mathematics section of the SAT. In spite of these strong scores, four themes emerged that summarized the challenges students of color had to overcome in their STEM college experiences: differences in cultural values and socialization, internalization of stereotypes, isolation and perceptions of racism, and inadequate program support. These themes highlight the multiple dimensions (institutional, social, and psychological) of the challenges associated with underrepresented racial minorities’ college experiences. It is important to note that faculty members often propagate a number of these negative factors such as stereotypes and socialization. After controlling for precollege preparation using SAT math scores as a proxy, URM
students still are more likely to drop out of STEM programs than their white and Asian American counterparts (Seymour and Hewitt, 1997).

The main limitation of a majority of the previous research is students of color and academic fields of study are reported in the aggregate. In other words, all students of color and all STEM majors are not disaggregated by race or specific majors; thus this body of research lends itself to a monolithic perspective on understanding the experiences of specific racial/ethnic groups within specific academic STEM disciplines (i.e., engineering). There have been relatively few studies focused specifically on the experiences of black undergraduate engineers. Smith (2003) conducted a qualitative study of twenty-four African American men who were juniors and seniors majoring in engineering at a single institution. The participants in Smith’s study described how they adapted and coped in a highly competitive engineering environment. Participants reported overcoming obstacles of being a first-generation college student, financial hardships, and getting to know professors. Lastly, students also indicated that professors, student peers, and society at large, who have doubted their ability to succeed in higher education in general and engineering in particular, motivated them to succeed, which Smith coined “to prove-them-wrong syndrome.” This finding is consistent with that of Carlone and Johnson (2007), who suggest students identify their engineering potential through the perceptions of “meaningful others.” Although students seek to prove faculty members wrong about their abilities, they know they have proven them wrong when faculty members recognize their abilities.

In another study specific to African American engineering majors, Moore (2006) conducted a qualitative study of forty-two students at a university in the southeastern part of the US. This study focuses primarily on the factors that lead students to pursue engineering as an academic major and career. Moore’s findings indicate the factors that positively influence African Americans to pursue the engineering field include encouragement from family, strong aptitude in science and math, meaningful academic experiences, significant relationships with high school teachers and counselors, and engaging enrichment programs, opportunities, and academic experiences. Although Smith (2003) and Moore (2006) focus on a number of salient issues, their research does not clarify the impact of faculty relationships on African American engineering students’ experiences. In this study, I examine a more nuanced perspective from the point of view of highly successful African American engineers and focus on their relationships with university faculty.

3. THEORETICAL FRAMEWORK

To make sense of the current study, I employ Fiske’s (1991) social-relational model to explain the social processes of university faculty and student relationships. Understanding the complexities of faculty and student social relationships will help scholars and practitioners differentiate the type of faculty interaction and the possible impact this may have on student outcomes. Differentiating faculty relationships is just as important as understanding the differential impact the type of faculty has on outcomes (e.g., Eagan and Jaeger, 2008).

Fiske’s relational model describes four universal forms of social relationships: communal sharing, authority ranking, equality matching, and market pricing. I characterize each relational form and describe how it may inform a study of African American engineering students and their relationships with university faculty. First, communal sharing suggests that social relationships are formed around something important in common or a common identity. As Carlone and Johnson (2007) suggest, a student may identify as being part of a domain like the engineering community. Fiske suggests that communal sharing gives way to placing people into categories (e.g., engineering majors and African American students). Individuals who may be categorized as a group may begin to form a common bond around a perceived sense of a shared experience, which may lend itself to further distinguish themselves from other groups (i.e., “othering”).

Next, Fiske’s social-relational model includes authority ranking, which focuses on the hierarchical ordering of social relationships. Prestige, power, and status are typically used to create and main-
tain an authority-ranking relationship. University faculty members are bestowed a high level of status in the US, which may play a role in how faculty situates their authority in relation to the students who are in their courses. A faculty member who develops relationships from an authority-ranking perspective may demonstrate a hierarchical ordering of faculty being above students.

The third form of human relation is equality matching, which is characterized by a relationship where all are “distinct but coequal individuals” (Fiske, 1991). In an equality-matching relationship, Fiske postulates that an individual’s identity is dependant “on staying even” or “keeping up with the reference group.” A faculty and student relationship which embodies an equality-matching frame would be signified by a near-peer relationship. Obviously, a faculty member has control over course grades and assignments, but in equality matching faculty may treat students as an equal member in the quest for knowledge.

Lastly, a market pricing relational model insinuates that people organize social relationships based on some meaningful rate or portion of exchange. Market pricing is typically linked to currency (e.g., hourly wage or price per unit), but it may also include something less concrete like time. For example, a university faculty member may have a number of demands on her or his time, which makes time a commodity. As a result, the faculty member may only be able to spend a minimal amount of time with each student outside of class. Similarly, time is also a commodity for students, especially those from lower socioeconomic backgrounds, because students must balance a number of responsibilities like going to class, studying, working, and taking care of other familial responsibilities. Fiske notes that “individuals interact with others when they decide that it is rational to do so in terms of these values.” This suggests that faculty may decide to spend a minimal amount of time with students outside of class. In all, Fiske’s (1991) relational model informs the psychosocial processes involved in university faculty and engineering student relationships.

4. METHODOLOGICAL APPROACH

4.1 Conceptual Framework

I use the theoretical underpinnings of Bensimon’s (2005) and Harper’s (2007) work on anti-deficit perspectives to inform the overall research design. I first examine the rationale behind the “deficit” frame and then describe the “anti-deficit” framework employed in this study. In examining institutional inequity, Bensimon (2005) presents a clear position on deficit framing. She believes well-meaning scholars employ a “deficit cognitive frame” in their research on underrepresented racial minorities. The deficit framework suggest that the academic and social barriers URM students face are either “self-inflicted or natural outcome[s] of socioeconomic and educational background[s].” Moreover, the deficit frame is oriented toward “stereotypical characteristics associated with the culture of disadvantage and poverty,” and the discourse of this pessimistic approach is focused on the “lack of preparation, motivation, study skills, blaming students and/or their backgrounds.” The typical strategies of those that espouse a deficit perspective promote “compensatory educational programs, remedial courses, special programs,” which are “all focused on fixing the student.” Bensimon argues that research focus should be placed on institutional practices that produce inequitable outcomes for URM students, which include institutional racism and a better awareness of white privilege to name a few.

Conversely, Harper’s (2007) “anti-deficit achievement framework” offers an informative view of how African American men navigate social settings, such as schools and colleges, despite all the barriers to persistence to bachelor’s degree attainment. Harper’s framework focuses on “what they experienced, who was supportive, and which educational interventions added value throughout their time at their institutions.” In short, this framework focuses on what leads African American students to succeed instead of what leads these students to fail. The concepts presented by Bensimon (2005) and Harper (2007) were used as a guide to frame the overall research design of this study of African American Undergrads.
American engineering students. Bensimon (2005) and Harper (2007) informed the parameters of my research inquiry, including selection of research participants and development of the interview protocol. In the sections which follow, I explain in greater detail my research methodology and data analysis techniques.

4.2 Data Source

This study is based on qualitative data collected from twelve African American undergraduate students from three higher education institutions, which I have assigned pseudonyms: three students from Millennium University, which is a large public research institution, six students from Campbell University, which is a large private research institution, and three students from Rayner State University, which is a comprehensive state university. These three institutions are located in the western region of the United States.

Participants were recruited through three mediums: the respective university’s National Society for Black Engineers (NSBE) student organization, through the registrar’s office official directory search for African American engineering majors, and through the respective institution’s minority engineering program office. The general criteria for participation in this study included the following:

1. Identity as African American or black
2. Current enrollment in undergraduate engineering major
3. Academically successful and involved in cocurricular activities

This criterion gave me the ability to purposefully sample students. Maxwell (2005) suggests purposeful sampling gives the researcher the opportunity to include a representative sample, which will provide more confidence in the proposed conclusions. Miles and Huberman (1994) propose that researchers conducting purposeful sampling must first set study boundaries and then create the framework for the “basic processes or constructs that undergird” the study. Although these criteria gave me focus, they were solely used as a guide and not as a means to rigidly exclude suitable participants. Similar to Fries-Britt (1998), Griffin (2006), and Harper (2007), the concept of success is operationalized to include persisting in the major past the introductory gatekeeper courses, serving in cocurricular leadership positions, participating in internships relevant to career goals, and engaging in research outside of required coursework.

4.3 Study Participants

Each participant selected a pseudonym name to protect her or his identity. The twelve students (see Table 1) participating in this study included seven men and five women and they maintained a 3.1 mean grade point average. The participants were diverse with regard to yearly family income, with four students with incomes lower than $40,000, three students with incomes between $40,000 and $59,999, one student between $60,000 and $99,999, and four students with family incomes over $100,000. The participants were declared majors in engineering with four students in mechanical, two in aerospace, two in chemical, two in industrial, and one in civil engineering. Additionally, eleven participants were active members of NSBE.

4.4 Research Design

This research investigation is guided by a phenomenological approach to study how successful African American students experience being undergraduate engineering majors. According to Patton (2002) the underlying assumption of this methodology is that “there is an essence or essences to shared experiences.” Merriam (1998) believes a phenomenologist’s role is to “depict the essence or
basic structure of experience.” A phenomenological account gets inside the experience of a person or group of people by capturing how the phenomenon is perceived, described, judged, and how this person or group makes sense of it (Patton, 2002). In short, this study seeks to better understand the “lived experiences” of the participants in this study—African American undergraduate engineering students at a large public and private research university and a comprehensive state university. Similar to Harper (2007), this study focuses on the sources of participants’ inspiration to pursue the engineering field, what faculty relationships and pedagogy they found most beneficial, and how their experiences shaped their career trajectories.

### 4.5 Data Collection

#### 4.5.1 Biographical Questionnaires

Participants were asked to complete a short demographic and biographical questionnaire prior to the interview or focus group. This brief questionnaire gathered data on a range of relevant background characteristics (e.g., parent’s income, high school attended, and racial demographic of the neighborhood the participant grew up in).

<table>
<thead>
<tr>
<th>Pseudonym name</th>
<th>University</th>
<th>Gender</th>
<th>Racial self-identification</th>
<th>Year in school</th>
<th>Engineering major</th>
<th>GPA*</th>
<th>Parental income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austin</td>
<td>Rayner State</td>
<td>Male</td>
<td>Black</td>
<td>4th</td>
<td>Aerospace</td>
<td>3.0</td>
<td>&gt;180K</td>
</tr>
<tr>
<td>Gavin</td>
<td>Rayner State</td>
<td>Male</td>
<td>African American</td>
<td>4th</td>
<td>Mechanical</td>
<td>3.0</td>
<td>100–149K</td>
</tr>
<tr>
<td>Taylor</td>
<td>Rayner State</td>
<td>Female</td>
<td>White/black</td>
<td>2nd</td>
<td>Civil</td>
<td>3.1</td>
<td>&lt;40K</td>
</tr>
<tr>
<td>Landon</td>
<td>Millennium</td>
<td>Male</td>
<td>African American</td>
<td>5th</td>
<td>Electrical</td>
<td>3.5</td>
<td>40–59K</td>
</tr>
<tr>
<td>Sara</td>
<td>Millennium</td>
<td>Female</td>
<td>Black/African American</td>
<td>4th</td>
<td>Chemical</td>
<td>3.3</td>
<td>&lt;40K</td>
</tr>
<tr>
<td>Sienna</td>
<td>Millennium</td>
<td>Female</td>
<td>African American</td>
<td>4th</td>
<td>Chemical</td>
<td>3.8</td>
<td>&lt;40K</td>
</tr>
<tr>
<td>Alexander</td>
<td>Campbell</td>
<td>Male</td>
<td>African American</td>
<td>3rd</td>
<td>Mechanical</td>
<td>3.3</td>
<td>100–149K</td>
</tr>
<tr>
<td>Benjamin</td>
<td>Campbell</td>
<td>Male</td>
<td>African American</td>
<td>4th</td>
<td>Industrial &amp; systems</td>
<td>3.0</td>
<td>150–180K</td>
</tr>
<tr>
<td>David</td>
<td>Campbell</td>
<td>Male</td>
<td>African American</td>
<td>4th</td>
<td>Mechanical</td>
<td>2.5</td>
<td>&lt;40K</td>
</tr>
<tr>
<td>Gabrielle</td>
<td>Campbell</td>
<td>Female</td>
<td>African American</td>
<td>3rd</td>
<td>Industrial &amp; systems</td>
<td>2.5</td>
<td>40–59K</td>
</tr>
<tr>
<td>Gage</td>
<td>Campbell</td>
<td>Male</td>
<td>Mexican/black/Filipino</td>
<td>3rd</td>
<td>Mechanical</td>
<td>3.2</td>
<td>40–59K</td>
</tr>
<tr>
<td>Leah</td>
<td>Campbell</td>
<td>Female</td>
<td>African American</td>
<td>4th</td>
<td>Aerospace</td>
<td>3.2</td>
<td>60–99K</td>
</tr>
</tbody>
</table>

*A mean GPA of 3.1 with a standard deviation of 0.4.
Individual interviews were the primary methods of inquiry and lasted from sixty to seventy-five minutes. A semistructured interview technique was used that allowed me to respond “to the situation at hand, to the emerging worldview of the respondent, and to new ideas on the topic” (Merriam, 1998). Maxwell (2005) suggests that this technique increases the “internal validity and contextual understanding, and is (are) particularly useful in revealing the processes that lead (led) to specific outcomes.” The interviews were audio-recorded, transcribed verbatim, and checked for accuracy. I contacted the participants and asked her or him to clarify when I had questions about technical terminology or acronyms. For example, one interviewee described in detail her current research on vapor deposition and a series of acronyms associated with chemical synthesis. Following up after the interview was more advantageous because the technical aspects were not the focus of this research but were used to provide better context for each participant’s experiences.

Data Analysis

Several techniques prescribed by Bogdan and Biklen (2007) were used to code and analyze the data collected from interviews. I first bracketed my thoughts and assumptions as I read each line of the participant’s transcripts. The margins of the transcripts were marked with comments regarding initial reactions and summarization(s) of the participant’s main point(s). After bracketing, the transcripts were sorted and key phrases were arranged under codes in the Nvivo 8, which is a qualitative data analysis computer program. This process resulted in the identification of three main coding categories which included, “Perspectives held by subjects,” “Subject’s ways of thinking about people and objects,” and “Strategy codes” (Bogdan and Biklen, 2007). The first two coding types are self-explanatory, but the “strategy code” references the “tactics, methods, techniques, maneuvers, ploys, and other conscious ways” subjects described achieving academic success in their engineering-related coursework and research experiences (Bogdan and Biklen, 2007).

Limitations

This study sought to identify what type of faculty interactions play a role in highly successful African American engineering students’ persistence in the major and career goals. Therefore, this study does not compare unsuccessful African American engineering majors. This study cannot make any conclusions about the experiences of unsuccessful engineers.

FINDINGS

The overall findings of this study suggest that faculty play an important role in encouraging or dissuading the African American engineers in this study to persist in their respective majors. Additionally, the involvement in faculty research laboratories and the referral by faculty to other opportunities and internships relevant to careers in engineering gave participants a much-needed practical application of their coursework. However, faculty can also have an equally paralyzing impact on students’ academic and subsequent career goals through an authority-ranking disposition. The African American engineers in this study cited examples of both faculty members that were inspiring and those that were barriers to the participants’ academic and career goals. Three themes emerged in analyzing participants’ relationships with faculty members: lone wolf supportive faculty, low expectations of faculty, and a lack of same-race faculty role models.

Lone Wolves

There was a common theme at all three institutions where students cited “lone wolf” supportive faculty members. A “lone wolf” faculty member is someone who engages students in the course mate-
rial and encourages and mentors students in their academic and career goals. Lone wolves embody an equality-matching relationship with their students. I coined the phrase “lone wolf” because these faculty members were described by study participants to be the only or one of few faculty members that epitomized the aforementioned characteristics in their respective departments. These faculty were seemingly working against the typical faculty culture at her or his respective institution. Interestingly, a majority of Campbell participants independently cited the same Campbell engineering faculty member as a professor who has had a meaningful impact on their respective academic careers. Leah, a graduating aerospace engineer at Campbell University, believes that this Middle Eastern male professor not only treated people equally, but challenged her and her peers to think critically. Leah stated:

Our professor would come in and you know how people would just believe stuff that teachers say? He would walk in the class and say like, “Didn’t you know this theorem means this” and we would all be like, “Wow! Really!” And he would say, “No!” I took it as a challenge like really being inquisitive and asking questions, and he encouraged us to always ask questions, especially in electricity and magnetism. It is a really difficult concept... so I think the combination of the type of course it was and the way that the professor taught it, he sort of taught us to challenge everything and it just sort of fit with me personally.

The professor that Leah describes does not approach students as empty vessels ready to be filled with knowledge from an authority figure. Instead, this professor encourages students to think critically about the material and challenge themselves to go beyond the surface of the concepts that were presented in his course. Other students like Gage and David conveyed excitement when they independently described the same Campbell professor’s teaching style. Gage believed this professor is very “methodical” and intentional in his teaching and he gave students the tools to enact “process-oriented problem solving.” David stated this professor was “the buzz of the engineering community” because he was known as being a great teacher and mentor. As a result of this professor’s open door policy, a number of participants mentioned taking advantage of office hours during the courses and even after the course was completed. This professor insisted students keep him abreast to all of their accomplishments, and a number of participants remained in contact with him even though they took his course in a previous semester.

Similarly, at Millennium University, students found it difficult to cite more than one “faculty member that had a positive impact on their academic careers.” However, Sara, a fourth-year chemical engineering major, described an Asian female chemical engineering faculty member who shattered the mold of what she has come to expect from faculty at Millennium. Sara stated:

At the end of the exam, she asks us to write suggestions on how she can improve and she actually reads them and she tries to change. We didn’t pick up our exams after the midterm. She emailed all of us and told us to meet her in her office so she could talk to us privately. [She would say], “I really want you to do well.”

Clearly, Sara’s description of this faculty member shows the positive impact of treating students as equals and results in students feeling more engaged in their coursework. Additionally, Landon, who is an electrical engineering major at Millennium, cited a part-time faculty member that offered him a job working in a computer software company because Landon scored the highest in his class on an exam. Landon later decided that he did not want to pursue a career in software development, but the experiences his faculty member provided gave him a tremendous opportunity to apply the theoretical knowledge from his coursework and a chance to explore a possible career path.

The students at Rayner State described a very different academic environment than their Millennium and Campbell counterparts. Rayner is primarily a commuter campus and faculty members are not as involved in research projects. As a result, most of the experiences that these participants’ described tended to focus on career preparation and job placement. However, like the participants at Campbell and Millennium, Rayner participants described being encouraged to pursue engineering majors by faculty members that positively challenged their intellectual capacity. For example, Austin,
a fourth-year aerospace engineer at Rayner State, described his white male aerospace structures professor by stating:

He was a very challenging instructor. His homework and his exams were very time consuming and difficult, but at the same time his lectures were amazing. I would say that this is the most that I have learned at this school. He is difficult and he will pass out the bad grades and things like that, but he still has a certain respect for students who try and he won’t talk down to you or anything like that just as long as he sees that you are putting forth the effort. I just feel like I can have a good professional conversation with him now, and overall I would say just getting through his classes was probably the most rewarding part of my college career so far and probably will be when I graduate.

Though this faculty member was not the same race as Austin, he demonstrated an interest in the academic success of all of his students. Like the lone wolves at Campbell and Millennium, this professor does not emphasize a hierarchical relationship, which gave Austin the opportunity to have one of his most rewarding college academic experiences. Additionally, Gavin, a fourth-year mechanical engineering major at Rayner, found a mentor in an African American male chemistry professor who provided considerable encouragement. Gavin stated:

He is the one that actually recommended that I go to [an East Coast university] and do the national student exchange. I kind of brought it up to him, and he was just like, “That sounds like a good idea you should do that.” And then occasionally I go by and check with him. He writes my letters of recommendation for the most part, and they are actually personal letters of recommendation.

When probed about the motivation of this faculty member, Gavin explained that the professor is supportive of all students and the fact that he was African American was not the sole reason why this professor demonstrated an interest in and provided support for Gavin’s academic strivings, which suggests that this faculty member was interested in the success of all students.

5.2 Low Expectations of Faculty

Although the aforementioned lone wolves played an important role in the developmental processes of the study participants’ academic and career aspirations, they were cited as the exception rather than the norm. A majority of the students described mostly apathetic faculty members who engaged in hierarchical authority-ranking relationships. Gage, a fourth-year mechanical engineering major at Campbell University, describes his experiences with disinterested faculty members by stating:

I definitely had faculty that are like, “I don’t show up on days to give you tests. I’ll just have the TA administer the test.” They have like one hour of office hours per week. Just because they are forced to by the university, but [the faculty member] hopes no one shows up. Doesn’t really reply to emails. Doesn’t put any thought into what they are teaching. Most of the faculty that I have had that problem with are professors with tenure. So you know they don’t give a shit.

The cumulative experience of taking courses with high-status tenure track faculty at Campbell gave Gage the impression that professors did not want to spend their valuable time with undergraduate students. Furthermore, the faculty–student relationship that Gage describes emphasizes a hierarchical structure with students at the lowest position.

Similar to Gage, a number of students from both Campbell and Millennium cited the challenges associated with attending a research university as having a difficult time in developing relationships with faculty members. Alexander, a third-year mechanical engineer at Campbell, best captured this sentiment when he stated:

They are all world renowned busy and that is the thing that you get at a university like this. You are dealing with top people and their time is very important. So, just finding time to talk to a faculty member to really get that relationship, it is hard when you are a
In this example, it is clear that the market pricing of time as a commodity had a negative impact on Alexander’s ability to develop relationships with faculty. Among the successful African American engineering students in this study, the shared and prevalent experience of faculty not having time for undergraduate students caused students to accept this as the norm. For example, Sara stated, “I found very few professors here that actually seem like they care. So, I think it just comes with the territory in being at a large research institution.” Like Sara, a number of students in this study seemed to accept the lack of commitment to teaching at the research universities. However, these students appeared to have a deep desire to have contact with faculty who are more engaged in undergraduate education.

The aforementioned examples were general experiences of faculty relationships, but a number of students cited very specific and negative experiences with faculty members, which contextualizes the experiences of the study participants. For instance, Taylor, a civil engineering major at Rayner State, described how some professors fostered hypercompetitive environments. Taylor cited an instructor who stated, “60% of this class will fail,” and Taylor noted this statement was made on the first day of class. Taylor went on to recount the professor saying, “it is not the teacher’s fault, it is the student’s fault for not putting the time in for their work.” Taylor found this to be in direct contradiction to another faculty member who strives for all of his students to succeed, and this professor described a class of students he had where 100% of the students received a passing grade. Taylor went on to describe how these contradictory expectations differentially impacted her motivation to exert effort in the former example when she felt like her effort did not matter, as compared to the latter example, where she felt that an A or a B was an attainable goal if she worked for it and sought faculty help when she did not understand a concept.

The most poignant story came from Leah, who described her visit with a white female chemistry professor during office hours at Campbell. After receiving a failing grade on an introductory gatekeeper chemistry course midterm, she asked the professor if she should drop the class. In Leah’s words, the professor told her, “There is no hope for you. You should drop this class right now.” As a result, Leah dropped the course immediately. To Leah’s dismay, a white male friend went into the same professor’s office after receiving the same low grade on the midterm and the faculty member told him that he could pull his grade up if he worked hard. Clearly, this faculty member prejudged Leah’s academic ability. This unequal treatment of students demonstrates how faculty members can dissuade students from persisting in a particular field of study. If Leah did not have the internal motivation to retake the course in a subsequent semester, where she received an A, then she may have changed majors because the chemistry course was a required course for almost all of the engineering majors.

5.3 Lack of Same-Race Faculty

Lastly, I found that a majority of the students in this study never took an engineering or STEM course with a same-race faculty member. However, a majority of students did not give a clear indication of how this positively or negatively impacted their academic careers. As cited in the above findings, a number of students had positive relationships with non–African American faculty members. However, I did find a few students like Sienna, a fourth-year chemical engineering major, who desired relationships with same-race faculty and peers. Although Sienna gained a considerable amount of experience working in a Millennium professor’s research lab, she described sometimes feeling racially isolated. Fortunately, as part of a summer research experience Sienna traveled to an elite East Coast university to work in a African American woman professor’s research lab. She compared and contrasted her experiences at Millennium by stating:

I wish I did not have to ask myself why no single engineering professor is black and why it is not diverse... And so, when I went to [the elite East Coast university] and I saw more
people that looked like me, they were cool and they were smart too. I was like, “This is awesome! Are you serious! I could really do this!”

Sienna’s experiences were especially salient for her because, at Millennium, she dealt with her professors and peers constantly asking her, “Where are you from?” The basis of this question came from the fact that these faculty and students had never seen a domestic African American student excel (i.e., overall 3.8 grade point average), as Sienna has, in science, math, and engineering. This constant barrage of racist questions assuming she was an international student from Africa had a cumulatively negative impact on Sienna’s belief that someone like her belonged in this particular field of study. However, at the elite East Coast university, Sienna realized it was normal for a domestic African American student to engage in engineering research and she saw her goal of becoming a tenure track professor at a top research university was attainable. Sienna’s experiences demonstrate how same-race faculty and peers may help successful African American engineers develop a sense of communal sharing as a member of the engineering community, which may help them persist through the major and into a career in engineering.

6. DISCUSSION

The three main findings from this study, “lone wolf” supportive faculty members, low expectations of faculty, and a lack of same-race faculty role models, are intrinsically linked to Fiske’s (1991) relational models theory. The lone wolves who were cited by study participants promoted equality-matching relationships with their students, which were signified by treating students as partners in a search for knowledge. In contrast, the faculty members who were cited in the low-expectations findings presented hierarchical relationships where high-status faculty members exerted her or his higher rank over students. Faculty incorporated a market pricing of time as the catalyst in maintaining these authority-ranking relationships with undergraduate students. The research findings I have presented indicate an overly authority-ranking relationship negatively impacts the highly successful African American students who participated in this study. On the other hand, the equality-matching relationships established by the lone wolves seems to have propelled these successful collegians over the barriers they faced.

These findings are important because it helps to clarify the type of faculty relationships that matter. As I have previously mentioned, a number of studies focus on faculty relationships (e.g., Astin, 1993; Kuh and Hu, 2001; Pascarella and Terenzini, 2005) but do not clearly differentiate the types of faculty interactions leading to the positive outcomes cited. The faculty members who were cited by the African American engineers in this study were intentional in creating an environment where the participants could critically evaluate and ask questions regarding their course content. Instead of erroneously assuming all faculty interactions are positive, this study has led to a better understanding about the differential negative impact of an authoritative faculty–student relationship.

The divergences in faculty member’s approaches to undergraduate instruction convey an important implication for the development of a diverse engineering workforce. Faculty members who teach undergraduate engineering and other STEM gatekeeper courses and are disengaged from teaching courses promote similar feelings among students enrolled in these courses. The disengagement of African American students, at institutions with small numbers of URM students and faculty, is further heightened by their having more difficulty in identifying with the engineering community because of feeling like an outsider. Fiske’s (1991) concept of communal sharing is linked with participants feeling racially isolated and longing for same-race faculty and peers. Although some participants longed for seeing more African American faces leading their engineering and other science courses, it is clear that non–African American faculty could have a similarly positive impact by supporting and
encouraging African American students through the engineering pipeline. African American faculty role models are needed for aspiring African American scientists and engineers to see this career goal as attainable. However, the findings in this research suggest that African American students who are not bombarded with invalidating stereotypes and are supported by faculty members can still excel academically in spite of not having a significant presence of same-race faculty.

7. IMPLICATIONS FOR PRACTICE AND FUTURE RESEARCH

The findings I presented have practical implications for engineering departments. It is clear the lone wolves sustain their respective departments with respect to faculty mentoring and advising. In spite of this, engineering departments should be cautious in resting on their laurels because they have one or two supportive faculty members. Deans of Schools of Engineering should ask themselves:

1. What would happen if these lone wolves left their respective institutions?
2. If lone wolves did depart, would all faculty mentoring and support discontinue in that department and what are the ramifications of this lack of support for African Americans and other URM students?

In considering the second question above, if the culture of the engineering department places little value on undergraduate education then conventional wisdom would suggest, yes, there will be a serious void of faculty support. The consequences of departures like these would have an adverse impact on African American and other URM students who are already pushed to the periphery.

Therefore, both the lone wolf and low-expectation themes suggest that deans, provosts, and academic promotion and tenure bodies need to reconsider how undergraduate science and engineering education is taught and rewarded at the modern research university. If institutions and departments want to seriously undertake the goal of being more supportive of African American and other URM students, they must incorporate the value of undergraduate education into their organizational culture. To this end, provosts and deans need to find ways to recognize the work of faculty who devote time and effort to undergraduate instruction and identify faculty hires who value undergraduate education. Unquestionably, the emphasis on undergraduate instruction will invigorate the aspirations of future scientists and engineers who will help the US meet future demands and challenges.

This study also raises important areas for future research. The three institutions that participants attended were located in the western region of the US, so it would be very important to better understand the role of geographic location in students’ experiences. For example, the African American population in the western region of the US ranges from 4 to 12%, depending on location. Researchers should investigate how the experiences of students in the western region compare to the eastern and southern regions of the US, where the African American population ranges from 30 to 75%. Also, future research should seek to include an even broader range of institutional types, which may include liberal arts colleges and historically black colleges and universities. A better understanding of the role of geographical region and institutional contexts will help scholars, practitioners, and policymakers disentangle the unique contributions of faculty in supporting students’ major persistence and career goals.

8. CONCLUSION

This study has demonstrated the importance of understanding the experiences of these twelve successful African American engineers. The participants in this study provided vivid accounts of how their experiences with faculty members have shaped their educational pathways. Faculty members that provided a more open environment and fostered an almost peerlike relationship with students created a more positive experience for the participants. In contrast, the faculty members who took the opposite approach promoted an almost paralyzing environment, which disengaged a number
of participants from their coursework. Although all of the participants in this study had overall success and demonstrated continued persistence, it is important to understand that faculty relationships are not all the same; simply increasing faculty–student interactions may not necessarily increase major persistence or strengthen career goals. However, the findings indicate that student participants flourished when they were exposed to faculty members interested in undergraduate student success.

REFERENCES


