

The Intersecting Perspective: African American Female Experiences with Faculty Mentoring in
Undergraduate Engineering

Courtney Shaleah Smith

Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in
partial fulfillment of the requirements for the degree of

Doctor of Philosophy
In
Engineering Education

Marie C. Paretti
Stephanie G. Adams
Holly M. Matusovich
Jennifer M. Bondy

July 2, 2015
Blacksburg, Virginia

Keywords: Mentoring, African American Female Students, Engineering, Phenomenography,
Intersectionality, Mentoring

© 2015 by Courtney S. Smith

The Intersecting Perspective: African American Female Experiences with Faculty Mentoring in Undergraduate Engineering

Courtney Shaleah Smith

ABSTRACT

The value of diversity in the Science, Technology, Engineering, and Math (STEM) fields has long been a leading topic of discussion among campus administrators and government officials. However, the number of African American women in STEM, and the engineering field in particular, has seen little growth over the past twenty years. To change this trend, there must be enhanced efforts to provide an environment and resources to support the retention of these women, and mentoring can play a key role. To gain a better understanding of the mentoring needs of these women, this research investigates the mentoring experiences of 16 current senior African American female engineering students.

What is clear is that African American women have a unique set of experiences based on the multiple sets of identity groups that they claim membership in. Intersectionality emphasizes the implications of the multiplication of these identities and how that multiplication impacts experiences. This research, addresses the intersection by exploring faculty mentoring relationships, with particular focus on the implications of having a matched (same race and gender) or an unmatched mentor. Current research is inconsistent on the benefits of each type.

Using phenomenography, this investigation of the various aspects of mentoring relationships that are salient to 16 African American women in engineering uncovered seven categories of mentoring: Guide, Proactive Supporter, Reactive Listener, Nurturer, Just in Time, Caring, and Role Model. Variation across these mentoring categories were reflected in the mentoring aspects that participants perceived. This set of interpersonal (listen, invested, and shared experience) and professional (development, opportunity, advice, and example) aspects depicted a set of mentoring types that varied in comprehensiveness. Additionally, variation in the race and gender of each mentor across each category suggested some trends surrounding the mentor characteristics that most frequently provided certain aspects. However, all of the categories that emerged were perceived to be effective. It is desired that the results of this research will impact the ways in which faculty understand the needs of African American women in engineering.

Acknowledgments

Thank you to the following individuals who without their contributions and support this dissertation would not have been written:

I am forever grateful of my amazing family that has supported me even though I would not stop going to school.

To Nigel, who has stood by me and supported me through the challenges and has continued to push me towards my goal.

An abundance of appreciation to the members of my research group (Dr. Kelly Cross, Cory Hixson, Ben Lutz, Mike Ekoniak, and Dr. Kevin Sevilla) who aided me in revisions, edits, analysis and most importantly moral support.

Members of the S.M.I.L.E group who let me run ideas past them and provided me first round edits (Dr. Walter Lee, Deirdre Hunter).

A special thanks to my mentee Glenda Young for her feedback and allowing me to garner a better understanding of my data in practice.

My committee who believed in my work, reinforced its value and provided me with new perspectives along the way.

All of the mentors who showed me that I could be successful in the ways that were important to me (Dr. Francis Williams, Dr. Pat Mead, and Dr. Carlotta Berry).

And most importantly, those that see me as a mentor, who inspire me to continue to reach as high as I can so that they never believe that their own dreams are impossible.

Table of Contents

Abstract.....	ii
Acknowledgments.....	iii
List of Tables	vii
List of Figures	viii
Abbreviations	ix
1 Introduction.....	1
1.1 <i>Need for the Study</i>	1
1.2 <i>Guiding Framework: Intersectionality</i>	3
1.3 <i>Focus and Purpose</i>	4
1.4 <i>Methodology</i>	5
1.4.1 Phenomenography.....	5
1.4.2 Data Collection and Analysis.....	6
1.5 <i>Contributions of the Study</i>	7
1.6 <i>Limitations</i>	7
1.7 <i>Overview of Dissertation</i>	8
2 Literature Review.....	9
2.1 <i>Underrepresented populations in higher education</i>	9
2.2 <i>The Intersection: Race & Gender</i>	11
2.2.1 Definition and History of Intersectionality	11
2.2.2 Intersection for AAFs in Engineering.....	14
2.3 <i>Mentoring as a Means of Support</i>	15
2.3.1 Benefits of Mentoring	15
2.3.2 Definitions and Functions of Mentoring.....	17
2.4 <i>Variations in Mentoring</i>	20
2.4.1 Formal vs. Informal	20
2.4.2 Matched & Unmatched Mentors.....	21
2.5 <i>Summary</i>	22
3 Methods.....	24
3.1 <i>Phenomenography</i>	24
3.1.1 History of Phenomenography	25
3.1.2 Uses of Phenomenography	26

3.2 Research Design	27
3.2.1 Sample justification	27
3.2.2 Research site	28
3.2.3 Sample size	28
3.3 Data Collection.....	30
3.3.1 Recruitment Strategies	30
3.3.2 Personal Profile Questionnaire	30
3.3.3 Interview	32
3.3.4 Pilot	35
3.4 Data Analysis.....	35
3.5 Reliability and Trustworthiness.....	38
3.6 Researcher's Bias	40
3.7 Summary	41
4 Results.....	43
4.1 Purpose	43
4.2 Outcome Space Overview: Supportive Mentoring Relationships.....	43
4.3 Categories of Description.....	47
4.3.1 Mentor as a Role Model.....	48
4.3.2 Mentor as Caring.....	50
4.3.3 Mentor as Just in Time.....	52
4.3.4 Mentor as Nurturer.....	56
4.3.5 Mentor as a Reactive Listener.....	59
4.3.6 Mentor as a Proactive Supporter.....	61
4.3.7 Mentor as a Guide	65
4.4 Initiation of Relationships.....	70
4.5 Unsupportive Relationships.....	73
4.5.1 Short Lived.....	74
4.5.2 Invested yet Ineffective.....	75
4.5.3 Discouraging	77
4.6 Hope.....	78
4.7 Summary of Research Answers.....	81
4.7.1 Research Question	81
4.7.2 Sub-Question A: Initiation	83
4.7.3 Sub-Question B: Mentor Demographics.....	83

4.8 Summary	85
5 Discussion	86
5.1 Discussion of Mentoring Functions.....	86
5.2 Initiation.....	91
5.3 Discussion of Mentor Characteristics	91
5.3.1 Race.....	94
5.3.2 Gender.....	95
5.3.3 Position in the University.....	97
5.4 Intersectionality	98
5.4.1 Structurally.....	99
5.4.2 Politically	99
5.4.3 Representationally.....	100
5.5 Summary of Results Discussion	102
5.6 Implications	103
5.6.1 Faculty.....	103
5.6.2 Administrators.....	104
5.6.3 Future Mentees.....	104
5.7 Limitations	105
5.8 Future Work.....	105
5.9 Conclusion	106
References	108
Appendix A: Recruitment Email	112
Appendix B: Personal Profile Questionnaire	113
Appendix C: Student Interview Protocol.....	118

List of Tables

Table 1. Mentoring functions (adapted from (Jacobi, 1991))	18
Table 2. Personal Profile Questionnaire	31
Table 3. Interview Protocol & Justification	33
Table 4. Categories of Description	44
Table 5. Definitions of Aspects	46
Table 6. Mentor as Role Model Relationships.....	48
Table 7. Mentor as Caring Relationships.....	51
Table 8. Mentor as Just in Time Relationships.....	53
Table 9. Mentor as Nurturer Relationships.....	56
Table 10. Mentor as a Reactive Listener Relationships.....	59
Table 11. Mentor as a Proactive Supporter Relationships.....	62
Table 12. Mentor as a Guide Relationships	66
Table 13. Initiation of Mentoring Relationships.....	71
Table 14. Unsupportive Categories.....	74
Table 15. Summary of Research Question Answers	84
Table 16. Foundational Mentoring Functions(adapted from (Jacobi, 1991)).....	88
Table 17. Outcome Space v. Previous Functions	90
Table 18 Mentor Demographics	93

List of Figures

Figure 1. Demographics by Race and Gender (Lichtenstein et al., 2014; NSF, 2010; Yoder, 2013a)	2
Figure 2. Some of the Identities of Intersectionality.....	13
Figure 3. Phenomenography Relationships and Focus of Study (adapted from Bowden (2005) and Mann (2007)).....	26
Figure 5. Data analysis process (adapted from Daly, Adams, and Bodner (2012)).....	36
Figure 6. Outcome Space	45
Figure 7. Outcome Space.....	82

Abbreviations

African American Female Student	AAFS
African American Female Faculty	AAFF
Predominately White Institution	PWI
Historically Black College or University	HBCU

1 Introduction

It's so important to be a mentor because there are so many people who are unfortunate to not have a mentor and be able to see people who look like them in the areas that they are trying to get to. When somebody believes that there is no path made for them, they feel like it's a hopeless road, versus having seen somebody who looks like them or who's been through something similar to them. Encourage them and tell them some great advice and be there for them, and really be rooting them on. -*Tiffanii*

These comments come from one of the African American Female Students (AAFSs) in this study as she reflected on what she gained from being mentored as an undergraduate engineering student. She sheds light on the disparity of many minorities who lack the guidance, advice, and even the visibility of someone who looks like them or shares their experience as they travel along an unknown journey. Tiffanii suggest that the hopelessness of this struggle can be overcome through mentoring relationships filled with encouragement, advice, examples, and support. Each of these aspects were salient to the African American female mentees in this study. Although the participants of this study are on the verge of success in their journeys to completing an undergraduate engineering degree, the numbers say that many are not. In order to understand why, this dissertation asks where these women can find the support that they need.

1.1 Need for the Study

Currently, more-so than other post-secondary degree fields, engineering is dominated by both Whites and males at 70% and 82.1% of the field's population, respectively, (Lichtenstein, Chen, Smith, & Maldonado, 2014). African American women represent 7% of the college student population, but their representation in engineering continues to decline at each level of academia. Only 0.9% of the 93,423 undergraduate engineering degrees, only 0.64% of the 10,764 engineering PhDs (NSF, 2013; Yoder, 2013a) and less than 0.5% of the 25,000 tenure-track faculty positions in engineering in the U.S. (Yoder, 2013b) are awarded to African American women, as shown in Figure 1. These statistics illustrate not only the lack of persistence of African American females

along the path to doctoral degrees and faculty positions, but the devastatingly low representation of a valuable source of experience and knowledge.

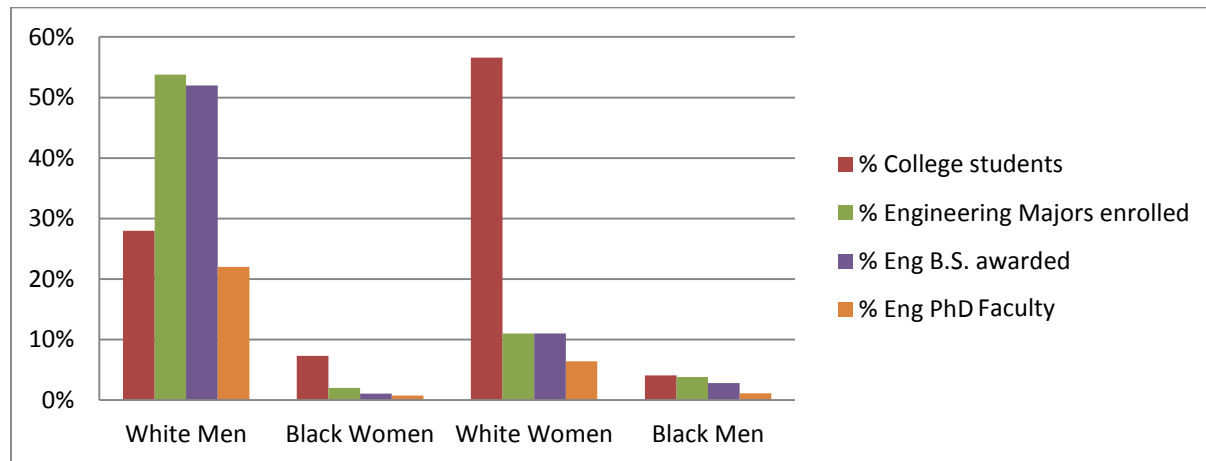


Figure 1. Demographics by Race and Gender (Lichtenstein et al., 2014; NSF, 2010; Yoder, 2013a)

As numerous reports argue that minority populations will continue to grow over the next few decades, they also acknowledge that minority women are an untapped population in sustaining the economic vitality of America (Ong et al., 2011; US Census, 2008). As a result, we must find a way to increase the number of African American women in fields affecting this vitality. Engineering is one such field. The inclusion of underrepresented gender and racial minorities in engineering has the potential to expand the range of intellectual perspectives in the field by increasing cultural diversity beyond the current largely White male perspective (1% African American females, 53% White males) (NSF, 2013). As Ong, Wright, Espinosa, and Orfield (2011) point out, “minority women’s unique backgrounds, cultural traditions, perspectives, and experiences could bring dramatically new approaches to scientific discovery and innovation and could be leveraged to help solve the complex technological problems of our time” (p. 176). The inclusion of women of color in engineering can enhance the field and help address the needs of other underrepresented populations who are often unaccounted for in engineering. Although the number of African American women who are enrolling in undergraduate engineering programs in the U.S. has increased over the past few decades, the retention of these women is not as encouraging (C. C. d. Cohen & Deterding, 2009). Increasing this retention rate will increase the number of both future engineers and future engineering faculty. Moreover, increasing the number of African American women persisting in engineering at the undergraduate level increases the

chances that they will continue on to graduate education and academic careers, where they can in turn provide support to future generations as well as contribute their insight and diversity to the field of engineering.

1.2 Guiding Framework: Intersectionality

Although there are numerous proposed interventions to improve retention and persistence across a range of diverse populations, it is dangerous to assume what is suggested for general use will be beneficial for individual underrepresented populations (Tsui, 2007). Moreover, most studies on engineering students, including studies on retention, fail to disaggregate results by both race and gender, making the experience of African American women in particular invisible. Most often, studies within engineering education have investigated “women of color,” which can include African American, Hispanic, and Native American, and in some cases Asian (Ong et al., 2011; Shain, 2002). Each of these racial groups are underrepresented within the U.S., but represent different cultures, needs, and experiences. As a result, this study explores the unique experiences of African American women to develop a more nuanced understanding of how to enhance their retention.

This specific identity lies at the intersection of both race and gender. The simple addition of the two categories, women and African American, does not, however, effectively capture the unique experiences of this group. Instead, intersectionality (Crenshaw, 1989), which specifically focuses on intersecting identities, guides this research in its attention to the ways gender and race play roles in these women’s experiences. This framework emphasizes the structural, representational, and political ways in which the intersecting identities of the African American woman occur within different domains.

Because intersectionality treats identities as socially constructed, throughout this dissertation I refer to “gender”, rather than “sex” to emphasize this social construction. Within the study itself, participants were asked to identify their gender as well as the gender of their faculty mentor. Because the identification of the faculty is from the perspective of the participant “gender” is used to indicate the gender expression perceived by the participant. The term “gender” is therefore also used throughout this dissertation to express the perceived identity of the faculty mentor and the stated identity of the mentee.

1.3 Focus and Purpose

As noted above, because few studies disaggregate findings by race and gender in engineering education, there is little research on how and why African American Female Students persist in or leave engineering. Known challenges come from a number of factors including stereotype threat, discrimination, and lack of mentors and role models (Cohen & Steele, 2002; Steele, 1997). Lack of mentors, in particular, plays an important role for minority students. Tokenism, being “othered,” or being one of a few can be a heavy burden to carry in the already challenging field of engineering. Facing these social stigmas without the psychosocial support or guidance of someone who has overcome or understands these obstacles can make this environment a fearful one for African American female students (AAFSs). Faculty mentors, can play a beneficial role in providing resources and being sources of support when students face these types of challenges (Cole & Griffin, 2013). Moreover, literature shows that providing students with positive interactions with faculty mentors has a significant impact on engineering students’ decision to pursue graduate school as well as their success in doctoral programs. (Lichtenstein et al., 2014).

Some research on mentoring suggests that women and minority engineering students find it particularly beneficial to engage in relationships with mentors of similar backgrounds to whom they can better relate (Amenkhienan & Kogan, 2004; Lichtenstein et al., 2014). Known as matched mentors, these same race and gender mentors are in limited supply in engineering programs. Thus AAFSs who may have a desire to pursue a career in engineering have a hard time saying that they have seen someone who “looks like me” who can serve as a mentor. As a result, many AAFSs who have succeeded do so without the mentorship of a matched faculty member, and instead have sought support and guidance from unmatched faculty members. Given the low number of available matched mentors, a better understanding of the aspects of both kinds of relationships that AAFSs find salient can provide insights to all mentors regarding some of the needs and desires of this population. Such understanding can potentially increase the effectiveness of matched mentors and reassure unmatched faculty that they, too, can be resources for support to AAFS. Doing so can in turn increase the number of mentors available to these students and increase their retention and persistence.

As a result, with this phenomenographic study I seek to understand the varying faculty mentoring experiences of 16 senior African American undergraduate women in engineering at a

Predominantly White Institution. By looking at the 27 faculty mentoring relationships of these AAFSs who have persisted in engineering, we can gain some insight into what these students found most meaningful in both matched and unmatched mentoring relationships. Although the ability to provide a more balanced demographic of faculty would seem the best solution, the reality is that these women need mentors *now* and there are a number of people who are capable and are currently serving as mentors and role models to them. My goal is to gain a better understanding of the types of faculty mentors that effectively support these women in matched and un-matched mentoring relationships. In turn I want to share this information with both students and faculty to broaden their understanding of what and how a mentor can provide support for African American female students in engineering.

To achieve these goals, this study identified the qualitatively different ways that African American undergraduate women in engineering experience faculty mentoring. In doing so, I answered the following research question:

RQ: What qualitatively different aspects of faculty mentoring relationships support African American female undergraduate students in engineering?

This question has two related sub-questions that support a clear understanding of these relationships.

SQ a. How do African-American female engineering students initiate relationships with faculty mentors?

SQ b. How do the racial and gender demographics of the mentor effect the mentoring relationships?

Together these questions seek to understand what aspects of mentoring relationships are most valuable to AAFSs in engineering, and how they are effectively carried out by faculty mentors. It is my aim to give faculty the tools to more effectively mentor this population.

1.4 Methodology

1.4.1 Phenomenography

As noted above, this study employs a phenomenographic approach. Ornek (2008) describes the focus of phenomenography as “how people experience a given phenomenon, not [a] study [of]

a given phenomenon” (p.2). The researcher is not searching for a single definition of a phenomenon, but is instead seeking to discover how people perceive and come to understand the phenomenon. The use of this methodology allows the researcher to identify the varied conceptions that a particular group has about the same phenomena (Marton, 1986). In this work, phenomenography allows me to explore the faculty mentoring relationships (the phenomenon) from the perspective of undergraduate African American women in engineering. As a result, although it focuses on a specific population, this study explores the variation within this group rather than searching for a singular experience.

Phenomenography is important to this study because of its emphasis on variations. Key to this study is recognizing that as AAFSSs, these women will be sharing experiences based on the intersection of their shared racial and gender identities as well as their varying individual experiences. As intersectionality works to emphasize that this population is unique, it also emphasizes that it is not monolithic. With this variation in mind, I am not seeking to essentialize the experiences of all African American females in engineering, but rather to understand the different raced-gendered mentoring experiences these women have with faculty members within undergraduate engineering programs. Phenomenography provides an ideal approach to achieve this goal.

1.4.2 Data Collection and Analysis

Employing phenomenography, I interviewed 16 AAFS participants from an engineering program at a Predominately White Institution (PWI) to participate in this research. Participants were solicited through a faculty gatekeeper as well as through snowball sampling (Creswell, 2009) within their institution. First, participants completed a questionnaire to gather information about their background and their mentoring relationship. Following the practices of phenomenographic research (Akerlind, 2005; Marton, 1986), I then conducted a single semi-structured interview, lasting an average of 60 minutes, with each participant.

Interviews were transcribed for analysis according to phenomenographic approach (Akerlind, 2005). Through an iterative process of separating transcripts based on varied experiences, categories of variation in mentoring relationships were developed. Further analysis provided descriptions of the degrees of variation between each category, and evidence from the transcripts was used to support these findings.

To ensure reliability, descriptions of the categories were provided to another researcher, who then sorted the transcripts into the preliminary categories, any discrepancies between coders were negotiated for consensus. Finally, an explanation of the categories and a discussion of the results were developed.

1.5 Contributions of the Study

Most studies of underrepresented populations in engineering use either gender or race as an analytic category. This dichotomy leaves significant gaps in understanding how race and gender intersect for AAFS in engineering. This intersection of identities can result in highly varied experiences, especially in the “pale and male” field of engineering. By disaggregating African American females in engineering from other populations, this study provides a new layer of insight into the experiences of these students within a traditionally White male dominated field. Specifically it shows a perception of more comprehensive mentoring received from mentors of the same race or gender, but effective and useful mentoring occurring across all boundaries. Going beyond previous investigations, this work shows not only ‘what’ specific functions (i.e. advice, opportunities, development) mentees perceive their mentors can provide, but also ‘how’ interpersonal actions can serve as a basis for these functions to be provided. Although we have known about a number of mentoring functions for decades, this work provides some insight on how those functions filter into levels of mentoring that are perceivably enacted by mentors with specific demographics of race, gender, and role within a university.

Understanding the experiences of AAFSs yields insights into how to improve the experience of these women and allows institutions to find ways to better meet their mentoring needs. As the focus of this work is student-faculty relations through mentoring, this work provides faculty members at varying levels with ways to approach mentoring relationships with African American female students and potentially other diverse groups within the field in order to aid diverse student persistence.

1.6 Limitations

As this is a qualitative and not quantitative study, there are a number of factors that cannot be controlled, and thus were not included in this work. First, data was only collected from one institution, therefore limiting this perspective to this study site. Second, although Latina and Native

American women are also greatly underrepresented in engineering, this study focused solely on African American women in engineering. However, with the aid of background information on the participants, a diverse set of participants were selected, and therefore diverse perspectives were included in the data sample. Third this study only collected the perspective of the mentee. Perspectives on the relationships were not collected from the mentors or observed by the researcher. Inclusion of the characteristics (race, gender, and role in the university) gives some understanding of who the mentors are. Fourth only students who had persisted in their academic programs (seniors) were selected to participate in the study. These participants were both 4th and 5th year students, again giving some diversity in the amount of time they had spent at the institution and potentially the depth of their relationships with faculty.

1.7 Overview of Dissertation

The next chapter will delve deeper into why this population was selected for investigation and the uniqueness of their perspective. Chapter 2 also provides a review of the current understanding of mentoring and the AAFS experience in higher education. The literature discussed serves as the basis for this study. Chapter 3 describes the development and design of the study, as well as how data was collected and analyzed. Chapter 4 discusses the resulting mentoring categories and their distinct attributes as they relate to the research questions. Chapter 5 situates this study's findings relative to existing literature and identifies implications for faculty, administrators, and students, as well as provides a concluding perspective from the researcher.

2 Literature Review

This study explores the variety of ways in which African American women in engineering experience mentoring relationships with faculty. The literature that informed the scope of this study and supports my overall argument is discussed in this chapter. Literature on the barriers experienced by underrepresented populations in higher education indicates the need for continued research. Gaps within the literature around African American Female Students (AAFSs) in engineering further illustrate the need for this particular study. To provide a framework for the study, the review also describes prior research on perceptions and definitions of mentoring in general, as well as current understandings of how mentoring impacts the persistence of AAFSs in engineering.

Within the literature, researchers studying this population use a range of terms, including “women of color,” “Black,” and “African American”. In this chapter, I use the terms used by the study under discussion, and use African American as a general term. In most cases the literature does not disaggregate the experiences of African American women, but includes them in studies as women or people of color.

2.1 Underrepresented populations in higher education

The social barriers that minority populations face in higher education, and more specifically engineering, affect their success and completion rates at all levels. In the review of the literature in this area, Lichtenstein et al. (2014) identify barriers that include “ unsupportive institutional practices and negative classroom environments..., [which lead to] experiences of isolation, self-doubt, and questioning about continuing in engineering programs ” (p.321). Through a variety of negative interpersonal interactions, underrepresented students begin to have a decreased sense of belonging in the engineering environment and often fail to persist in the field.

At the institutional level, the campus environment plays a role in the experiences of underrepresented students (Hurtado, 1992). The “campus racial climate is defined as the attitudes, perceptions, and expectations within an institutional community around issues of race, ethnicity, and diversity” (Cole & Griffin, 2013, p. 597). Exposure to ‘cold climates’ in academic environments can be a challenge for all students, but particularly for women of color. The investigation of the classroom climate for women in higher education by Hall and Sandler (1982),

for example, describes negative occurrences identified by minorities and women that include being ignored or interrupted, a lack of assistance, and perceptions of incompetence or of luck when members of these groups are successful academically. The effects of these ‘cold climates’ often discourage participation, impede career aspirations, discourage help seeking outside of class, taking certain courses, and damage the confidence of students (Hall & Sandler, 1982). Most often these negative environments are facilitated by faculty and staff members. Lichtenstein et al. (2014) identify faculty actions, “including negative interpersonal relations, subtle and overt denigration of skills, attribution of attainment to affirmative action policies, avoidance of eye contact, favoritism towards male and majority students,”(p.321) as practices that negatively add to the racial climate.

At the classroom level, feelings of isolation develop for underrepresented students because they are in a field where, in most cases, almost no one looks like them. African American students make up 8% of the engineering student population overall, and only 4% at most PWIs. Often this lack of representation in the field carries into how minority students internalize their experiences, mostly based upon their perceptions of their abilities to succeed. Ong (2005) found that students of

nontraditional gender, racial/ethnic, and class categories must contend with common effects of low representation, including isolation, doubts associated with tokenism, tenuously balanced social identities, and disproportionate skepticism from others-and themselves-about their qualifications and abilities to succeed in a predominately male and/or White fields (p. 597)

These feelings of isolation and doubt are often resolved by assimilation. In essence, minorities must find a way to appear to belong in “a culture of no culture” (Ong, 2005, p. 598) with standards that were not designed for them, often causing them to feel the need to work harder than others to feel equivalent and to disprove the negative stereotypes often associated with their race or gender (Paretti & Smith, 2013).

Another classroom challenge that some African American students may not be accustomed to is tokenism, in which students find themselves treated as the representative for their race. Being

asked to respond for an entire group or serving as the visual representative for diversity can be a burden for underrepresented students that majority students do not have to contend with.

Finally, larger cultural issues can also inhibit the success of underrepresented students. A common issue among African American's in engineering is the fear of stereotypes, Cohen and Steele (2002) argue, for example that minority students and women in the sciences mistrust faculty and peers because they fear their efforts and abilities are being stereotyped. This perception that one will be "judged negatively due to a commonly held devaluing stereotype that exists about one's group" is known as stereotype threat (Bell, Spencer, Iserman, & Logel, 2003, p. 307). For example, a common stereotype is that women are less capable than men in their ability to "do engineering" (Bell et al., 2003), and as a result, to seek refuge from the threats and tensions associated with the stereotype, women often leave engineering fields (Ong, 2005). As Cohen and Steele (2002) explain, "stigmatization [i.e. from stereotypes] impedes trust, which in turn undermines motivation" (p.8). That is, minority students' perceptions or anticipations of stereotyping by faculty and peers are enough to deter these students from persisting.

In essence, barriers at varying levels can have a significant impact on the success and persistence of underrepresented populations in higher education. These barriers threaten and challenge students' own perceptions of themselves and the skills that they have.

2.2 The Intersection: Race & Gender

As the previous section indicates, there are a number of factors that can have a negative impact on the persistence of underrepresented students in higher education broadly and engineering specifically. It is also important to understand that African American women experience these barriers in a unique way. The dualistic perspective of most research solely focuses on either race *or* gender, but African American women are not *solely* women or *solely* African American. Rather they stand at the intersection of both of these identities and thus are often invisible in these studies. Intersectionality, in contrast, emphasizes the value of the experiences of this group as both women *and* African American.

2.2.1 Definition and History of Intersectionality

Within intersectionality, identity is defined as the socially constructed groups that an individual takes membership in (Shields, 2008). This membership includes ownership by the

individual of the meanings associated with the group (i.e. stereotypes, and social norms). These groups often derive their meanings from historical contexts. The construction of people of color as minorities, for example, has been passed down through generations within the U.S. and has shaped African American experiences, particularly through historical moments such as slavery, segregation, and the civil rights movement. The historical context impacts how these identities have been defined over time as both lesser and marginalized (Shields, 2008). Although the demographics of the U.S. have drastically changed, people of color, who still hold a statistical minority, still maintain a marginalized status.

Central to intersectionality, is the concept that these socially constructed identities have multiple dimensions, which can include race, gender, social class, culture, and sexual orientation (Weber, 1998). As individuals who have salient identities in both the African American and Woman social groups, African-American women experience the world through a unique intersection. Early research into the intersection of these multiple identities was done to separate African American women's experiences in response to feminism in the early 1970s. Much of the work in women's studies during the 1970s and 80s focused on the experiences of White, middle-class, educated women. Often Black women were considered lesser, and the experiences of White women were allowed to speak for all women as reflective of true womanhood (Crenshaw, 1989). Pushed by feminist scholars of color, intersectionality came to the forefront as a way to include the intersection of gender with other social identities, particularly race (Shields, 2008).

Research by Crenshaw (1991) identified three ways that race and gender intersect for Black women: structurally, representationally and politically. Structurally, the dual positions of *woman* and *Black* are both at marginalized positions within U.S. society. Often this double marginalization is realized through a lack of resources based on their legal status or social needs (Shields, 2008). For example, Crenshaw (1991) demonstrates the effects of structural intersectionality through better access to rape counselors for women of economic and racial privilege over African American women who have been sexually assaulted. Representationally, Black women have been portrayed culturally as Mammy's (obedient and nurturing; the public face that Whites assume Black women to portray), as Matriarchs (overly aggressive and masculine; spend too much time away from home and family working), and as Welfare mothers (lazy, poor and in need of a male for support; taking the hard-earned money of tax payers) (Collins, 2000b). These cultural definitions of the Black woman become stereotypes that define expected behavior, but do not

represent the reality of Black women's lives. Finally, Shields (2008) defines the political aspects of intersectionality as highlighting "the different and possibly conflicting needs and goals of the respective groups from which an individual draws her or his identity"(p.304). In other words, Black women often find themselves caught between politics that support women and those that support people of color; often political agendas surrounding racism or feminism, simply through their discourses, exclude the African American woman, devaluing her multiple identities.

In time, the uses and definition of intersectionality evolved and became more inclusive of other factors outside its initial focus on African American women. Intersectionality became a way to emphasize the qualitative differences between identities that intersect –including race, gender, class, culture, and sexuality – to shed light on how the multiplication of these features create and define social identities (Shields, 2008). Essentially, this evolution of intersectionality has developed into an approach to highlight the ways in which individuals identify themselves in a number of different groups (Figure 2), while understanding the differences and similarities among those groups that influence their experiences.

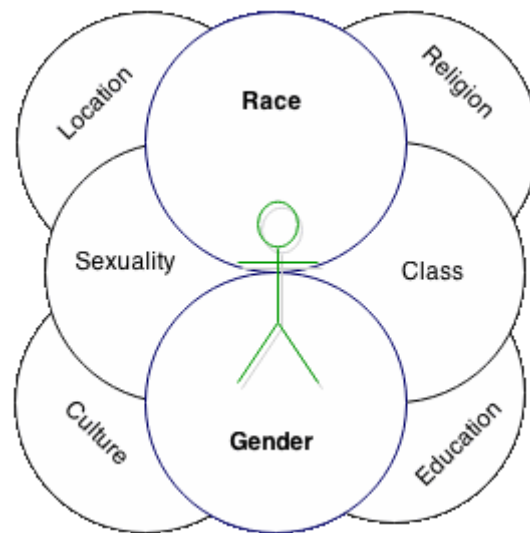


Figure 2. Some of the Identities of Intersectionality

Intersectionality's explanatory power is not only to shed light on the experiences of women of color, but also to bring awareness to the multiplicity of their identities in order to realize that women do not all share the same experiences, nor do all African Americans, or all African American Women.

2.2.2 Intersection for AAFs in Engineering

In academia, the intersection of these multiple identities can impact how students succeed and persist within the university environment. According to Crenshaw (2005), the experience one has varies by domain or context. Unfortunately, because the literature rarely distinguishes the experiences of African American women in engineering from other women or from African American males, there is little knowledge about their experiences. Although many of the barriers found to impact other underrepresented populations are also relevant to this population, intersectionality emphasizes that the intersection of the multiple identities of AAFs is indeed unique (Crenshaw, 1989). It is important to recognize that African American women in engineering, who represent two different social identities, have different experiences than other members of society generally and others within engineering specifically. There have been a number of studies that reflect the faculty mentoring experiences of African American women at the graduate level (Patton, 2009; Patton & Harper, 2003; Williams, Brewley, Reed, White, & Davis-Haley, 2005) or faculty level (Stanley & Lincoln, 2005), and a small subset that focus on those women within STEM (Ceglie, 2011). However these studies represent a vastly different type of relationship (often more formal) and reflect a different level of experience for students who have already succeeded in academia to some level. In order to recognize this distinction in this research, intersectionality provides a theoretical lens to understand the experiences of this group of women not solely based on their race *or* gender, but rather in terms of the unique experience created by multiplication of these two identities.

In the context of this research, these same intersections of race and gender, through structural, representational, and political factors, still come into play (Crenshaw, 1991). Structurally, AAFs within an engineering department remain a dual minority. They have maintained a low population, and often serve as token members (the only representative) of their racial and gender group (NSF, 2010). Majority representation of engineers as a White male also puts these women at odds with the norms of their environment, which they may interpret as identity conflict or not having a place within engineering. Media and popular culture most often reflect the engineer as a White male, such as seen in *MacGyver* (1985-1992), *A Beautiful Mind* (2001), *Fantastic 4* (2005) and *The Big Bang Theory* (2007- Present). This “pale and male” representation of engineering creates an environment in which African American females rarely see themselves either within society or within their institutions. Collins (2000b) makes the point that historically,

Black women have had to create an independent standpoint about what it means to be a Black woman in such a marginalized environment; this creation would seem even more of a challenge without other faculty or peers to identify with. Politically, an African American female may find herself negotiating ways to support the goals of both women in engineering and African Americans in engineering, as these may both be salient identities that create identity conflict. These types of negotiations may become apparent in decisions about what types of organizations to seek membership in, such as the National Society of Black Engineers vs. the Society of Women Engineers. Membership in only one of these organizations may not actively support their full identities, but the strenuous time demands of engineering students would make it difficult for these women to be actively involved in both of these groups.

2.3 Mentoring as a Means of Support

One of the ways AAFs can learn to navigate these challenges is through mentors. There have been a number of methods that have been suggested and employed to aid in the retention and persistence of minority students, including summer bridge programs, research experience, tutoring, financial support, and mentoring. The literature identifies mentoring as a particularly prominent tool that has been successful in the retention and diversification of engineering (Tsui, 2007) .

2.3.1 Benefits of Mentoring

Most of the mentoring literature reflects the benefits in business and industry contexts (K. E. Kram, 1983, 1988); however there are also significant benefits within academia (Jacobi, 1991; Tsui, 2007). Specifically, particularly relevant to this project, in particular, studies have discovered a wide range of positive effects among undergraduate minority students who have been mentored (Cole & Griffin, 2013; Crisp & Cruz, 2009). Students with mentors are able to benefit from their mentor's "knowledge and expertise and have help in adapting to the political environment within the industry, university, or academic setting" (Austria & Austria, 2010, p. 133). Academic success such as increased GPA is one of the most often studied benefits of mentoring (Crisp & Cruz, 2009). Other benefits have included increased self-efficacy, integration into the community, retention, career goals, academic and social development, and intention to persist (Jacobi, 1991; Tsui, 2007).

There have been a number of interventions that have been suggested and employed to aid in the retention and persistence of minority students, including summer bridge programs, research experience, tutoring, financial support, and mentoring (Tsui, 2007). The literature identifies mentoring as a particularly prominent tool that has been successful in the retention and diversification of engineering (Tsui, 2007). Mentoring for undergraduates has been shown to support students' integration into college life and their progression into graduate studies and employment. As Ginorio and Grignon (2000) note, "each student needs at least one person to serve as a mentor, someone who has faith in them and will provide necessary information or support at key junctures involving choice" (p.167). This support and knowledge serves as a useful tool to counteract many of the barriers described earlier that impact the persistence of underrepresented populations in higher education.

Some studies suggest that such mentoring is particularly helpful when faculty share the student's race and gender. In their review of the literature, Cole and Griffin (2013) explain that "students of color seek out minority faculty for support when navigating the challenging environments at Predominantly White Institutions (PWIs)" (p. 597). However, the number of minority faculty available is insufficient to provide all of the support required for multiple underrepresented students in engineering. Therefore it is important that *all* faculty, administrators, and students be aware of the complexities of being a student of multiple marginalizations in a multi-privileged environment. For faculty and administrators, understanding the needs and desires of these students will benefit not only the student, but the department and field by increasing persistence and advancing levels of diversity.

However, currently neither the mentoring needs of AAFSs nor the mechanisms by which mentoring relationship counteract these negative factors and increase persistence are well understood. To address this gap, this research focuses on how mentoring has played a role in navigating the intersections of race and gender for AAFSs. Additionally, an investigation of African American students who have mentoring relationships with both matched (same race and gender) and unmatched (different race and/or gender) mentors will provide insight into how mentors of varying race and gender can have effective relationships with African American female students in a way that encourages them to persist.

2.3.2 Definitions and Functions of Mentoring

The term mentor was first used in Greek mythology to represent the wise old man, Mentor, who guided Telemachus (Austria & Austria M., 2010). This male-to-male relationship has been the basis for the mentoring experience. Today, often this relationship is found in the business realm and is used as a way of grooming and developing junior employees (Jacobi, 1991; Schunk & Mullen, 2013). Over the past few decades research into the functions of mentoring has transitioned from the workplace into academia (Jacobi, 1991; Pembrige, 2011). In this section, I review generally the agreed upon components of mentoring relationships.

Throughout the literature the use of both *mentee* and *protégé* are employed to describe the younger member of the mentoring relationship and therefore both will be utilized in this review.

A commonly used definition of mentoring within higher education comes from Blackwell (1989):

"Mentoring ... is a process by which persons of superior rank, special achievements, and prestige instruct, counsel, guide, and facilitate the intellectual and/or career development of persons identified as protégées"(p.9).

Unfortunately, what is limited in this definition are the ways in which mentoring is enacted. There are no single agreed-upon guidelines as to the initiation, development, and maintenance of an effective mentoring relationship. According to reviews of the literature on mentoring by Jacobi (1991) and Crisp and Cruz (2009), no theoretically valid model of mentoring has been established to date. What has been developed over the years are a number of functions that have been identified as aspects of mentoring. In her review of the literature, Jacobi (1991) identifies 15 functions that she describes as being 1) general without respect to any specific population or setting 2) based on an original definition developed from data and 3) having detailed descriptions.

Table 1 summarizes these functions and highlights their varied use in multiple representative studies over time.

Table 1. Mentoring functions (adapted from (Jacobi, 1991))

Functions	(Levinson, 1978)	(K. Kram, 1985)	(Blackwell, 1989)	(Pembridge, 2011)
Acceptance/ support/ encouragement	X	X	X	X
Advice/guidance	X	X	X	X
Challenge/ opportunity/”plum assignments”		X		X
Clarify values/ clarify goals			X	
Coaching		X		X
Information			X	
Protection		X	X	X
Role model	X	X	X	X
Social status/ reflected credit				
Socialization/ “host and guide”	X		X	
Sponsorship/advoc acy	X	X	X	X
Stimulate acquisition of knowledge			X	
Training/ instruction	X		X	
Visibility/exposure		X		X

The studies in Table 1 were selected because of their foundational contributions to mentoring literature. Levinson’s (1978) work in psychology recognized early on mentoring’s role in adult development and its varying definitions based on the functions that are provided through the relationship. Kram (1985) provided the first model that was able to distinctively describe the major functions of mentoring, specifically within industry/management, and separate them into two broad categories of career and psychosocial components. Blackwell (1989) identified eight

mentoring functions among minority student populations and, confirmed many of Kram's findings within higher education generally. Pembridge's (2011) study applied Kram's model to capstone engineering courses, providing some similar context to the population under investigation.

Across the extensive research done in these and other studies, three components were identified by Jacobi's (1991) review of the literature, each of which continues to be relevant. First, mentoring is focused on the growth and accomplishment of a mentee and can consist of several forms of support. Despite the variety, one key aspect that has been supported over the years is that when mentors provide both career and psychosocial support, mentees reap greater benefits (K. Kram, 1985; Scandura & Pellegrini, 2007). Second, the various forms of support may address professional and career development, psychosocial support, and role modeling. K. Kram (1985) defines career development and psychosocial support as major functions that respectively a) aid protégés in their preparation for their careers and b) support the protégé's personal and emotional needs, often within the career. Although she identifies it as an aspect of psychosocial support, Kram (1985) defines role modeling as imparting attitudes, values, and behavior that provide a model for the protégé to emulate. Work by Scandura (1992) argued that role-modeling was actually a separate function on par with Kram's psychosocial functions. Finally, mentoring relationships are both personal and reciprocal in that they can develop deep bonds that impact both the mentor and mentee. N. H. Cohen (1995) argues that one of the most fundamental characteristics of mentoring is that it is "an interactive and evolving process between mentors and their adult learners" (p.17). The evolving process of these relationships can be seen in Robert's (2000) evaluation of the mentoring literature from 1978-1999, which suggests that a mentoring process is focused around the needs of the mentee, which consists of establishing rapport (initiation), direction setting (getting established), progress making (development), and moving on (finalizing/maintenance). Although there is no length of time for each phase, it is believed that each mentoring relationship goes through this process. Within this process, the mentoring relationship holds mentees equally responsible for their development and contribution within the relationship.

These three broadly agreed-upon aspects of mentoring still leave significant gaps in understanding the concrete functions of an effective mentor. Additionally, as Jacobi's (1991) review of the literature points out, these gaps include a lack of understanding of the salient aspects of mentoring for certain groups, particularly minorities. And while a great deal of work has been

done in the past 24 years, unfortunately, women are often still left out of the mentoring equation in the workplace as well as in academia. As men tend to dominate upper-level positions and are able to provide the most mentoring, they are often unwilling to mentor women (Austria & Austria, 2010). Moreover, often women in industry are looking for more psychosocial guidance and role modeling on how to balance personal/family and work life that their male counterparts and supervisors are unable to provide (Rayburn, 2010). As an alternative way of having their needs met, women are often encouraged and tend to utilize multiple mentors of varied racial, gendered, and professional backgrounds that can potentially meet more of their psychosocial needs (Packard, Walsh, & Seidenberg, 2004; Rayburn, 2010). These same variations in mentoring needs exist among AAFSS in engineering, along with other aspects that have yet to be accounted for.

Although the work by Pembridge (2011) brings mentoring into the realm of engineering education through his model of capstone design mentoring, it overlooks the distinct mentoring experiences of minority students. Yet, Ragins and Kram (2007) argue “an assessment of the effects of race and gender on mentoring relationships needs to incorporate an understanding of the impact of social and political context on the research questions we ask, the variables we study, and the conclusions we draw” (p.668). In essence, as we begin to evaluate the salient aspects of effective mentoring for African American women, we must recognize that the standards for mentoring have been established around the White male, who lives an entirely different experience.

2.4 Variations in Mentoring

Although research has identified a number of benefits resulting from mentoring, as described above, variations among relationship types and participants can significantly impact those benefits. Often these variations are based upon the resources and programs available at an academic institution and the number and type of mentors willing to volunteer their time. This section will discuss the impact of some of these variations that may be particularly salient for students: formal vs. informal relationships and matched (same race and gender of mentee) vs. unmatched mentors (of differing race and/or gender than mentee).

2.4.1 Formal vs. Informal

As a first step in the mentoring process, the mentor and mentee/protégé must establish a relationship, which generally takes one of two forms: informal or formal. Informal or “natural”

mentoring relationships, initiated either by the mentor or the protégé, often provide a higher level of contact between student and mentor and provide a haven for discussion of a broad range of topics, including emotional and cognitive well-being (Cole & Griffin, 2013). Studies show that protégé initiation is most common as protégés select mentors based on their perception that the mentor will be able to satisfy their needs (Roberts, 2000). Often these relationships last the longest because they evolve into a friendship. However, if a mentee is unable to find someone that they perceive can satisfy their needs as a mentor, a relationship may never be formed and the needed support not provided.

To mitigate against this possibility, formal mentoring relationships are formed by a third party, generally an established mentoring program. These types of programs often regulate meeting frequency and length of the relationship between mentor and mentee. However, Roberts (2000) points out a fundamental concern of formal mentoring with respect to whether the program's interest or the protégé's needs are the first priority. Often mentoring programs are established to increase retention or academic success, in which students' needs for psychosocial support are not always met. In fact, recent work by Lee (2015) examining student support services in engineering found that pressure to succeed academically was one cited negative in such programs.

Based on the literature, although formalized relationships may meet the needs of some students as well as organizations, informal relationships seem to have a wider range of benefits for mentor and mentee. (Cole & Griffin, 2013; Jacobi, 1991; Roberts, 2000). Zey (1984) argues, in fact that the best formation of a mentoring relationship develops when the mentee and the mentor are both able to freely choose one another, and few if any studies to date definitively demonstrate otherwise.

2.4.2 Matched & Unmatched Mentors

In addition to variations in how mentoring relationships start, research also points to variations in who makes an effective mentor. As described earlier, a consistent theme in academic research is the dualistic organization of the populations based on either race or gender, and this organization leaves African American women out of the conversation. The specific characteristics of an effective mentor may vary between women of different race, and within a given race for men and women.

Much of the literature on mentoring minority women encourages matched mentoring (Cole & Griffin, 2013; Ong et al., 2011). Maton and Hrabowski III (2004) argue that interaction with minority faculty in and out of the classroom can decrease the feelings of isolation among minority students and contribute to positive outcomes. The greater number of African American female engineering faculty and professionals there are, the more tangible the idea of engineering being filled with women and minorities becomes as well. Similarly, the literature has shown that in many instances, faculty also prefer mentees who share similar backgrounds. Blackwell (1989) states, “mentors tend to select as protégés persons who are of the same gender and who share with themselves a number of social and cultural attributes or background characteristics such as race, ethnicity, religion and social class” (p.11). The implications of these preferences can greatly hinder the number of accessible mentors for minority women as the majority of engineering faculty are White males. The discouraging number of African American female engineering faculty members (137 tenured/tenure-track out of 25,004 (Yoder, 2013a)), makes it difficult to provide AAFSs with these types of relationships. The limited number of African American female faculty (AAFF) mentors exposes some of the challenges that these students face. The long term effects hinder the number of minority women who rise to positions of power because they receive no support or sponsorship from faculty currently in those roles. This perception that there are racial and gender barriers to mentoring is a challenge for women and minorities in academia; as a student there is a presumed exclusion from opportunities relevant to their academic success because of lack of available mentors.

Although there are a limited number of AAFs who can serve as mentors, faculty of varying races and genders can and in many cases do serve as mentors to diverse students. Unfortunately, the general myths about cross-race mentoring seem to prevail, including “a) only minority faculty can effectively mentor minority students, b) mentoring minority students is no different than mentoring same-race students, and c) simply engaging minority students in class and showing interest in them is enough” (Johnson, 2007, p. 170).

2.5 Summary

Overall, each aspect of this literature review has played a role in framing the subjects (AAFSs) and phenomenon (faculty mentoring) for this study. As mentoring has been noted as a method to support the persistence of minority students, it is the focus of this research to uncover

the types of faculty mentoring relationships these women have had. However, the literature also suggests that based on different factors such as race, gender and environment, the salient aspects of a mentoring relationship may change. Although the wide range of literature suggest much about mentoring relationships for undergraduates with varying experiences and backgrounds, I have found no such research on the experiences of African American females in engineering and their experiences with matched and unmatched faculty mentors.

From the literature, there is a clear value in exploring the experiences of the uniquely intersectional perspectives of AAFS in engineering. The low representation of this group within the field calls for ways to increase persistence in ways that mentoring can directly address. According to the literature having a matched mentor has a number of benefits for minority students, but again these benefits have not been investigated for African American females or African American female students in engineering. The complexity of finding a matched mentor for these women is a challenge that cannot be easily overcome. A subsequent goal of this research is to increase the number of African American females in engineering to provide more faculty mentors for future generations of African American female engineers. In the meantime, exploring both matched and unmatched sources of faculty support are practical ways of exploring positive mentoring relationships for AAFSs and providing some insight into their needs and desires more immediately.

Without investigation to provide insight into the salient aspects of mentoring from the perspective of AAFSs, there can be no change to the current methods of mentoring that often exclude these women. The investigation of matched and unmatched mentoring relationships for African American women in engineering has the potential to “alter social practices to free individuals and social groups from the normative fix of hegemonic order and to enable a politics that is at once more complex and inclusive”(McCall, 2005, p. 1777). The goal is therefore not only to understand the experiences and needs of African American women in engineering, but to find ways to change mindsets to provide a better environment for all marginalized students to feel and to be included and successful. What is most important is that access and the opportunity to be successful within engineering and all fields is made equitable to all.

3 Methods

What the literature has revealed is a gap in understanding how mentoring has made an effective impact on the persistence of African American Female Students (AAFSs) in engineering. To begin to address that gap, the goal of this research is to explore the qualitatively different ways that African American undergraduate women in engineering experience faculty mentoring. In doing so, I answered the following research questions:

RQ: What qualitatively different characteristics of faculty mentoring relationships support African American female undergraduate students in engineering?

SQ a. How do African-American female engineering students initiate relationships with faculty mentors?

SQ b. How do the racial and gender demographics of the mentor effect the mentoring relationships?

In order to address these questions, I conducted a qualitative phenomenographic study in which I interviewed 18 self-identified African American senior female engineering students. Each participant was interviewed to understand her definition of mentoring, her perceptions of how her mentoring relationships developed, detailed examples of interactions and conversations she had with her mentors, and the perceived benefits. Following phenomenographic analysis approaches (Akerlind, 2005; Marton & Booth, 1997), I used the interview transcripts to develop categories that identify the varied experiences of mentoring expressed by the participants. The study was conducted with full IRB approval (IRB # 14-474).

In the remainder of this chapter, I first justify my use of phenomenography to conduct this investigation and describe the general principles of the approach. Second, I elaborate on my research design, including the sample population, sample size, and research site. Third, I describe my data collection and analysis processes. Finally, I identify my personal perspective in order to address my bias as a researcher and describe how bracketing was conducted in order to preserve the reliability of the study.

3.1 Phenomenography

Qualitative methods are generally employed to explore *how* and *why* questions such as those that frame this study (Creswell, 2009). More specifically, Jacobi (1991) argues that

qualitative methods are necessary to investigate mentoring relationships as they provide a better “understanding of the dynamics and development of mentoring relationships” (p.526). Within this study, qualitative methods are utilized in order to gain a detailed understanding of how AAFSs develop and maintain effective mentoring relationships with diverse faculty. The following section describes phenomenographic research in general, and Section 3.2 describes the specifics of my research.

3.1.1 History of Phenomenography

The creator of phenomenography, Ference Marton (1986), defines it as “a research method adapted for mapping the qualitatively different ways in which people experience, conceptualize, perceive, and understand various aspects of, and phenomena in, the world around them” (p.31). In other words, while other qualitative methods focus on understanding the *phenomenon*, phenomenography focuses on the various ways that individuals can come to make meaning of a phenomenon. The relationship formed between the subject and the phenomenon is “the result of a person thinking intentionally,...interacting with the phenomenon and striving to create meaning” (Larsson & Holmström, 2007, p. 56). This relationship between the participant and the phenomenon, faculty mentoring, is the focus of the study, as depicted in Figure 3. That is, the study considers how AAFSs experience faculty mentoring. From this perspective, the participant begins to reflect upon her experience with the phenomenon and can express what she believes to be its meaning.

In light of the tenets of intersectionality, this study used phenomenography for its ability to shed light on variation. Specifically, research on AAFSs essentializes these women, placing them in a single classified box that provides limited perspectives of their experiences. The variation-based approach of phenomenography, in contrast, allows for insights into the group as a whole while simultaneously valuing variation over a synthesis of their experiences.

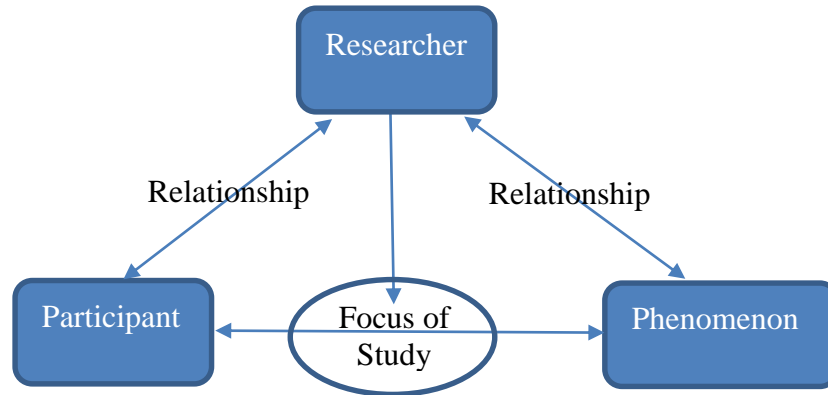


Figure 3. Phenomenography Relationships and Focus of Study (adapted from Bowden (2005) and Mann (2007))

Initially developed to understand the ways in which students understood a specific classroom phenomenon, often a concept being taught, phenomenography focused solely on learning (Marton & Booth, 1997). The method aimed to develop a hierarchy of categories that could represent lesser to greater degrees of comprehension with respect to learning a given concept; it has since been expanded to a number of aspects of the world, including engineering design and wicked sustainability problems (Daly, 2008; Lönngren, 2014)).

As suggested by Figure 3, phenomenography looks at how one's understandings, interpretations or meanings of a phenomenon (in this case, faculty mentoring) are demonstrated through actions (interview responses). It is considered a second-order process of investigation because it looks not directly at the phenomenon, but at the various ways in which people come to understand it. When varied meanings exist among people of the same group, varied behaviors result. Here the meaning of mentoring that is perceived by each study participant will reflect varying types of relationships and experiences with their mentors. Phenomenography recognizes that the mentoring experiences of this population have some unifying aspects that caused the mentors to be identified as positive and effective by these women. However, consistent with the method, these mentors demonstrate differing traits that lead to a full set of categories reflecting the varying experiences and meanings expressed by these students.

3.1.2 Uses of Phenomenography

A number of methods could have and have been utilized to investigate the phenomenon of mentoring (e.g. phenomenology, case study, grounded theory). However, my rationale for

selecting phenomenography for this study is because it allowed me to broadly comprehend the experiences of a specific group without limiting them to a set of pre-defined or essentialized aspects. For the population of my study, AAFSs in engineering, it is important to employ a method consistent with intersectionality that reinforces that the experiences of all AAFSs in engineering are not the same nor are they the same as other race or gender groups. Phenomenography exposes the varied yet related aspects of how a given population experiences an aspect of the world. In doing so, it highlights commonalities among group members without essentializing the group. As the literature has shown, this specific population has a unique perspective based on the intersecting identities they claim. These unique intersections create variety even within members of the same group, which can be explored through phenomenography.

3.2 Research Design

The phenomenon (aspect of the world) that was the focus of this study was mentoring relationships with faculty experienced by African American women in engineering. Within this study “faculty” has come to be defined by the participants as tenure and non-tenure track faculty, administrators, and university program directors and staff both within and outside of a college of engineering. The context of the study was a Predominantly White Institution (PWI) in the eastern United States. In the following sections I discuss how phenomenography and intersectionality were utilized to investigate this phenomenon.

3.2.1 Sample justification

Because an explicit goal of this research was to understand the faculty mentoring experiences of African American undergraduate women in engineering, the study focused on the first-hand accounts of their lived experiences. Study participants were African American female engineering seniors who have faculty mentors. Seniors were selected for two reasons: 1) they are more likely to have had extended mentoring relationships, and 2) they have successfully persisted to the completion of an engineering degree. Davis et al. (2004) suggests that participants who are successful (i.e. about to graduate) have little fear about future difficulties such as retaliation based on their responses, and will therefore provide more honest accounts of their experiences. These senior African American female engineering students were interviewed to investigate their

definitions of mentoring, how their needs and desires were or were not met by one or more mentor, and what types of interactions they experienced with mentors during their academic career.

3.2.2 Research site

Because there is so little known about the mentoring experiences of AAFSs, this study focuses on a single institution to minimize variation in context. The target institution was a Predominately White Institution (PWI) because such institutions have historically been places where minority students are the statistical minority, have lower persistence rates and academic achievement, and experience lower psychosocial adjustments than White students (W. R. Allen, 1992; W. R. Allen, Epps, & Haniff, 1991; Fleming, 1985). It was my desire to better understand the experiences of AAFSs in a place where it seemed more of a challenge to succeed.

This study was conducted at a research intensive PWI located in the eastern United States. To protect confidentiality, I provide only a general description of the university as definitive statistics for the school, in combination with student comments, would likely reveal both faculty and student identities. The research institution has more than 20,000 students, of which African American students represent just over 5% of the population institution-wide and within the college of engineering. Additionally, there are at least two African American female tenured/tenure-track faculty employed at the university. Yoder (2013a) reports that there are only 137 African American women among the 25,004 tenured/tenure-track faculty in engineering nationwide. According to research from the 2012 *Engineering by the Numbers* report assembled by the American Society for Engineering Education (Yoder, 2013a), the most AAFS at any U.S. institution is five, with an average of zero. Setting a minimum of two AAFS was designed to increase the likelihood that at least some of the participants in my study would have experiences with a matched mentor. At the same time, with so few AAFS in academia, it was also likely that some AAFSs in the study would have sought mentorship from unmatched mentors. Drawing participants with both kinds of mentors from a single institution provided another level of insight without adding additional context variation.

3.2.3 Sample size

Although phenomenography does not aim to generalize its results to a larger population, it does try to capture the diversity within the population under investigation. Because of this

emphasis on variation, it is important to maximize diversity when selecting participants (Akerlind, 2005). In order to capture the full range of how a population experiences a phenomenon, Trigwell (2000) suggests that a sample size of fifteen to twenty is appropriate for phenomenographic research. He notes that ten to fifteen could be enough at the low end to identify variation among responses, whereas more than twenty becomes too large a number of transcripts to consider as a whole during analysis.

Following Trigwell (2000), in selecting participants the initial aim was to identify between 15-20 participants. This number helps to maintain the variation among participants needed for a phenomenographic study (Bowden, 2000). The hope was to be able to elicit a significant number of participants with each type of mentor, keeping in mind that some participants may have both matched and unmatched mentors. Demographic data was also collected from each student to ensure diversity among the sample with regards to engineering major.

Following the procedures outlined in the next section, eighteen participants were interviewed. However, only sixteen of the eighteen were included in the final analysis. Two of the participants were excluded completely from analysis after careful consideration of how their experiences represented the population. One participant was a first semester transfer student and although she was able to identify mentors from her initial institution, was unable to identify any mentoring experiences at the institution under investigation, mostly based on her limited time at the site. The inclusion of this participant would thus have altered the data set as the context of the mentoring she did receive was quite different from the other participants. Her experience would have portrayed a lack of mentoring that may have been established over a longer span of time. A second participant was excluded because of her cultural identification and her inability to identify a mentor. Her identification as a native of Trinidad and Tobago and not as an African American (within the interview) indicated her lack of identification as an African American and therefore different from the other members of this study.

Finally, a portion of the data for a third participant was excluded. As a transfer student she was able to identify mentors at both institutions, but only those mentors at the site under investigation were included in the study.

The remaining participants consisted of 9 fourth year students and 7 fifth year students. All of the participants self-identified as African American females enrolled at the institution (2 also identified as African and 1 as Haitian during the interview). The engineering majors represented

were computer, biomedical, civil, mechanical, chemical, environmental, and industrial. Two of the participants were transfer students, but each had been at the university for at least a year. The participants ranged in age from 20-45 years old, with the average being 21. Each interview lasted between 35 and 75 minutes.

3.3 Data Collection

Qualified participants were selected based on a screening questionnaire administered electronically, and a semi-structured phenomenographic interview was conducted to collect data. The details of each of these are described further in the following sections.

3.3.1 Recruitment Strategies

A project partner at the university acted as the access point through which recruitment emails were sent to students. This faculty member distributed the participant recruitment email announcement (see Appendix A: Recruitment Email) to all African Americans within the college of engineering at the institution. A follow-up email was sent after a week to increase the number of participants after the first week. The recruitment email included a link to a Personal Questionnaire Survey that the students were asked to complete if they were interested in participating in the study (See Appendix B: Personal Profile Questionnaire). Snowball sampling (Creswell, 2009) was also used to solicit other student participants.

3.3.2 Personal Profile Questionnaire

In order to ensure the recruitment of the desired sample population, a Personal Profile Questionnaire was developed to collect general background information on those interested in participating in the study. The aim of the questionnaire was to elicit participants who span a wide range of relevant demographics while also ensuring some balance in the number of matched and unmatched mentoring experiences. By obtaining variety within the sample population, I was able to explore a broader representation of this population, allowing for ample insight into varying perspectives and experiences (Akerlind, 2005).

The electronic survey was administered online using Qualtrics software. In addition to gathering some background information, the questionnaire verified that participants are AAFSs in engineering and had at least one faculty mentor. Each participant that completed the survey and

was qualified on the basis of self-reported race, gender, and senior status was interviewed. The questionnaire responses were used to finalize those utilized for analysis and reporting. The questions from the online questionnaire are presented below in Table 2.

Table 2. Personal Profile Questionnaire

	Question	Justification
Q3	Which race do you identify with?	Verify AAFS
Q4	Gender	Verify AAFS
Q5	What is your current major?	Verify engineering major
Q6	What School do you currently attend?	Background
Q7	Have you ever transferred schools?	Background
Q8	What year of school are you currently in?	Verify Senior Status
Q9	What is your current GPA?	Background
Q10	What is your MOTHER'S highest degree attained?	Socioeconomic Status
Q11	What is your MOTHER'S current profession?	Socioeconomic Status
Q12	What is your FATHER'S highest degree attained?	Socioeconomic Status
Q13	Where did you attend high school? (name, city, state)	Socioeconomic Status
Q14	Do you have a Faculty Mentor?	Qualify for Study
Q15	What do you believe your mentor's gender to be?	Mentor Background
Q16	What do you believe your mentor's race to be?	Mentor Background
Q17	What department is your mentor in?	Mentor Background
Q18	What is your mentor's title?	Mentor Background

Questions 9-13 provided background information that exposed the diversity of the participants within the population based on factors that have been proven to impact student success, as described in the literature review. From the survey I was able to learn that participant GPAs self-reported ranged from 2.0-3.81. Additionally, parents of the students in this study had an educational background ranging from high school education to Medical Doctorates, with four of the mothers and two of the fathers being engineers. Knowledge about these aspects of participants' backgrounds ensured sample diversity and might be helpful in looking at the results through a different lens for future work. The remaining questions provide some initial information about their faculty mentors. In the survey, many of the respondents did not identify as having a faculty mentor, which lead me to adjust the interview protocol to investigate further if this was true. Based on their self-identification as an African American female engineering student at the senior level, they were qualified to participate in the study.

3.3.3 Interview

The primary data collection method of phenomenographic studies is the phenomenographic interview (Bowden, 2000). Much like most qualitative interviews, the phenomenographic interview is semi-structured in nature to allow for probing of unanticipated responses and freedom to expand the conversation. However, unlike many other methods of qualitative research, the interview, along with any field notes taken during the interview were the sole source of data collection. The interview allows participants to express their experience in a way that is relevant to them. How the participant responds to questions is the primary issue during analysis because “the dimensions [of the phenomenon] they choose are an important source of data because they reveal an aspect of the individual’s relevance structure” (Marton, 1986, p. 46). In other words, the aspects of the phenomenon a participant includes her responses reveal the most salient aspects of the phenomenon to the participant, and often the order of salience. Allowing the participant to define the phenomenon at the beginning of the interview provides a basis for the rest of the discussion as the interview flows with clarifying questions such as “What do you mean?” or “In what ways?” Additional probing questions might include (Akerlind, 2005, p. 105):

- How did you go about that?
- Why did you do it that way?
- What did you gain or hope to gain from it?
- Why was that important to you?

The goal is to allow the participant to expose new meanings about the phenomenon without leading or making judgmental comments during the interview (Trigwell, 2000). The interviewer works toward an “ articulation of the interviewee’s reflections on experiences that is as complete as possible” through explicit examples (Marton & Booth, 1997, p. 130).

Akerlind (2005) also emphasizes the importance of trying to “elicit underlying meanings and intentional attitudes towards the phenomenon being investigated” (p. 70). In essence, the interviewer seeks to get participants to give a descriptive enactment rather than a philosophical reflection on something they may not have put much thought into, through explicit examples. The value comes in the ways that participants talk about their experience with the phenomenon and the aspects of it that they identify (Akerlind, 2005). These elicited examples also provide an

illustrative description of the phenomenon in relation to the participant. By utilizing a concrete example, participants can provide answers instead of what they anticipate to be the desired response (Larsson & Holmström, 2007).

Following these guidelines, the interview protocol was divided into sections as a guide for the conversation. As it was a semi-structured interview, there was also flexibility in what order the questions are asked. The interviewee led the conversation and the interviewer followed that lead through probing questions. The protocol served more as a framework of things to be discussed, but it was malleable in that it allowed for unexpected but relevant topics to be pursued without disrupting the aims of the study – i.e., understanding the relationship between the subject and the phenomenon.

Table 3. Interview Protocol & Justification

#	Question	Justification
Define Phenomenon		
Q1	How would you define mentoring? I.e. what are the essential components of mentoring?	Define Phenomenon (Åkerlind, 2005; Trigwell, 2000)
Q2	Which components are most important in your mentoring relationship and why?	Define Phenomenon (Åkerlind, 2005)
Q3	How did you become a mentee? (i.e. formal or informal) and explain Who initiated the relationship?	Relationship Formation (Cole & Griffin, 2013)
Q4	Can you share an example of an experience in your mentoring relationship that really stood out to you?	Explicit Examples (Åkerlind, 2005)
Q5	What were the most meaningful behaviors that your mentor conveyed? In what ways has your mentor supported you? What things do they do to help you?	Define Phenomenon (Trigwell, 2000)
Personal Gains		
Q6	What are the fulfilling aspects of being a mentee? Are your expectations and needs being met?	Characteristics of Mentoring (Cole & Griffin, 2013; Jacobi, 1991)
Q7	What have you learned/ gained from being mentored? <i>Can you give specific examples</i> What did the mentoring relationship mean to you?	Benefits of Mentoring (Åkerlind, 2005; Cole & Griffin, 2013; Jacobi, 1991)

#	Question	Justification
Challenges/ Underrepresentation Effects		
Q8	Have you had a mentoring relationship that didn't work out?	Challenges of Mentoring (Cole & Griffin, 2013; Jacobi, 1991)
Q9	Did being an AAFS affect your mentoring relationship? Do you think African American women have different mentoring experiences?	Promoting Understanding (Lichtenstein et al., 2014; Ong et al., 2011)
Q10	Do you have experience discussing issues related to underrepresentation in engineering with your mentor? Did you feel comfortable? Did you have the opportunity Do you prefer to avoid If so, can you give an example? If not, would you have liked to and if so, why and what about?	Racial Challenges (Cohen & Steele, 2002; Cole & Griffin, 2013)
Recommendations		
Q11	What advice would you give a fellow AAFS who is seeking a mentor? A faculty member seeking a mentee?	Discover New Aspects
Q12	What should faculty members know about your experience?	Promoting Understanding (Scisney-Matlock & Matlock, 2001)
Q13	Do you think you will seek mentors in the future and what will they look like?	
Q14	Is there anything else that you want to add about your mentoring experience?	

As shown in Table 3, the second and third sections of the protocol were developed from the review of the literature on mentoring. Specifically, given that students of color often acknowledge the ways in which underrepresentation plays a role in their mentoring relationships, questions 7-13 attempt to draw on these aspects of the mentoring relationship. Other frequently discussed aspects of student-faculty mentoring relationships include role-modeling, psychosocial and career support. Although these characteristics were not specifically asked about, there was space for them to be identified as salient to participants. However, the framing of the questions in this protocol was very much open, allowing participants to define the phenomenon of mentoring in their own way, which may or not include aspects identified in the literature. Importantly, the participants were allowed to define not only mentoring, but “effective” mentoring; all relationships that participants identified as effective are presented as such in Chapter 4.

Each of the interviews were conducted on campus in a reserved room within one of the administration buildings. The building housed the administrative offices for the engineering college, but was located in a different area of campus than the academic engineering buildings. The room itself had no windows and thus provided a level of privacy for the participants.

3.3.4 Pilot

In order to test the recruitment tools, questionnaire, and interview protocol, a pilot study was done at Virginia Tech based on convenience sample. IRB approval was received before proceeding (IRB #14-474). Study participants were recruited through snowball sampling (Creswell, 2009), using faculty and students at the university. The recruitment email containing the link to the questionnaire was sent to 5 AAFSs ranging from rising seniors to graduate students in various engineering departments. Graduate students were allowed to participate due to their ability to reflect on their experiences with a bit of reflection and post undergraduate experience. Their interviews provided some insight on topics that undergraduates might not readily consider valuable. This insight broadened the questions and probes that I included in the final version of the interview protocol.

For the pilot study, all students who identified having had a mentor were interviewed. Each student was contacted to determine a convenient time and place for the interview. The interviews averaged 60 - 90 minutes. The pilot study revealed an unexpected aspect of trust that seemed salient within the mentoring relationships. These findings primarily impacted the structure of the interview protocol and revealed the need to be more explicit in asking participants to provide specific examples. Another unexpected finding was that participants, although they indicated a certain mentor in the survey, talked in depth about other mentors, often several, in as much detail. These findings impacted the full study by making me aware of the types of additional probes that might be necessary to draw out the specifics of the multiple relationships held by each participant.

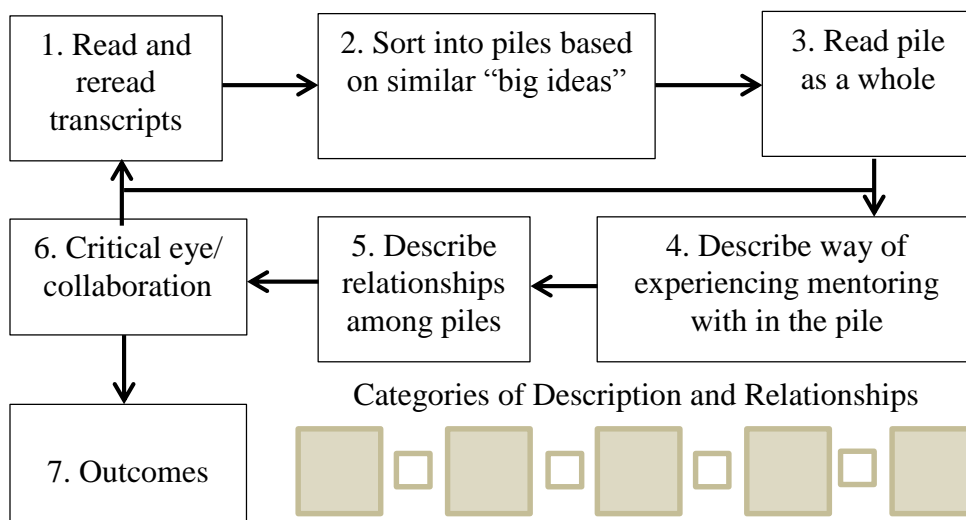
3.4 Data Analysis

Traditionally, phenomenographic analysis begins once all of the interviews have been completed and transcribed. Each interview is read multiple times thoroughly by the researcher. Analysis has historically been conducted in one of two styles: 1) selecting quotes from transcripts (Marton, 1986), 2) utilizing full transcripts for analysis (Bowden, 2000). In the first style, quotes

from each transcript pertinent to the phenomenon are collected together and sorted into groups based on variation in the meaning of the phenomenon. Through this style, the quotes are taken from their transcripts into a decontextualized group known as a ‘pool of meanings’ (Marton, 1986). From this pool, the quotes are then sorted into categories to describe the varied meanings. An iterative process occurs as the researcher arranges and rearranges the quotes from the transcripts into the coherent categories (Marton, 1986). In the second style, the process is similar, but entirety of the transcript is utilized for analysis (Bowden, 2000) and whole transcripts are grouped together. By utilizing the entire transcript, the context of specific quotes are maintained and can constantly be referred to when interpreting meanings of specific comments. In both styles, no *a priori* categories are used. Instead categories emerge and are adjusted and tested multiple times before a concluding analysis is developed.

This study used a variation of the second style. Because most participants had multiple mentors, the transcripts were segmented by mentoring relationship, and these mentoring relationships were taken for analysis while keeping the entire transcript as a reference for the context of each relationship. In accordance with phenomenographic methods (Akerlind, 2005; Bowden, 2000; Marton & Booth, 1997), Figure 4 provides a visual representation of the analysis process

Figure 4. Data analysis process (adapted from Daly, Adams, and Bodner (2012))



The process of data analysis began with multiple readings of the transcripts for familiarity (Box 1 in Figure 4). After the first reading, the transcripts were highlighted and commented on to

reflect where participant responses gave some insight to the research questions. On the third reading, index cards were implemented to record a summary of each mentoring relationship identified by the participant. Each index card identified the mentee, demographics of the mentor, details about how the relationship formed, and any other information that seemed valuable in understanding the basis of the relationship. These relationships (index cards) were then sorted into piles based on similar “big ideas” (Box 2). The big ideas that seemed to develop at this stage were context, tone, and formation. It was clear to the researcher that there were certain topics that were representative in each relationship (context), which made it a reasonable basis for sorting. How the relationships formed became another way to sort the relationships into piles. Finally, there were subtle tones that the participants relayed in how they talked about their experiences in a relationship which seemed to play a role in both the formation and context.

Once these piles were made, each index card was reread repeatedly to ensure consistency within the pile (Box 3). Throughout this process some different nuances emerged that serve as better indicators of variation between relationships. This very iterative process called for constant clarification by returning to the entire transcript to ensure that neither the details nor the context of the relationships were lost. Updates were made to the index cards if more details were necessary to clarify the relationship. Once the relationships were sorted into what the researcher believed to be cohesive piles after multiple iterations, a description of each pile was written based on the relationships that were compiled within it (Box 4). Some resorting was done during the writing of the descriptions. Next each pile was compared and contrasted to the others to determine what separated one from another (Box 5). Phenomenography approaches insist that each pile be distinctively distinguishable from the others to establish the degree of variation, so this step was crucial in making sure that the categories were both coherent and distinct.

Once the degrees of variation were identified, the description of each pile was taken to another researcher (Box 6). This additional researcher took each relationship and placed it with one of the descriptions. Relationships that were not sorted in the same ways as the primary researcher were negotiated for agreement between the two researchers. Negotiations and agreement were also made in a similar manner for the degrees of variation. This process occurred twice in this study.

The final categories and the degrees of variation are represented visually in Chapter 4 in a way that best depicts clearly the distinctive variation between each category (way of experiencing

the phenomenon) (Box 7). The output of a phenomenographic study is what is known as the *outcome space*. This outcome space consists of “categories of description comprising of aspects of the phenomenon and the relationship between them” (Marton & Booth, 1997, p. 125). These categories depict the variety of ways in which the phenomenon is experienced, separated by both similarities and differences. Marton and Booth (1997) argue that the categories present “layers of individual experiences” that provide a ‘complete’ sense of the experiences of the population, leaving nothing out. This is best reflected when the categories are placed in a hierarchy, as each category reflects a different layer of comprehension of the experience, with the most comprehensive consisting of every aspect of the experience. However, placing categories into a hierarchy of increasing comprehension or complexity is not always necessary and is contingent upon the data. Because of its roots in studies of learning, the organization of the categories into a hierarchy of comprehension (usually less comprehensive to more comprehensive understanding) allows for teachers to help students improve their understanding by moving them up in the hierarchy. However, within this study, a hierarchy did not emerge because rather than describing poor to excellent mentoring experiences, the categories depict various effective ways of mentoring. At the same time, as Chapter 4 shows, different types of relationships do address increasingly comprehensive dimensions of participants’ lives.

3.5 Reliability and Trustworthiness

Within phenomenography, several methods are available to ensure reliability and validity. According to Creswell (2009), to ensure readers of accuracy of the findings (trustworthiness) as well as consistency in the researcher’s approach (reliability), a number of actions should be taken by the researcher. In order to ensure that the categories present a comprehensive set of experiences, three criteria were verified (Marton, 1986). First, each category should represent a distinct aspect of the experience. Second, there should be a clear relationship between each of the categories, and often this relationship demonstrates the development of the hierarchy. Finally, the development of the outcome space should be a concise set of categories that carefully capture critical variations. The number of categories generally range from two to nine (Akerlind, 2005). In this study, these criteria were verified through a number of actions to ensure reliability and trustworthiness. In this study, these criteria were verified by the following actions:

- *Keep interview protocol consistent* and avoid leading questions and statements. The interview protocol was followed as diligently as possible while still allowing the participant to expand on her experiences through a variety of probes when necessary.
- *Utilize the entire transcript.* By using the whole transcript rather than segments, the researcher maintains that the context of the data is not lost in analysis. Since the focus was on each mentoring relationship, the basis of the transcript was any content surrounding a particular relationship; therefore, large sections relevant to the study were referenced constantly throughout analysis.
- *Iterate when developing the categories.* Akerlind (2005) posits that reliability in phenomenography is done by constantly referencing the data (transcripts) and being transparent about decisions being made. Multiple iterations of analysis were conducted to develop the categories and each iteration was documented by the researcher with explanations for decisions made with references to the transcripts. Several of the iterations were reviewed by peers and colleagues.
- *Provide another researcher with the descriptions of the categories.* After some negotiations, the two researchers were able to sort the segments of transcripts into the same categories (Bowden, 2000; Walsh, 2000). The secondary researcher was also a PhD student in engineering education, well-versed in qualitative educational research, who is also an African American female attending a PWI.

In addition to following all of the above steps, an important aspect of phenomenography is the absence of *a priori* coding or the use of an existing framework to develop the categories. The outcome space is solely reflective of the data collected and therefore reflective of the specific population being studied. It is important that the researcher keep the data as the focus and bracket other theories, conceptions, and personal experiences from the analysis to ensure that the outcome space is a true reflection of the data. Although I reviewed the literature to become familiar with the existing knowledge on mentoring surrounding this population, prior definitions of mentoring were not used in developing the categories. To ensure this I avoided any reading or review of the literature during data collection and analysis as to minimize being influenced by the literature.

3.6 Researcher's Bias

A critical step in qualitative and phenomenographic research is to provide the readers with a statement of the researcher's bias. As qualitative research is often an interpretation of the experiences of others, understanding how the researcher interprets the data provides a better understanding for the readers (Fisher & Margolis, 2002). Being open about my experiences allows an understanding of how my bias may have contributed to the results of the study.

Much like many researchers, I sought out this research because of both an awareness of a gap in the literature and personal experiences. As an African American female engineer, I shared a number of the experiences with my participants, but my experiences were in a vastly different context. I was once an undergraduate student in engineering at an HBCU at which I had both positive and negative mentoring experiences. These mentors were of both genders and a variety of races. Although I had two African American female faculty members available to me, I had very different relationships with both of them. I found both women to be essential in my continued success, but I often wonder how my journey would have differed at a PWI or with fewer available African American female faculty members. This large difference in context relative to my participants kept me from experiencing many of the noted barriers discussed in the literature, such as tokenism and isolation, because I was surrounded constantly by people who looked like me in an environment specifically designed to educate African Americans. I experienced a great sense of inclusion and support from both peers and faculty. Based on my more recent transition to a PWI as a graduate student, however, I have developed vested interest in discovering who African American women in engineering rely on for support in different environments.

Given researcher bias, qualitative research encourages researchers do their best to bracket themselves when investigating a phenomenon. Particularly in phenomenography, in which the goal is to understand the experience of the participant, it was important to set aside my personal experiences and expectations during both data collection and data analysis. When listening to participants, I focused on understanding how these students define mentoring for themselves and did not look for them to define it the way that I would or push them to do so. I had a level of openness, and was willing and ready to hear things that were contrary to my own experiences and expectations.

In order to truly gain knowledge about the experiences of these women, as is dictated by phenomenographic interview procedures, I allowed the participants to define the phenomenon of

mentoring and express examples of their own experiences. From there, the vocabulary and definitions used by interviewee became the vocabulary and definitions used throughout the interview.

Avoiding guiding questions that pushed participants to provide answers that I was anticipating was also an aspect of bracketing. Additionally, based on my pilot data, I realized that there were many scenarios that I would be able to relate to and I became more aware that I must continue to probe for full understanding rather than assume I understood the student's experiences. Most often participants would say "you know what I mean" based on a sense of commonality because of my own race and gender, in which case I was forced to say 'no' and ask for more detail. This separation of preconceived notions and previous experiences from the data collection and analysis process were key components to qualitative and phenomenographic research.

Within the analysis process, as I developed the categories, transparency regarding how the categories were made and any decisions made in that process were documented and discussed with a number of peers and other researchers (Akerlind, 2005). Additionally, the second major researcher who was provided the categories was also an African American female. Our perception of the participant experiences may have been shared context, but the variation in our own experiences allowed us to have very different perspectives of the data, which encouraged us to further ensure that we were making decisions based on the participant's experiences and not our own.

3.7 Summary

Overall, my focus throughout this research was to understand the various mentoring experiences of African American women in engineering that have enabled them to persist to the completion of an undergraduate degree. Although the literature says that their experiences should reflect some sort of positive relationship with a mentor that is of the same race and gender, I am aware of the limitations of this population and I was interested in discovering what other effective relationships have been beneficial to them along their journey.

Allowing students to define mentoring, and expose the components that were most important to them was central. Although the literature claims that an effective mentoring relationship can be either formal or informal and typically consists of role modeling, psychosocial

and career support, I am now better able to understanding the experiences of the African American women that I interviewed and have learned what is important to them.

The investigation of the mentoring experiences of African American women in engineering seems best suited for the use of phenomenography. It provided a display of the categorical ways in which these women experienced mentoring in ways that were both relational and diverse. Overall phenomenography aims to see beyond the similarities between individuals in a group, but to also uncover the variance in their experiences. Although members of a group may share some aspects of a phenomenon, there are aspects of the relationship between the individual and phenomenon that create different experiences.

4 Results

This chapter provides the results of the phenomenographic interview analysis as described in the previous chapter.

4.1 Purpose

The purpose of this study is explore the qualitatively different ways that African American undergraduate women in engineering experience faculty mentoring. To do so, I employed a phenomenographic investigation to answer the following questions:

RQ: What qualitatively different aspects of faculty mentoring relationships support

African American female undergraduate students in engineering?

SQ a. How do African-American female engineering students initiate relationships with faculty mentors?

SQ b. How do the racial and gender demographics of the mentor effect the mentoring relationships?

These questions sought to understand what aspects of mentoring relationships are valuable to AAFSS in engineering, to in turn aid the retention of these students by giving faculty the tools to more effectively mentor this population. The focus of analysis within this study was each individual faculty mentoring relationship, and not the individual participants. Within this chapter I present an outcome space that answers each question. First, I present an overview of the outcome space through a series of tables and figures that depict the seven developed categories of effective mentoring and the ways in which they vary. Second, I illustrate the categories through direct quotes from participants, and include insights relative to the demographics of the mentors in each category. Next, I discuss the unsuccessful mentoring relationships and provide evidence of why the mentees believed those were ineffective. Finally, I provide details of the ways in which the relationships between mentee and mentor were initiated.

4.2 Outcome Space Overview: Supportive Mentoring Relationships

Transcription and segmentation of the interviews uncovered twenty-seven faculty mentoring relationships, of which twenty were supportive and seven were not, based on participants' perceptions. Participants defined relationships as supportive or unsupportive as they

responded to questions about faculty mentoring relationships they had experienced in general, relationships they identified as supportive, and relationships they felt did not work out (see Appendix C for interview questions). Thus the effectiveness of these mentoring relationships is based solely on participant perceptions, with no evaluative judgment from the researcher. Within this study, “faculty” was operationalized to include tenured/tenure-track faculty (including departmental administrators), and program administrators such as diversity and minority support program directors and staff.

The analysis process resulted in the development of seven categories describing the qualitatively different ways in which this group of African American undergraduate women in engineering experienced supportive faculty mentors: Guide, Proactive Supporter, Reactive Listener, Nurturer, Just In Time, Caring, and Role Model. Table 4 provides a description for each category. These categories represent a hierarchy of types of mentoring relationships from least comprehensive to most comprehensive. Importantly, however, less comprehensive in no way represents less effective; rather, it reflects a narrower range of aspects that mentees associated with the relationship. Each of these categories and their descriptions were developed by the researcher from the data, and as described in Chapter 3, all of the data comes entirely from the perspective of the mentees.

Table 4. Categories of Description

Category	The mentor is perceived to:
Role Model	Serve as an example of success that the mentee admires and/or desires to emulate
Caring	Make themselves available to listen to things personally and professionally relevant to the mentee
Just In Time	Render useful advice to aid the mentee in decisions pertinent to their professional success
Nurturer	Be invested in the overall well-being of the student, and provide personal support to aid professional success
Reactive Listener	Provide professional opportunities based on personal knowledge about the mentee
Proactive Supporter	Develop the mentee’s professional skills based on a vested interest in the personal and professional success of the mentee

Category	The mentor is perceived to:
Guide	Share the mentee’s racial demographics, understand her personal and professional experiences, and be willing to serve as an example in developing the mentee’s success

As Marton (1986) dictates, each category is distinct and the outcome space represents the critical variations within the results. These distinctions are represented in the degrees of variation, which I refer to as “aspects” throughout this chapter. Each category is able to stand on its own and is distinguished from other categories based on one or more aspects. A visualization of the variations by category can be seen in Figure 5, and the aspects are defined in Table 5.

Figure 5. Outcome Space

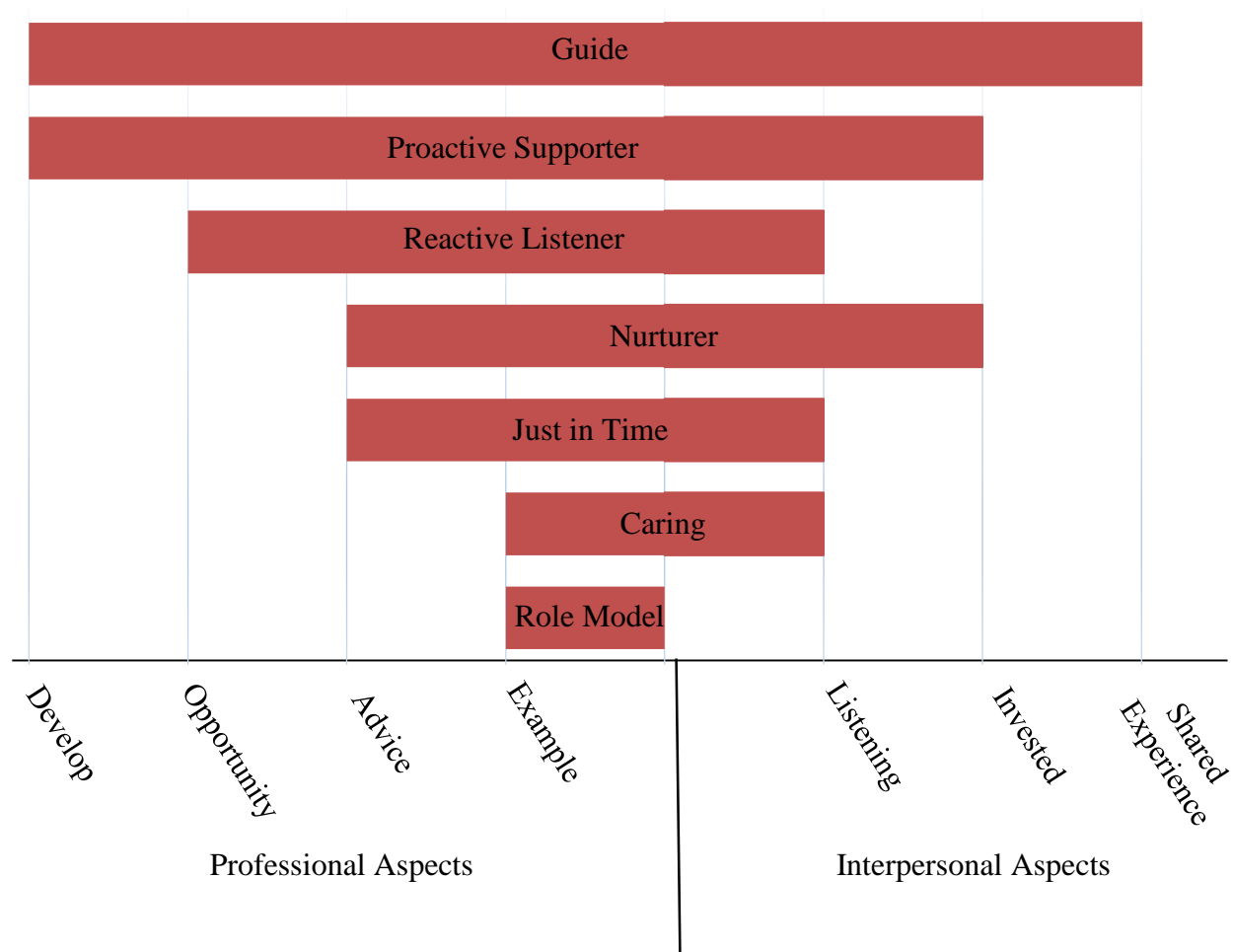


Table 5. Definitions of Aspects

Aspects		Description
Professional	Example	Show the mentee how they were successful either through their day to day actions or by sharing their own life experiences
	Advice	Share wisdom or expertise in an area that was valuable to the mentee
	Opportunity	Provide the mentee with a tangible experience (i.e. an internship, conference or award) that could benefit their professional career.
	Develop	Put forth the effort to develop the mentee's professional skills (i.e. application writing, research, and networking skills)
Interpersonal	Listen	Take the time to listen to the student
	Invested	Exert effort and time to getting to know the student
	Shared Experience	Relate to the mentee's experience based on mentor's own lived experiences

The aspects in Table 5 can be categorized as either professional or interpersonal. The professional aspects aided the mentee in their academic and career success. Four major activities were representative of the professional aspects: example, advice, opportunity and develop. Mentees perceived that their mentors who served as an *example* were able to show how they were successful either through their day to day actions or by sharing examples of their own life experiences. *Advice* was perceived as the act of sharing wisdom or expertise in an area that was valuable to the mentee. Three of the mentees spoke of ways that a mentor was able to provide them with a tangible *opportunity* for an internship, conference, or award that could benefit their professional career. Finally some mentees discussed how their mentor helped directly *develop* the mentees' professional skills, including application writing, research, and networking skills.

The interpersonal dimension, depicts 'how' the mentors were perceived to provide support and addressed the needs of the student. These aspects included listening, investment, and shared experience. By *listening*, mentees indicated that mentors often took the time to hear about the things that were going on in the mentee's life both in and outside of the classroom. Those who were perceived as *invested* made an explicit effort to reach out to the student. Finally having a *shared experience* created a deeper level of understanding and limited the need for explanation

between the mentor and mentee due to the perception of very similar lived experiences. The next few sections provide more detail regarding how these mentees perceived the interpersonal and professional aspects within the relationships.

4.3 Categories of Description

This continuation of the outcome space provides examples to support the variation between the categories to gain a better understanding of how mentees experience these mentoring relationships. Each mentoring category is a compilation of several different mentoring relationships that share similar aspects. Note that because many of the participants had multiple effective mentors (again, based on participants' perceptions of effectiveness), the participants themselves appear in multiple categories, but each mentoring relationship belongs to only one category.

The following sections present the categories in order from least comprehensive to most comprehensive in terms of the interpersonal and professional aspects of mentoring presented in Figure 5. Each category is described first in terms of the characteristics of the mentors (demographics, role in institution, etc.) who comprise each category. Next, because the categories are additive with respect to the aspects as they grow in comprehension, the descriptions focus primarily on the added aspect, unless the category also contains some unique nuance of a previous aspect. Finally, I include a brief summary of some of the benefits mentees described as a result of the relationships within the category.

Mentor characteristics are based on information reported by the mentees, as follows:

- Professor (Prof)- people mentees identified as course instructors (i.e. tenured or tenure-track faculty)
- Administrator- someone the mentee identified as a department head or chair
- Research Advisor (RA) - someone the mentee identified as the supervisor for their undergraduate research (a number of which also served as professors)
- Program Director- someone the mentee identified as the head of a minority support program within the college or institution
- Race and gender are reported as:
 - AAF – African American Female

- AAM –African American Male
- WF –White Female
- WM –White Male
- ME- Middle Eastern
- F-Female with an unidentified race

4.3.1 Mentor as a Role Model

The mentor is perceived to serve as an example of success that the mentee admires and/or desires to emulate.

Two of the mentoring relationships in this study align with the category of role model. The mentees within this category point out the valuable example that these mentors represented for them within the academic setting. In a variety of different ways, the mentees were able to identify them as successful and learn from them about the struggles that may face women in engineering. A distinct aspect of this category is the lack of interaction between the mentor and mentee; much of each mentee's perspective on the mentor is through observation from afar. They are categorized as mentors because in both cases, the participants included them as examples of mentors, and although they are limited in their one-on-one interactions these mentors still provide an example of success and inspiration to these mentees. As discussed below these mentors also have the potential to serve as more comprehensive mentors in the future.

Table 6. Mentor as Role Model Relationships

Category	Participant	Matched Demographics	Mentor Demographics
Role Model	Toni	1	WF Prof
	Danielle	1	WF Prof

4.3.1.1 Mentor Characteristics

This group, which consists solely of women, emphasizes the way in which faculty can be effective mentors to these African American students despite limited contact. Each of the participants had taken a course from their role model or saw them in their department. As seen in Table 6, the aspect of matched gender seemed to be a valuable aspect of this type of relationship.

4.3.1.2 Interpersonal and Professional Aspects

This category encompasses mentors who are able to provide some insight into experiences that these mentees might face in the future, and/or who represent characteristics they aspire to. Therefore, these mentors provide a professional example of success to the mentees. However, some barrier hindered the development of a more comprehensive relationship. In this category, each of the mentees was able to express the characteristics they admire about these women, despite limited contact with them.

Danielle best identified what has hindered her relationship with her professor is also a trait that she admires, and she does hope to change the status of their relationship in the future:

She is the epitome of "professional" to me. That's actually what makes it so intimidating. She came to class, she always looks really, really nice. She knocks it out of the park with intelligence, and she dresses nice. That's intimidating to me, which is really hard to do.

Maybe if she was more outgoing, I'd go, "You're so cool." But I better not approach her given that. ... I'm not going to rule it out. I really want her to be my role model or mentor. I'm not going to rule out not being able to talk to her about being Black and an engineer [i.e. even though she is White]. I know that there's still a bunch more things that she can teach me regardless of whether she can answer that question. *Danielle w/ WF*

Despite the mismatch in race and some self-imposed barriers that Danielle believes are hindering her relationship with this role model, she certainly is able to see the benefits of developing the relationship. Danielle is able to reflect on the inability of this faculty to meet all of her needs as a mentor because of the mismatch in race, but is still able to see the value in the other types of advice she could potentially provide. And even without the direct interaction, this mentor provides a level of inspiration or aspiration for Danielle.

Toni's role model, too, was a woman she had as a course instructor, and this mentor provided specific knowledge of the struggles faced by a successful woman in engineering.

She actually says stuff in front of the whole class about how she's been perceived as a woman in the field. She's one of the top people in our college. I know that she said a lot of the guys there don't really like that. A lot of the male professors give her bad looks. They don't respect her to a certain extent. She's a very strong woman, though, so I look up to that. *Toni w/ WF*

Toni admired her role model's boldness to discuss her struggles as a woman in engineering in the classroom and admired the strength her honesty took as a woman in engineering.

4.3.1.3 Benefits

Although these mentees do not often interact one-on-one with the mentors they have been effective examples of success and strength as women in engineering. They provide the students the opportunity to see parts of themselves, successful women in engineering, and sources of insight into experiences they might face along their journey in the field.

4.3.2 *Mentor as Caring*

The mentor is perceived to make themselves available to listen to things personally and professionally relevant to the mentee.

Like the role models, mentors in this category served as examples, but added a personal dimension in which they actually listened to mentees personal concerns. Care and intentionality seems to be the core of this category. This category is the first in which the mentees experience both interpersonal and professional aspects. Mentees identify ways in which faculty show they care in a way that makes each mentee comfortable seeking them out for conversation.

4.3.2.1 Mentor Characteristics

The two mentoring relationships in this category have no clear pattern with respect to race or gender (Table 7); rather they are categorized by a level of compassion recognized by the mentee based on specific interactions with each of the mentors. Each of the mentors serve in a very different role within the institution, one as a tenured/tenure-track faculty and administrator, and the other as the director of a minority engineering program. The extreme variation in race and

gender among the mentors implies that neither factor serves as a barrier or benefit in showing a mentee care.

Table 7. Mentor as Caring Relationships

Category	Participant	Matched Demographics	Mentor Demographics
Caring	Taylor	0	WM Prof & Administrator
	Tiffanii	2	AAF Program Director

4.3.2.2 Interpersonal and Professional Aspects

The focal point of this category is the mentee's perception that the faculty member cared about the mentee. Taylor is able to best express the aspect of care through her mentor's actions in the classroom that revealed his approachability outside the classroom.

He always just had a really big heart for his students. I think the first day, he'd know all of our names and there would probably be 50 people in the class. It was really impressive. I felt really comfortable going to him for office hours or whatever I needed. From there, we just built this relationship where I could talk to him about my goals throughout school and he would give me some more additional advice about that. It all started, I guess, on some personal level. *Taylor w/ White Male Prof*

Through an act as simple as learning his students names, Taylor's mentor expressed his care for his students enough for her to feel comfortable to seek him out for assistance outside of the classroom.

Another important aspect of this category is the limited amount of time that the mentees felt that their mentor had to spend with them. Tiffanii recognized this as an aspect of her mentor's position and her obligation to serve a large number of mentees.

Tiffanii: She is super sweet. She's very helpful. I think that she does have a lot of students that she takes care of. I think that's not realistic to have a hundred mentees. I don't think that's realistic. She does the best that she can with what she has... She

can't go talk to, like connect with, do all these other stuff with every single students. I feel like she did, I think, her best. She gave me advice.

Interviewer: Is there an example of something that happened in your relationship that really stood out to you?

Tiffanii: I'll just say her, more than the relationship. I just feel like she was very positive, and there's not a lot of positive people out of Univ. X. *Tiffanii w/ AAF Program Director*

Tiffanii found her mentors positivity and kind nature to be beneficial. She felt that the existence of her mentor within the university was significant, based on her negative perception of the university environment and the limited number of people she felt could show her that positivity.

4.3.2.3 Benefits

Although these mentors were considered successful as examples who could be sought out for casual conversation, they were limited in what they could actually provide in this hierarchy. They showed the mentee that they cared, were open to conversation, and were willing provide a listening ear and occasionally some general advice. These types of interactions allowed personal relationships to be established that provided students a safe haven to discuss aspects of their lives and receive positive support and openness. Despite a willingness to be a listening ear, however, the way that these mentors are discussed by the participants, they appeared burdened with a number of mentees and therefore only played a minimal role in the participants' lives.

4.3.3 Mentor as Just in Time

The mentor is perceived to render specific advice to aid the mentee in decisions pertinent to their professional success.

The mentees in this category valued the ability of their mentors to provide just the right type of advice at just the right time. The addition of advice within this category gives it more of a professional focus, which is reflected in the type of advice the mentees received. Unlike the general

advice associated with caring mentors, Just in Time mentors typically provide concrete advice on specific questions or issues.

4.3.3.1 Mentor Characteristics

The three mentors in this category serve in different roles within the university. Stefani interacted with a female professor in the classroom as well as with an administrator with whom she had little to no contact with before their seemingly most impactful conversation. Erica also experienced Just in Time mentoring from an administrator outside of her engineering discipline, which may have impacted the type and extent of advice he was able to provide her. Each of these relationships can be seen in Table 8.

Table 8. Mentor as Just in Time Relationships

Category	Participant	Matched Demographics	Mentor Demographics
Just In Time	Stefani	1	Female Intro Professor
	Stefani	0	Indian Male Administrator
	Erica	1	AAM Program Director

4.3.3.2 Interpersonal and Professional Aspects

The mentees in this category specifically sought out their mentors in order to garner advice for a specific objective. In each case, the mentee targeted the individual because she believed that the mentor was knowledgeable in the area about which she was seeking advice. In exchange, the mentors in this category deliver useful statements that seemed to be just what the mentee needed at the moment. Stephanie recalled a conversation with a mentor who gave her some valuable advice about deciding to take a job over a study abroad experience:

The biggest thing I got from that conversation was prioritize- the job that's not going to happen again. That's something you should prioritize..... Which was pretty much what I needed at that moment. *Stefani w/ Female Prof*

The insight that her mentor provided seemed to be precisely the advice she need at the time, hence the designation of 'Just in Time'. In a different situation, Stefani was looking for

answers about the options that she might have at the completion of her degree, and she sought out her department chair who was able to give her just in time advice that she felt left a lasting impression:

I would go to him for those kind of questions and he would kind of guide me in those career choices. But I also don't keep a consistent contact with him either. I feel like whenever something pops up I go to someone who is like, "who can help me with this problem?" Then that's it until I have a next thought in my mind.

With him, what stuck was the concept of 'do what you love and make money.' I feel like that was the most important thing I got from that conversation and that's why I was going to him, was like, "I don't think that I love [major] engineering." I know that I can make money from it. He pretty much told me that the degree in itself, you do so much with it but you can definitely find what you love so don't give up on it yet. That was the big thing that still resonates with me. Now I feel like I'm still on that journey of 'I have this very broad knowledge, let me try and find something I can apply it to and enjoy.' *Stefani w/ Indian Male Administrator*

Stefani believed that this mentor's previous experience and role as an administrator gave him the wisdom necessary to provide her with precisely the information she was looking for when she felt she needed it most. Stefani was unique among the participants in that she acknowledged that she was very intentional in her selection of mentors based on the needs she had at specific points in her career. She sought people who she knew could give her precisely the answers that she was looking for. Although she didn't describe her search process in detail, it seems that at some point she had researched the mentors that she was seeking in advance in order to know what each person had to offer.

Although the knowledge that was shared by these mentors was highly impactful for these women, it was fairly specific based on limited personal knowledge about the mentee. Erica seemed to recognize lack of personalization, but was still able to find the value in it. Her mentor's role as

a Diversity Program Director provided him a great deal of experience with students and a wealth of information that could benefit almost any student, as Erica explained:

[He told her,] ‘If you do well and take the [engineering prep] program seriously, you’ll get a good GPA and you have no issues finding the internship. Eventually, you’ll circle back around and you’ll be helping the other kids.’ That’s exactly what happened. I guess his main role for me has always been able to process decisions. Not that I do everything that he says, but I definitely value his opinion because he sees so many students go in and out of his office with that type of questions. *Erica w/ AAM Program Director*

Erica certainly valued her mentors’ opinion, but recognized that not every bit of advice that he gave her would always be applicable to her. However, she recognized the experience that he had with students and could utilize his opinions when making her own decisions. Each of these mentees knew that their mentor could provide valuable advice and it seemed to be an important factor into why the mentee reached out to them for advice. However, the fact that only certain topics were discussed with each mentor indicates some knowledge by the mentee the limits to what effective advice the mentor could provide.

For both participants, these mentoring relationships consisted mostly of brief conversations, which is not surprising given the administrative title of two of the mentors in this category and the limited time they potentially had to spend with a mentee. However, these women were able to reflect on a significant piece of information they took away from these conversations (even if it was only a single conversation) and still consider each as a faculty mentor.

4.3.3.3 Benefits

These women were able to access mentors as resources for specific information they needed to make important professional and life decisions. Although all aspects of the advice provided was not always relevant to their needs, they were able to gather what was valuable. These women benefited from ability to identify mentors who could provide them beneficial advice in moments of need. Despite a lack of personalized advice, the general wisdom of their mentors was

of great value to them and helped them make decisions that were important to their professional success.

4.3.4 Mentor as Nurturer

The mentor is perceived to be invested in the overall well-being of the student, and provides nurturing and personal support to aid the professional success.

A reflection of a much more personal relationship, this category is full of mentee accounts of ways in which their mentors invested in many aspects of the mentees lives. The two mentors in this category provided the same type of advice that Just In Time mentors did, but both were much more fully involved in the academic, personal, and financial aspects of their mentees lives. These relationships can be seen in Table 9.

4.3.4.1 Mentor Characteristics

Both mentors in this group were African American females who served in administrative and staff roles within diversity/engineering support centers. Despite their matched racial and gender demographics, neither of these mentors were particularly connected with the field of engineering. As outsiders to the field, these mentors were able to provide support unrelated to academics, but also were hindered by their limited knowledge of some of the realities of being an AAF in engineering. Additionally, although not surprising, both mentees described the same two AAFs, and both mentees talked about these two AAFs more as a single mentor rather than as two separate individuals.

Table 9. Mentor as Nurturer Relationships

Category	Participant	Matched Demographics	Mentor Demographics
Nurturer	Deborah	2	AAF Program Director
	Shelly	2	AAF Program Director

4.3.4.2 Interpersonal and Professional Aspects

Although the emotional support was a major component of this category, the academic success of these students was still a recognized factor in their relationships. But the mentees also believed that they were clearly concerned with the overall well-being of the student and not solely their academic success. Deborah makes a clear acknowledgment of this emphasis by both of these mentors:

It's never a moment of, "We just want you to do well academically." It's, "How are you doing as a person? All that usually transcends into me having improved my academic performance. *Deborah w/ AAF Program Director*

As program directors, the role of these faculty is certainly to provide some academic support to the students, but they also make it clear to these mentees that they are equally invested in the personal well-being of the mentees as well.

Both of the mentees in this category experienced the ability to share personal aspects of their lives with their mentors in a way that was often reciprocated through the mentor's willingness to listen and share aspects of her own life. Shelly talked about her positive experiences with an AAF who was the director of a diversity center on campus:

Just support. Anything you tell them, they're not disappointed in you. You could disappoint them, but they don't necessarily show it, but there's always a positive attitude. Even when you come in down, you leave happier than when you arrived. They help you come up with something or just encouragement in general. Anytime I go into their office, I always leave happier than when I left....I just go there to check on them. I don't feel mad about anything. I just tell them how my week has been and stuff. How everything has been going since the last time we spoke. I guess they say that people like to talk about themselves to you; they'll like you. That's all they do basically listen and offer support if they can. *Shelly w/ AAF Program Director*

The relationship, described as very casually here, is reflective of the level of comfort Shelly felt in going to speak to her mentor whenever necessary, not only for tangible support, but for the emotional impact it had on her time at the university.

Deborah's experiences also reflected a great deal of emotional and financial support at the time she needed it most. In turn, her mentoring relationship altered her course in academia and how she approached others for help.

Just going through a lot of personal battles, financially and emotionally during that time period. I just went out on a whim and confided in this person. It took off from there. If it were not for ... I guess there's more than one individual, these two individuals, I would not still be here. I would not be an engineering student if I was still here. They've been my rocks in a lot of different ways since I've been here, especially because I'm 1000 plus miles away from my family. Having an additional support system to be able to guide me and provide that emotional support.

I think it was something that guided me to them and to trust in them because they're the first people I actually confided in with anything of that nature. I think from that point on, I was able to break down that barrier of me being able to confide in people and let them know a little bit more about my life moving forward.

Deborah w/ AAF Program Director

For Deborah, finding her mentors was a major turning point in her academic career as well as her personal life. She found mentors who could truly serve as a familial support to her when she felt she could confide in no one else.

4.3.4.4 Benefits

The roles of the mentors in this category were very reflective of maternal figures. Although they were limited in their ability to provide engineering-related support, they provided nurturing and care to these student when they most needed them, as well as a sense of family away from home. For both of these students, their mentors were able to meet needs that were being unfulfilled

by other faculty and staff on campus. And for Deborah in particular, the support of her mentors kept her in the field of engineering and at her institution.

4.3.5 *Mentor as a Reactive Listener*

The mentor is perceived to provide professional opportunities based on personal knowledge about the mentee.

Although like Nurturer, this category consists of four aspects, the two categories differ in their emphasis on professional rather than personal. The reactive listener mentors enact mostly the professional aspects of mentoring and therefore the mentees perceived a very different type of relationship. The mentees in this category facilitated the topics of conversation in these relationships. Each student shared with their mentor a desired goal or interest that the mentor was able to provide a resource toward that went beyond simple advice. The mentor invested enough time to listen to the mentee and provide a specific opportunity that corresponded to the mentee's interest.

4.3.5.1 Mentor Characteristics

A unique facet of this category is that it is composed entirely of male administrators as seen in Table 10. Potential explanations for this gender imbalance could include the amount of time they had to offer as well as about the types of roles that male mentors tend to play. More discussion about these potential explanations will be discussed in the chapter 5.

Table 10. Mentor as a Reactive Listener Relationships

Category	Participant	Matched Demographics	Mentor Demographics
Reactive Listener	Taylor	1	AAM [Haitian] Administrator
	May	0	WM Prof & Administrator
	Deborah	1	AAM Administrator

4.3.5.2 Interpersonal and Professional Aspects

The Opportunity aspect is key to the reactive listener. These mentors provide their mentees with specific opportunities to gain professional experience. In order to make these types of

opportunities available, the mentors are aware of the interests and desires of their mentees because they have taken the time to listen and then act. Each of the mentees in this category described a specific opportunity their mentor provided. For example, Taylor had an interest in doing research in a specific part of the world. She sought out her mentor because she knew he had access to the types of opportunities she wanted to be a part of:

He is one of my mentors in [engineering major]. I knew that he had done some work in Haiti, he's Haitian, and I was really interested in the earthquake that happened. This is approximately a year after the Haiti, the big earthquake. I went and sent him an email. I said, "Hey, I want to talk to you about this. It's something that I'm interested in and getting involved."

I went and talked to him about that, just a casual conversation about my views on that and what his views on that were since he'd been there and seen it. From there, we started to build a relationship based on a common interest. I did research with him. *Taylor w/ AAM [Haitian] Administrator*

For Taylor, as these comments suggest, the opportunity was research experience with her mentor in an area that was of interest to her. But these tangible opportunities came in different forms. For Deborah whose mentor interacted with her as both advisor for a student organization and a department chair, she had several opportunities to share her interests with him, and in return he became a valuable resource for letters of recommendation.

That's how I actually connected with him, more so from a major perspective, from a [student organization] perspective because he does serve as our [student organization] advisor. He's writing one of my recommendations for grad school, and he's a homey too. He's been a lot more of an academic mentor as well, not necessarily a personal level. *Deborah w/ AAM Administrator*

Notably, Deborah was able to make a clear distinction about the type of support that her mentor was able to provide (professional vs. personal) and the types of resources he was able to provide her. Although she had established some level of rapport with her mentor, as a "homey," it

was clear that the basis of their relationship remained professional, a consistent trait among all of the mentors in this category that separates them from the Nurturer mentors.

Importantly, the professional aspect of providing opportunities was in many ways contingent on the interpersonal aspect of listening. May, in fact, was surprised that her mentor had acted on knowledge about her interests that she had shared. His ability to connect her to a project related to her interest was a major component of their relationship.

[The mentor] he knew I was interested in going back to Haiti and helping eventually, after I graduated. What he did for me is he talked to that [administrator] and he got me to be able to sit in on a meeting with Haitian delegates that came to our school to talk about how they partner up with the school. I thought it was amazing. The fact that he did for me ... That's how I was ... He's like the best professor you could really ever have. He's really there for you. *May w/ WM Administrator*

Because her mentor had listened to May's interests, he was able to react and connect her with someone who could fulfill her desires to work on projects relevant to Haiti.

4.3.5.3 Benefits

Unlike the guidance in previous categories, Reactive Listeners provide their mentees with something tangible in the form of professional opportunities. These mentees felt their mentors listened and made an effort to provide them with opportunities that would address/help the mentioned need. The opportunities provided professional experience in their field that specifically aligned with the mentees' interests. These opportunities were certainly customized to the needs of the mentee, but did not necessarily reflect the kind of personal relationship seen in the Nurturer category.

4.3.6 Mentor as a Proactive Supporter

The mentor is perceived to actively invest time to develop the mentee's professional skills based on a vested interest in the personal success of the mentee.

Two mentoring relationships can be classified as proactive supporter. The mentees in this category discussed ways in which they believed their mentor invested a great deal of personal time in getting to know them, much like the Nurturer mentors, and helping them not only access professional opportunities like the Reactive Listeners, but also develop the professional skills needed to be successful. The participants discussed concrete ways in which these mentors reinforced their competencies and successes in the context of a more personal and invested relationship.

4.3.6.1 Mentor Characteristics

Each of the mentors in this group were identified by the participants as women who shared no racial demographics with the mentee. Taylor's mentor served as her research advisor, while Michelle's mentor was her assigned academic advisor and Erica's mentor played a role that included both aspects. These relationships can be seen in Table 11.

Table 11. Mentor as a Proactive Supporter Relationships

Category	Participant	Matched Demographics	Mentor Characteristics
Proactive Supporter	Taylor	1	WF Research Advisor
	Michelle	1	WF Academic Advisor
	Erica	1	Middle Eastern F Prof

4.3.6.2 Interpersonal and Professional Aspects

The mentees in this category expressed receiving all of the professional aspects, but the primary aspect of this category was professional development. These types of mentors made an effort to genuinely reinforce the capabilities of their mentees and aid them in areas where they needed to improve. Taylor expressed the level of investment that her mentor grew to have in her and the impacts it had on other areas of their relationship. As was common among all the mentees in this category, Taylor explains how her mentor was extremely honest with her about areas that she needed to improve on, but also provided her with the resources and support she needed:

She's the type of person who's not going to put a lot of effort into somebody who's not going to put effort in herself. I think when she saw me putting an effort, she was a lot more open to guiding me along where I needed to go. She's been brutally honest, but at the same time, has given me the things that I need to succeed, so it's been helpful...when she sees opportunities, she'll send me an email and be like, "Hey, I thought of you for this." *Taylor w/ WF Research Advisor*

Taylor saw her mentor reciprocating effort once Taylor showed that she was invested in herself. Once this personal investment was established, Taylor's mentor became an advocate her success in a number of different ways that included opportunities, but also went beyond to help Taylor develop herself. Similarly, Erica found that in addition to providing tangible opportunities for her, her mentor was also endorsing her among larger networks:

She has really been supportive of me. She wrote two of my recommendations for grad school. Not only does she talk to me, but she also represents me as well and vouches for me. I really appreciate her doing all of it. *Erica w/Middle Eastern Female Professor*

Importantly, though, the same mentor also worked with Erica to better be able to present her qualifications and success when she was applying for different opportunities. This development of Erica's skills is what separates her mentor from the Reactive Listener who simply provided recommendation letters:

[S]he was really big on helping me finish my Fulbright application. I would bounce my proposal off to her and she would give me suggestions and send it back and be like, "Hey, change these few things." That was incredibly helpful to have her eye; for someone who does research and writes proposals to be able to tell me what's right and what's wrong. *Erica w/ Middle Eastern Female Professor*

The efforts made by Erica's mentor were an investment of her time to help Erica be successful in her academic and professional career.

Beyond providing professional development, Erica felt that her mentor was truly invested in her, a sentiment shared by all of the mentees, because of the personal interest she took in her very early on:

Just being able to have someone that has taken a personal interest in me and has stuck with me since sophomore year and is helping me transition into the next phase of my life has been really important to me because I have people that I can talk to at school but they're not specific to my major. The fact that she's a woman too I think helped. *Erica w/ Middle Eastern Female Prof*

This sense of long-term investment is the second element that separates this group from the Reactive Listeners. The support provided by these mentors were personalized to the mentee based on the mentor's investment and recognition of the specific needs of the student. As a result, these mentors were able to reinforce the strengths that their mentees demonstrated, which helped to increase the mentees self-esteem. This relationship seemed to have a genuine impact, as when Taylor described knowing that someone else recognized her strengths even when she was unsure about them.

That's been really meaningful, I guess, because there are times where you're like, "Am I doing things right? Do people trust me enough? Am I showing myself in the best light to where people can understand that I'm capable of doing these things?" When she sends me those things, yes, I am. It's fine. Someone believes in me, so that's okay. *Taylor w/ WF Research Advisor*

Taylor reflected on the reassurance she felt regarding her abilities because her mentor was suggesting opportunities and believed that Taylor was capable of being successful in those roles.

Michelle best describes the development efforts of these mentors through her experience with her mentor, who believed that she was a phenomenal student, but recognized that she needed to be involved in a broader array of activities. Specifically she recommended several leadership opportunities that helped Michelle broaden her skill set.

She thought I was great, I was a [athlete] back then and she saw my grades and she's like, "Oh, my gosh. You're awesome." and "How do you balance this?" and.... I don't know. She just talked to me about life and in general where I was going. She was really interested in where I was headed even my freshman and sophomore year when I didn't even know. So I think just an instant connection when we met and also her ... she was really interested in what I wanted to get out of University X and also how University X could basically influence my career. So I think that's where our relationship kind of started. And she's emailed me about opportunities of whether its minority opportunities or getting more involved with [engineering major] - like I'm an [engineering major] ambassador because of her. I work with the curriculum because of her so it's just - she reaches out to me about stuff, getting involved. *Michelle w/ WF Academic Advisor*

The encouragement that Michelle's mentor was able to provide pushed her to embrace new opportunities and develop in a number of ways that would be beneficial to her engineering career and personal development that she may not have sought out on her own.

4.3.6.4 Benefits

Mentees clearly noted Proactive Supporters' active efforts to develop the mentees' skills, self-esteem and self-efficacy. These women feel that their mentors were constantly providing them with the skills that they need to improve academically and professionally, while also reassuring them of their competence and ability to succeed through a sense of personal investment.

4.3.7 Mentor as a Guide

The mentor is perceived to share the mentee's racial demographics, understands her personal and professional experiences, and is willing to serve as an example in developing the mentees success.

Four mentoring relationships within this study can be categorized as a guide. As the most comprehensive category, Guides are perceived to provide all of the aspects of interpersonal and professional support depicted in Figure 5. Nicole's comment best captures this comprehensive balance as provided by her mentor:

What really stands out to me, just in general, my mentor does this a lot, is just making sure that I'm on track as far as academia and also just personal life.

Nicole w/ AA Male Prof & Research Advisor

Table 12. Mentor as a Guide Relationships

Category	Participant	Matched Demographics	Mentor Characteristics
Guide	Lisa	2	AAF Prof
	Toni	2	AAF Prof & Research Advisor
	Vanessa	2	AAF Research Advisor
	Nicole	1	AAM Prof & Research Advisor

4.3.7.1 Mentor Characteristics

The characteristics of these mentors are presented in Table 12. A key feature of this category are the perceived shared racial experiences between the mentor and mentee. Each of the mentors in this category are AA tenured/tenure-track faculty in engineering. For these AA engineering students, the value of these shared characteristics played a large role in the relationships. Toni talked about the many things that she felt she shared with her mentor:

How similar we are. We're both African-American females. She has a PhD. I want to get a PhD one day in the same exact thing she has hers in. That's probably the biggest thing that stuck out to me, finding somebody that I was shocked to find that at this school, especially somebody who was pretty much in the same boat as me...*Toni w/ AAF Prof & Research Advisor*

These mentors were able to serve as a visible example of success, a source of knowledge in how to succeed in a similar fashion, and a person who could understand their own experiences and struggles as an African American in engineering. As a result, many of the aspects in this category were enacted slightly differently in comparison to other categories. Therefore, examples for a number of the aspects will be provided in this section.

4.3.7.2 Interpersonal and Professional Aspects

The ability to serve as an example came in a number of different forms in this category. Not only did many of these mentors serve as examples of success, having earned concluding degrees and becoming professors, but they also serve as examples of engineers who are a passionate and enjoy the work that they do. Vanessa talks about seeing the passion her mentor exuded about her own work:

The passion that she exuded is the type of thing that I was ‘oh wow, she's really passionate about what she's doing’. That was the thing that really caught my eye. *Vanessa w/ AAF Prof & Research Advisor*

Simply seeing this passion from this faculty member who was like her was enough to spark Vanessa's interest in have her as a mentor.

Although the professional example was an important aspect of this category, the ability to provide both personal and professional support was a critical element. In part Nicole believed that the personal aspects existed because of the shared understanding of the African American experience.

I'm really grateful for that because just both academically and personally, he really cares, and I feel like the reason why he cares, or he cares a lot more in a sense because he understands, he had to go through the same thing [as an African American man], so he just wants us to be able to achieve whatever it is that we set out to do. *Nicole w/ AA Male Prof & Research Advisor*

Nicole believed that her mentor was more willing to provide professional support because he cared about and understood the experiences that she might face in her personal and academic journey as an African American.

The interpersonal aspects were most often enacted outside of the classroom. Vanessa talked about the event that her mentor hosted with her students to get to know them better and an obvious investment of care about the welfare of her students:

Having picnics, or gatherings, or things of that sort to get to know you on a more personal level. Aside from just being an academic atmosphere, doing things outside of school hours. She was willing to talk with you outside of the classroom. It wasn't just a job for her. You can tell that she is genuinely concerned about the welfare of those that are under her. *Vanessa w/ AAF Prof & Research Advisor*

Vanessa was certain about her mentor's level of investment in each of her students based on her actions beyond those required of her as a faculty member. For Toni, this level of investment was shown by her mentor once Toni made initial efforts of persistence and dedication:

I consistently came in and asked her questions and showed her that I was interested and serious about what I was trying to learn. She took me under her wing. *Toni w/ AAF Prof*

In turn, Toni's mentor made an investment in guiding her along her academic career. For Lisa, the effort her mentor exerted played a major role in developing their relationship.

She reached out the most to me. I would literally hide because for instance when I finished her class, I wasn't too proud of what have I did. I tried to avoid her because I was embarrassed. I was like no, and she's like hey come over here, how about you come to my office and we talk. *Lisa w/ AAF Prof & Research Advisor*

The extra effort by Lisa's mentor removed the barrier of embarrassment that Lisa felt about her performance in the class. A relationship was able to be formed because the mentor reached out to offer support despite Lisa's efforts of avoidance.

As the example above suggest, the relationships in this category included the aspects seen in other categories, but in these cases, the mentees also talked repeatedly about the shared experience between the mentor and mentee as a key aspect of the relationship. Each of the mentees recognized similarities between themselves and their mentor. In some cases, these shared experiences emerged once the mentor first demonstrated their ability to fulfill the other interpersonal and professional aspects, listening, advice, and investment. For Lisa, this

identification of similarity allowed her mentor to become a source of knowledge how to overcome the obstacles that she might face in the future:

She also is a really good listeners and she had really great advice about especially because she's also African-American and she's achieved so much and she's super young. I wanted to find out more about how she did it. What kind of obstacles she went through. I don't think I would have talked to her as much if she didn't reach out as hard as she did. *Lisa w/ AAF Prof & Research Advisor*

Despite the initial barrier that may have existed because of Lisa's hesitancy, Lisa found her mentor to be a valuable resource and example. Because Lisa perceived that her mentor could relate to her experiences, she wanted to know more about her mentors' journey. Lisa also realized how much she would have missed out on in the relationship had her mentor not reached out to her.

Toni found great value in having someone who not only shared her racial and gender experiences, but her career goals. Her mentor was able to provide insight that no one else could:

Nobody in my family is an engineer. Most of my family didn't even attend college. Having somebody there that's knows what it's like and can give me advice when I felt like I had nobody to go to is really important to me. *Toni w/ AAF Prof*

It seems that Toni found great value in having someone in her field that she could go to who is willing to offer her advice.

Although Nicole's mentor did not share her gender demographics, because they shared racial demographics she felt he had a greater level of understanding than other faculty that she may have encountered. She felt this shared understanding impacted the ways that her mentor interacted with her and his desire for her to be successful:

Actually, my faculty mentor is African American. I think that plays a huge role. He identifies better and I feel like he's a lot more understanding. I feel like I got lucky in a sense, and I kind of feel like that's sad because if I worked in a different lab, I don't think I would have that same experience, just because I'm Black, honestly. I still have to work hard, there's no slacking, but just kind of that

feeling of knowing I don't have to prove myself, in a sense ... because we have that sort of understanding amongst each other, that we're all equal regardless of our skin color. In other places that's not always the case, people don't always see it that way.

Nicole w/ AAM Prof & Research Advisor

Nicole's perception of him provides some insight of how salient race was to her relationship. It was her belief that interactions with faculty of unmatched race would not have that equal level of understanding.

4.3.7.4 Benefits

The students in this category gained a number of things from their mentors. One significant benefit that Toni expressed was an increased sense of self- efficacy:

I feel more prepared in general. I feel like I'm not just wandering without any sense of direction... I feel better prepared to be an engineer. *Toni w/ AAF Prof*

These four mentors who showed significant care for the personal and professional aspects of their mentees lives were perceived most often to do so because they shared many a number of characteristics with the mentee: race, career, and gender. These shared experiences created an air of shared understanding that was highly valued by the mentees. Finally, as successful African Americans in the field, they served as an example to be modeled, but also someone who was willing to aid the mentee in developing her own success.

4.4 Initiation of Relationships

The majority of the relationships in this study were initiated through an informal process without the involvement of a third party. The three exceptions were one mentor who was an assigned academic advisor and two other mentors met through an event hosted by a formal program. The informal relationships begin through a variety of mechanism that included actions by the mentee, actions by the mentor, and meetings through departmental interactions. Table 13 summarizes the initiation mechanisms for each relationship.

Table 13. Initiation of Mentoring Relationships

Category	Participant	Mentor Demographics	Initiated
Guide	Lisa	AAF Prof	Took her class & stopped her in the hall
	Toni	AAF Prof & Research Advisor	Introduction by administrator
	Vanessa	AAF Research Advisor	Took her class & was interested in her research
	Nicole	AAM Prof & Research Advisor	Heard at presentation, sent email and went to his office
Proactive Supporter	Taylor	WF Research Advisor	On a research project together then took class & wanted to do more research with her
	Michelle	WF Academic Advisor	Assigned but instant connection b/c of bubbly & happy personality of mentor
	Erica	Middle Eastern Female Prof	Was hanging out in the dept. office asking questions
Reactive Listener	Taylor	AAM[Haitian] Chair	Student sent email about specific interest
	May	WM Prof & Dean	Organization dinner function then took his class
	Deborah	AAM Dept. Head	[Org.]advisor & dept. administrator, did some research with him
Nurturer	Deborah	AAF Program Director	Applied for program through their office
	Shelly	AAF Program Director	Random meeting in the mall
Just In Time	Stefani	F Intro Prof	Went to office hours for help w/ homework
	Stefani	Indian M Chair	Scheduled a meeting & went to see him (researched him first)
	Erica	AAM Program Director	Through minority program
Caring	Taylor	WM Prof	He learned students names in class & felt comfortable going to office hours
	Tiffanii	AAF program director	Through minority program
Role Model	Toni	WF Prof	Took her class
	Danielle	Female Prof	Took her class

As Table 13 shows, there is no consistent pattern to how these mentoring relationships were initiated. It is possible to note, however, that for all of the relationships, the mentees perceived a sense of approachability and care from the mentors that aided formation. In a few cases, mentees

mentioned having heard positive feedback from their peers about certain faculty's genuine desire to assist students. Five of the relationships stemmed from classroom interactions, indicating that perceptions of faculty are certainly established within the classroom and often blossom during office hours. From the initiation through programs hosted by others, students are provided the opportunity to know their faculty outside of the classroom and garner a different perspective. A key aspect to those types of functions seemed to be the appeal of free food for students.

One important perception that came up in a number of the interviews was the realization that faculty were busy people and often the mentees feared 'bothering' them. This perception could have played a large role in how many of these relationships were initiated, depending on the level of accessibility a mentor was able to demonstrate to the student. In a few cases the mentees acknowledged the limits of their relationship with faculty based on time constraints. Erica provides a very clear example of this acknowledgment, citing the numerous responsibilities and roles that faculty members have and describing how she believes that balance should play out between a mentee and mentor as a result.

She was the advisor for the ambassadors last semester. She has a husband and she has kids. She's a higher authority than me. She has more rank. She already has her PhD and has taught at other schools so I can't be like, "Hey, Dr. [mentor's name], you didn't return my phone call yesterday." It's up to me to find her and really pursue her and be flexible on her schedule even though I have a busy schedule.

I don't have a husband. I don't have bills. I don't have kids. I'm not teaching classes. I acknowledge her and I respect the path that she has taken to get where she is. I know I need to come to her.

At the same time, a real mentor, I feel like will make themselves available to you. They're not impossible to find if they're truly your mentor because there's that care component, they actually have a personal investment in your success but at the same time they're not a genie and they're not just magic person that's just going to fix your life.

There is a degree to which they do can, they will make themselves available and flex their schedule if they can. For the most part, I'll say it feels like a spectrum from 0 to 10, I'm like up to the 7 and then they can do the 3.

All the studying and doing research and scheduling the meeting to come in their office and then they'll be available. Then they'll talk to me. They'll give me the advice. *Erica w/ ME female Prof*

Erica recognizes that her responsibilities may not be as great as her mentor's, but she also recognizes that a true mentor will make the time and effort, and cares about their mentees success. It is also Erica's belief that as the mentee she should put in 70% of the effort and leave 30% for the mentor to provide what is needed to the mentee. This perspective is certainly reflective of many of the aspects within the outcome space. In many of the relationships the mentees sought out their mentors for specific needs and got exactly what they needed despite the limitations of faculty time. Although some of the mentors were perceived as investing less into the personal realm of the mentee, all except those in the role model category cared and made time enough to listen or provide an opportunity. This quote is also indicative of the limits of several of these relationships because students often equally did not invest a large amount of time in further developing the relationship, potentially due to a lack of need beyond what they received or recognition of the limits of their mentors' abilities to provide only specific aspects.

4.5 Unsupportive Relationships

Unfortunately, not every faculty mentor described by participants was effective. Some faculty had the potential to be an effective mentor or at one point had a successful relationship that later failed. Although the focus of this study was to understand the aspects of successful faculty mentors, these counter examples are included here because they add value in understanding the experiences of these women. Descriptions of these relationships can be seen in the categories in Table 14.

Table 14. Unsupportive Categories

Category	Description	Participants	Mentors
Short Lived	A relationship that the student believed could have been successful, but ended sooner that the student would have liked	Ruth	AAM
		Lisa	AAM
Invested yet Ineffective	Less than desirable advice administered with positive intent that limits the mentees future interactions with the mentor	Tiffanii	AAF
		Tiffanii	Indian M
Discouraging	Makes the student feel inadequate or incapable of succeeding	Melissa	AAM
		May	AAF
		Tiffanii	WF

4.5.1 Short Lived

The mentees described a significant amount of contact and effort by these mentors. Unfortunately, though, the relationships were deemed ineffective by the student for several reasons.

For Ruth, her relationship with her AAM professor started out positively as she sought him out for assistance during office hours, which he encouraged her to come to. Their relationship grew to conversations about both of their personal lives. Unfortunately her lack of success in the course abruptly ended the relationship. She was disappointed in this breaking of ties, especially after she reached out via email.

One of my teachers was a Black male... And he really thought highly of me. Which you should. His class was just really hard. So he would try to help me, and help me. And I would go to office hours, we'd talk.

And I know that he was trying to be my mentor. Like, I told him about [personal issue] the problems I was having. He was talking about his family, and blah, blah. He was trying to help me out, and final time came, and I totally bombed the final. And I know, I feel like he was very disappointed in me, because when I did send him an email about it, I was like, hey, I know I bombed the final, I'm sorry.

Like, I ended up getting a C in the class, which I'm pretty sure he gave to me, because I don't know how else I would get that. But I emailed him to kind of apologize, and he didn't really -- Not really. He didn't respond at all. And I haven't seen him since. I think I saw him on campus once, and he was like, oh, hey, Ruth, how are you? And I was like, hi.

And that was just kind of it. Not that, I mean, he didn't try to reach out to me, and I guess, I mean, the class is over. I really, I tried in the email, but he didn't respond. So I was like, maybe he's just upset, because he expected more out of me.

Ruth w/ AAM

This relationship could have continued to blossom and be a great source of support for Ruth over the span of her academic career, but the level of perceived disappointment from the mentor hindered the progression of the relationship.

Similarly, Lisa acknowledged that her mentor had very high expectations of her academically and when she did not meet his expectations he reacted in a way that was discomforting for her. In turn she limited how much she shared with him.

He's very, he's almost like he's ambitious for you. He was super awesome and I want that for me too, but he's a lot like my dad too, the fact that he just cannot understand how I got a C in a class and he just couldn't take it, what is this. He meant well. He expects so much out of me but I was like Okay, I'm not coming [to see him] for a while. *Lisa w/ administrator male*

She appreciated that he was ambitious for her, but it seems that his approach did not appeal to her and therefore limited her willingness to engage with him more frequently.

Both Ruth and Lisa had mentors who listened and invested, but couldn't help the mentees develop where they were weak.

4.5.2 Invested yet Ineffective

The mentees in this category describe these faculty as being greatly invested in providing support, but their lack of listening hindered their ability to properly provide for the needs of the mentee.

Tiffanii had the opportunity to connect with a fully matched mentor, an AAF. Although the mentor did not receive tenure and left the institution, she still made an effort to reach out to Tiffanii and check-in on her. Unfortunately, Tiffanii often perceived this mentor as negative in the type of advice that she provided:

There is another woman who is in my department, and African American woman, who unfortunately lost her job in the department, or didn't get tenure. She was somebody who I would say a mentor, per se, kind of I say, mentorish. She was so negative. She was so negative, like, "Oh, I don't think you'll be able to do it. Oh well, you gotta consider this. Oh well, not everybody can do that." Just like that very undertone, thick layer of negativity. She reaches out to me a little bit, more than I would say I reach out to her. She's just like, "Oh, how is everything going?" That's like the extent of it. *Tiffanii w/ AAF*

Although Tiffanii could recognize that her mentor was putting forth a great deal of effort to connect with her, their relationship was also hindered by what Tiffanii perceived as a very negative perspective. Although this mentor continued to reach out to Tiffanii from afar, her termination as a faculty member also hindered the extent of their relationship as she could no longer represent a successful example.

Tiffanii also had the opportunity to interact with an AAM faculty member, but again, the relationship was ineffective. She often felt that although he was always willing to give her advice, he was providing information that did not pertain to her.

[He] doesn't know me like that...doesn't know my background, so he's telling me what his perspective is of me or his life is" *Tiffanii w/ AAM*

This relationship is missing a fundamental aspect that served as a foundation for six of the seven effective relationships above, listening. It seems that this relationship could have been more effective if the mentor had taken the time to listen to what Tiffanii's needs were or get to know her better. Listening may have helped him to understand what aspects they shared and in turn what advice he could provide that she could relate to.

4.5.3 Discouraging

The mentees in this category received a strong message that these faculty did not believe the students were cut out to be engineers. In some cases, these messages were expressed through subtle actions and statements, but others were clear and direct.

Melissa's interaction with the administrator of a diversity program, for example, made her feel as though the program coordinators were disappointed in her because of her lack of academic excellence.

I started not to do well. This could be either my reflection of myself onto them or it's genuinely how it was.

I didn't do so hot after my sophomore year. I was just kind of like, oh no, they're all disappointed in me, I'm making the program look bad, that kind of thing. I don't know. I feel like when you're a director of a program, you can only keep up with so many people. There's that. I feel like those he was close to or worked with that department, or students who were always there, of course you're going to have a better relationship with. I guess I just felt like because I wasn't a star student, I wasn't worthy of their time kind of thing. I'm only going to invest my time into those who we know are going to make 3.5s and higher. *Melissa w/ AAM*

Melissa's interactions with a potential mentor translated into a perception that she was unworthy of the program director's time because of her grades. Although she expressed an understanding of his role as an academic program administrator, it seems that she was in need of some personal support in addition to academic support. In this case, she felt the director was unwilling to provide that support, this lack of investment by the mentor certainly contributed to the unsupportive nature of the relationship.

In Tiffanii's case, the discouragement was also implied in her interactions with her research advisor. Although Tiffanii could recognize that her mentor was concerned with her GPA and how it would play into her acceptance to graduate school, she found her advisor's approach to lack any kind of positive encouragement or belief in her. Tiffanii was able to suggest a potential approach that may have made the relationship more productive:

It was like the conversations that were consisted of or, "Oh well, are you still trying to go to grad school because you need to have this GPA, you need to have this." She was aware of all that stuff. It was just like, "Are you encouraging me? Are you saying I can't go?" It wasn't like, "Oh my goodness Tiffanii, I know you could do it. Just pull up these grades."

There is a completely different approach to if you are trying to have somebody be successful or that you are just like, "Well, you're really not where you need to be." I'm just like, "Okay, I have professors telling me that all the time. I don't need to come to you, like hear that. I do know." *Tiffanii w/ WF*

It seems Tiffanii may have been looking more for constructive criticism instead of the constant reminder of poor grades that she felt she was already receiving from her other faculty members. Although Tiffanii's mentor didn't explicitly discourage her, she did not experience the same kind of encouragement and professional development that other students received from Guides and Proactive Supporters.

Lastly, May had the misfortune of a more directly discouraging conversation with her academic advisor. May truly believed that this woman may have been a good point of contact and potentially a mentor; however, their one conversation turned out to be the first and last conversation that they had when her advisor said, "Maybe you're not cut out to be a [major] engineer" (*May w/ AAF*). The important aspect of this conversation is that May believed there to be no basis for this statement as the advisor had no prior knowledge or insight about May and therefore made a generalized assumption based solely on her GPA in non-discipline specific courses.

Unfortunately, in each case the mentees received no positive reinforcement, belief or hope to these students. As a result of their limited personal knowledge of the students, they tended to pass judgment on these women and their ability to succeed.

4.6 Hope

Finally, one participant who was included in the final analysis merits a separate discussion because unlike all the other participants in the study, Hope, ultimately had no mentors, effective or otherwise, not without effort. Hope's story, though outside the primary focus of the analysis, is

important to include here because it points to the need for better mentoring of AAFSSs. Hope expressed her experience as an undergraduate in engineering as a lonely journey without guidance and mentoring, despite numerous efforts to seek mentors. In turn, she expressed a desire to leave the field at the completion of her degree. She believed that with the aid and guidance of a mentor, she would have been able to better navigate some of the challenging experiences throughout her undergraduate experience, but without such mentoring, by the time of the interview she was no longer interested in trying. Hope talks in depth about how her identification as an AAFS has played a role in her experience:

It's even worse when you're a Black student because there's no one else here like you. I'm always the only girl. I'm always the only Black student and so when you're trying to reach out, make these friendships or make these connections with people, they're reluctant. They're just like this is not helpful.

Hope pointed out the salience of her race before her gender to explain her experiences but also to frame the challenges that both of these identities brought to her experiences.

Hope: I feel like, I do not necessarily reach out to people, but I found people that I thought could help me, but like I said before, it never materialized into anything. Something happened and it just didn't work out for whatever reason. Not to say that it happened a lot times. It happened once or twice.

Interviewer: Some people you felt could help you. Why did you feel they could? What made you go to them?

Hope: I felt like they were successful. I felt they were in the position that they were satisfied or they really enjoyed what they were doing. I feel like they had been where I am and they overcame that and they were in a position now where they had a lot of advice that they can give. I just feel like they were in a position where they have learned from something. They have learnt from what they have went through and they can give me that same advice and help me get through school as well.

It became clear from this exchange and others throughout the interview that Hope had, on several occasions, made an effort to reach out for mentoring with little success. She sought out people she believed could provide her insight on how to be successful in the areas she knew she was struggling, but the relationships simply never developed. One challenge for Hope may have been a narrow definition of mentor. When asked about what steps she might take in the future to acquire a mentor she again indicated the ways in which race and gender might play a role:

I guess I've gotten to a point now where the whole being Black thing is like being thrown out the window because it's so rare or so hard to find someone that looks exactly like me ...it probably won't be a requirement, more so, just someone who can actually just offer me advice.

Hope was aware of the limited number of matched mentors within her discipline and therefore of the challenge it was to develop relationships with those women. In turn, by the time we talked, she had accepted these facts and was ready to seek mentorship from anyone who would be able to give her the advice that she longed for. However, Hope was also aware of some of the barriers that come with having an unmatched relationship:

It wouldn't be an ideal conversation because they wouldn't have had the same struggle that I've had. They're going to talk about the things that they've been through. It's almost the same thing. I would talk to a White professor about me being a Black student and the only female student at the school. What would he be able to offer me, because he hasn't experience[d] the same things that I have experienced?

Hope's perception of an unmatched mentor's lack of ability to relate to her experiences supports the idea of Mentor as Guide, built on shared experiences, but excludes the possibilities identified in the other six categories. Hope puts a great deal of emphasis on a mentor's ability empathize with what she has experienced and provide her guidance and advice around those types of experiences. However, Hope's earlier quote suggest that she may be ready to find some value in having an unmatched mentor. She seems to have recognized that there are other (unmatched mentors) who can provide her quality advice on how to succeed.

4.7 Summary of Research Answers

The basis of this research was to explore the qualitatively different ways that African American undergraduate women in engineering experience faculty mentoring. To do so, I employed a phenomenographic investigation to answer the following questions:

RQ: What qualitatively different aspects of faculty mentoring relationships support African American female undergraduate students in engineering?

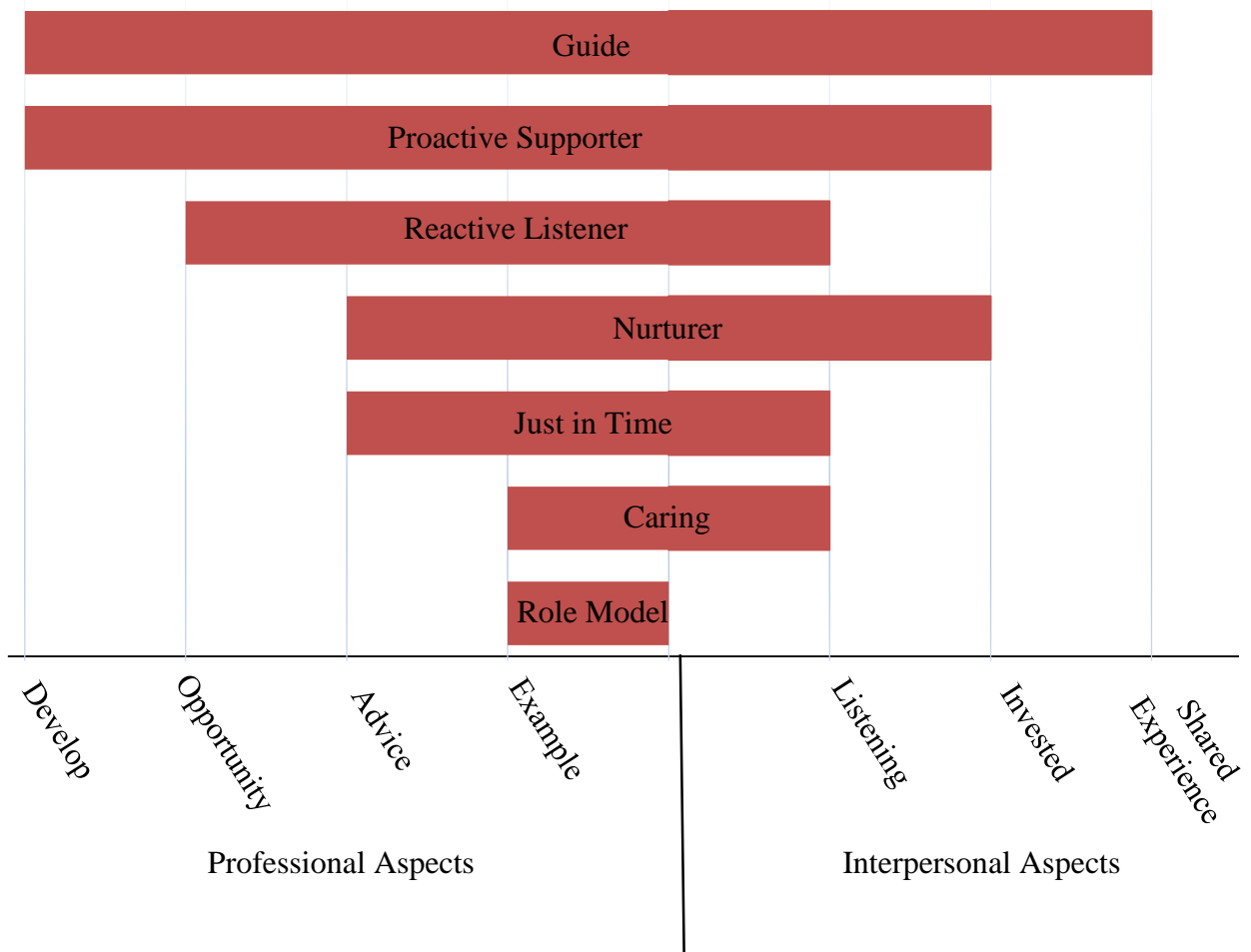
SQ a. How do African-American female engineering students initiate relationships with faculty mentors?

SQ b. How do the racial and gender demographics of the mentor effect the mentoring relationships?

4.7.1 Research Question

The answer to the overarching question resulted in the development of seven categories of mentoring: Role Model, Caring, Just In Time, Nurturer, Reactive Listener, Proactive Supporter, and Guide. Each of these categories consist of a set of aspects that were experienced by this group of AAFSs from their faculty mentors. The categories form a hierarchy of comprehensiveness, as seen in Figure 6. The more comprehensive categories represent mentors who are perceived to provide a wide range of support to their mentee. Less comprehensive categories in no way indicate ineffective mentoring, but rather indicate a narrower set of aspects that these types of mentors are perceived to provide. Every category represents effective mentoring and is able to shed light on the valuable aspects of a faculty mentoring relationship for this group of AAFS's in engineering. Section 5.2 discusses this aspects in detail.

Figure 6. Outcome Space



The two major aspects, professional and interpersonal provide insight on not only the specific things that mentees want, but the ways in which faculty are able to provide them. The professional aspects are the types of support that the mentees believe that their mentors are able to provide, while the interpersonal aspects are the faculty behaviors and characteristics through which those types of support are successfully provided. The aspects that fall into each category can be seen in Table 15.

4.7.2 Sub-Question A: Initiation

The results of this study turned up no major themes in the ways in which students initiated relationships with faculty mentors. What was significant was the informal nature of a majority of the relationships. All but two of the relationships formed informally through student actions, mentor actions, or departmental interactions. Notably, all of these informal relationships were established based on the mentee's perceived sense of the mentor's approachability. These mentors were able to assure these students that they were willing to support them in some way. Although students recognized the amount of responsibility that each of their faculty had, they knew that a true mentor would make the time to listen, care and support them. Section 5.2 discusses these findings in the context of prior research.

4.7.3 Sub-Question B: Mentor Demographics

There were several trends across the categories with regards to race and gender of the mentors. The results indicated that the mentees believed that mentors of matched race, Guide, were able to provide the most comprehensive mentoring relationships. These racially matched mentors had a unique ability to share and empathize with the mentees' experiences as African Americans. Mentors of shared gender, Proactive Supporter, were believed to provide the second most comprehensive support and were diligent in their actions to provide mentees with professional development. The all-male category of Reactive Listener were a bit less versed in their interpersonal involvement with students, but were still able to provide a significant level of support through the opportunities they provided. The only group of fully matched mentors, Nurturer, shared both race and gender with the mentees and were believed to excel in their interpersonal relations. However, this category also highlighted the value of a mentor's ability to share their mentee's area of study, and therefore role the faculty member holds within the university as salient to the mentoring relationship. The lack of experience with the field of engineering by the Nurturer mentors proved to limit the amount of support these mentors could provide, despite sharing race and gender with the mentee. However, at other institutions these faculty may have the engineering background to overcome this barrier. The categories of Just In Time and Caring had a mixed group of mentor characteristics, indicating that these roles can be provided by faculty of a range of demographics. Finally, the Role Models, all of whom were women in engineering, suggest that

these mentees value the existence of female mentors in engineering to serve as visible examples of who they can become. Overall, this variety of mentor characteristics across the categories show that faculty of differing races and genders can provide each of the aspects that are salient to AAFSs. This variation in mentor characteristics can be seen in the last column of Table 15. Section 5.3 discusses mentor characteristics in more detail.

Table 15. Summary of Research Question Answers

Category	Professional Aspects	Interpersonal Aspects	Mentor Characteristics (SQb)
Guide	Example	Listen	AA professor within the mentees engineering discipline
	Advice	Invested	
	Opportunities	Shared Experience	
	Developed		
Proactive Supporter	Example	Listen	Female professor within engineering
	Advice	Invested	
	Opportunities	-	
	Developed		
Reactive Listener	-	Listen	Male administrator
	Advice	-	
	Opportunities	-	
	Developed		
Nurturer	-	Listen	AAF program director
	-	Invested	
	Opportunities	-	
	Developed		
Just in Time	-	Listen	Mixed
	-	-	
	Advice	-	
	Example		
Caring	-	Listen	Mixed
	-	-	
	-	-	
	Example		
Role Model	-	-	Female professors in engineering
	-	-	
	-	-	
	Example		

4.8 Summary

The goal of this research was to answer the research question, what qualitatively different aspects of faculty mentoring relationships support African American female undergraduate students in engineering. This research has provided seven ways of understanding how African American women in engineering experience faculty mentoring. A mentor as Guide, Proactive Supporter, Reactive Listener, Nurturer, Just in Time, Caring and Role Model are qualitatively different ways in which this group of AAFSSs experienced faculty mentoring. Each category consisted of several aspects that represented how each way of experiencing mentoring was qualitatively different than the next. The basis of these aspects were either interpersonal or professional. Although some categories of mentors provided more aspects than others, each category of mentoring represents effective mentoring from the perspective of the mentee.

As the counterexamples show, however, there are some aspects that when not present in a relationship inhibit their success. The three counter mentoring categories of short lived, invested yet ineffective, and discouraging, although not the initial focus of the study, provide understanding of the aspects of a relationship that are ineffective and can be highly informative to faculty who desire to understand what exactly they should not be doing in order to develop effective relationships.

5 Discussion

The focus of this work was to understand the faculty mentoring experiences of African American undergraduate women in engineering, an area of mentoring that has for decades gone unexplored. The literature on mentoring theories and frameworks has for many years explored mentoring from the perspective of men and women separately, but most often without going a step further to understand how the intersection of gender and race might play a role. As both women and African Americans, the participants in this study had experiences from a mentoring relationship that overlap with previous literature, but also had perspectives unique to their intersectional position, and there has been little work done to date to explore this gap. Fortunately, this study provides insight into this area. Specifically, the results of this study provide three major contributions to the literature: 1) support of some well-known mentoring functions for this population, 2) perspective on mentoring levels and how they are enacted for this population, and 3) new insights into how race and gender factor into effective mentoring relationships among this population. This chapter discusses what the results of this study means broadly and how it contributes to existing bodies of knowledge. First, answers are provided to the questions posed at the beginning of this study. Second, these results are positioned against existing literature to highlight the additional insights developed from specifically examining the perspectives of African American women. Second, I present implications for faculty, administrators, and students that result from the study's findings. Next, I discuss the limitations of this study and possible future work. Finally, I conclude with a summary of the ways that this dissertation supports and expands current mentoring literature.

5.1 Discussion of Mentoring Functions

The aim of this study was to answer the question, “What are the qualitatively different aspects of effective mentoring for AAFSs in undergraduate engineering?” As presented in Section 5.1.1, the AAFSs included in this study perceived seven different categories of mentors: a Guide, a Proactive Supporter, a Reactive Listener, Just in Time, Nurturer, Caring and a Role Model. The aspects that compose each of these categories – development, opportunity, advice, example, listening, invested, and shared experience – build on several noted mentoring functions described previously, but also highlight some unique findings that both add to the current literature.

In Chapter 2, I presented many of the major functions of mentoring that have been established within the literature and summarized them in Table 16. As discussed previously, Ragins and Kram (2007) argued that although there were a number of theories around mentoring, there was little known about how the functions listed in Table 16 (or mentoring in general) were experienced by minority populations. With limited knowledge on the mentoring experiences of minority students, there was certainly no literature that explored the unique perspectives of undergraduate African American women, particularly within engineering education. To address that gap, this dissertation provides insights that can be used as a basis to further understand their experiences and situate them against existing mentoring theories and models.

Overall, the results of this study are consistent with much of the existing mentoring literature. In Jacobi's (1991) literature review of mentoring and undergraduate success, she identified fourteen mentoring functions from previous works. Distinctly, this work is most consistent with work by both Pembridge (2011) in engineering (based on Kram's model), and Blackwell (1989) on mentoring for African American's. This consistency indicates that this work captures both a piece of the identity of the participants as African American, and their domain of engineering. The functions identified in Table 16 (left column) from Jacobi (1991) (with the addition of Pembridge's work in engineering) focus heavily on the professional and career functions of mentoring and leave out a number of the more personal and psychosocial functions. Both Pembridge and Kram's models (highlighted below), which have been used in academia, include the function of friendship/rapport, counseling, and acceptance/confirmation. These functions are defined as psychosocial functions, yet still broadly describe actions that can be provided, rather than interpersonal practices that these functions require to be enacted but that clearly emerged as salient in the present study. The absence of these functions in Jacobi's (1991) literature review highlights the ways in which much of the research on mentoring continues to emphasize career development over the more social and emotional functions, and thus highlights the evidence of absence of the female experience within existing theories and models. Although most of these models are quite dated, they are still the most utilized to date, as evidenced not only by Pembridge's (2011) work, but also by more recent literature reviews such as Crisp and Cruz (2009).

Table 16. Foundational Mentoring Functions(adapted from (Jacobi, 1991))

Functions	(Levinson, 1978)	(Zey, 1984)	(K. Kram, 1985)	(Blackwell, 1989)	(Pembridge, 2011)
Acceptance/support/(emotional support&)encouragement	X	X	X	X	X
Advice/guidance	X	X	X	X	X
Bypass bureaucracy/ access to resource		X			
Challenge/ opportunity			X		X
Clarify values/ clarify goals (professional work ethic)				X	
Coaching			X		X
Information about education programs				X	
Protection		X	X	X	X
Role model	X		X	X	X
Socialization/ “host and guide”	X	X		X	
Sponsorship/advocacy	X	X	X	X	X
Stimulate acquisition of knowledge				X	
Training/ instruction	X	X		X	
Visibility/exposure			X		X

Below, Table 17 illustrates the relationship between the aspects identified within this study and many of those previously identified functions. These findings indicate that functions previously identified in literature are components of effective mentoring for this group of AAFSs in engineering as well. The emergence of “Role Model” as a specific category, in particular, reinforces Scandura’s (1992) claim that role modeling is a separate function, equivalent to Kram’s career and psychosocial dimensions. At the same time, this work also adds to the definition of several of those functions, highlighting nuances and practices that may be particularly salient for AAFSs as well as the types of people who tend to provide those functions to this population.

While the functions established previously identify “what” mentors are able to do, this work is unique in its ability to add to ‘how’ those aspects can be provided. The professional aspects that emerged from this study correspond with each of the functions identified previously, as seen in Table 17. The interpersonal aspects go a step further to indicate the ways in which mentees perceive these functions to be provided. The correlation between the functions and the interpersonal aspects can be seen in Table 17, which highlights the levels of effective mentoring that these interpersonal aspects support. For example, when mentors listen they are able to serve as an example and provide mentees with advice and opportunities. By serving as a “Just in Time” mentor, faculty are listening and are able to provide so much for their mentees. By going a step further, like “Proactive Supporters” do, and investing in a mentee, faculty members can help their mentees develop their professional skills. At the most comprehensive level, the shared experiences of a Guide provides more depth and breadth to each of the other aspects.

Along with the addition of the “how” aspect of mentoring provided by this work, there are also a number of areas that this work is able to expand existing literature. Unlike much of the literature these aspects emerged from an academic setting, from the perspective of undergraduate AAFSs in engineering at a research intensive PWI, and therefore provides a greater sense of the specific actions that are perceived as effective within this environment. It is a valuable finding of this study to recognize that different types of mentors are able to provide a broad array of functions, and this work argues that each of these categories of mentoring, regardless of their degree of comprehensiveness, can be effective.

Table 17. Outcome Space v. Previous Functions

Functions	Professional Aspects				Interpersonal Aspects		
	Develop	Opportunity	Advice	Example			
Acceptance/ support/ encouragement	X						
Bypass bureaucracy / access to resource		X					
Challenge/ opportunity	X	X					
Clarify values/ clarify goals (professional ethic)	X	X	X				
Advice/guidance		X	X				
Stimulate acquisition of knowledge	X			X	Role Model	Listen [C, JIT, RL]	Invested [F, PS]
Role model				X			
Information about education programs		X	X				
Sponsorship /advocacy	X	X					
Visibility/exposure	X	X					
Socialization/“host and guide”	X	X					
Coaching	X						
Training/ instruction	X						
Protection	X						

5.2 Initiation

Although there were no consistent patterns regarding the formation of each of the mentoring relationships, informal relationships seemed dominant; most relationships in this study were formed without the aid of a third party. The exceptions were a formal relationship with an assigned advisor and two others formed through an event hosted by a formal program at the institution. In most cases, however, mentees approached faculty based on their sense of the mentor's approachability. This student initiation is common among informal relationships and tends to be based on the mentee's perception that the mentor will be able to satisfy her needs (Roberts, 2000). For several of the relationships, in-class interactions with a professor allowed the mentee to identify a level of care and willingness from the faculty to aid students in both academic and personal needs. A few other relationships blossomed from shared research interests at times when mentees were able to observe faculty members' passion for their work. As this work stems from the students' perspective, it is critical for faculty to note that these mentees felt comfortable enough to approach their faculty in order to express their interests and personal circumstances and ask for assistance. Without some air of access from the faculty, these relationships may not have formed.

While perceived accessibility was important in formation, a number of participants also described relationships that were restricted due to lack of approachability or intimidation by a faculty member. In these cases, the mentee talked about wanting more from a relationship, but struggled to overcome this barrier. A related barrier that mentees often mentioned was fear of bothering someone who "has more going on than me, with my problems." This perception by a number of the mentees prevented their relationships with some less comprehensive mentors from possibly becoming more comprehensive. Importantly, participants did not describe this message as directly verbalized by the faculty; instead, they reflected the beliefs of the mentees. Unfortunately, from this data, it is unknown how many mentoring relationships did not form at all because of a lack of approachability by the mentor and/or a self-imposed barrier by the student.

5.3 Discussion of Mentor Characteristics

As described in Section 5.1.3, race and gender both appeared to correlate with different types of mentors. At the same time, although previous research has emphasized shared race and

gender as the most salient demographic factors, this study also highlighted another factor: the role of the faculty member within the university has a unique impact on the ways that these mentees perceived their relationships. The ways in which this characteristic impacts the mentoring experience of these students emerges in a number of ways.

Initially in this study a matched mentor was defined as someone who shared the same racial and gender demographics as the mentee. Literature suggested that having a matched mentor in these terms was preferred and often the most beneficial type of mentoring for minority students (Cole & Griffin, 2013; Ong et al., 2011). Unfortunately, literature also suggests that mentors tended to mentor those who shared their gender and/or racial/cultural perspective, suggesting that unmatched mentors might be unwilling to provide the necessary support for these women (Austria & Austria, 2010). However, the data from this study indicates that varying degrees of matched and unmatched mentoring can and do successfully occur, and each relationship can have its own benefits. **Error! Reference source not found.** presents the racial and gender demographics of the mentors in each category developed from this study. Within each category except Nurturer, variation in either race or gender occurs, suggesting that many of these mentoring aspects can be performed by a variety of people. The results again reflect the capability of cross-race and cross-gender relationships to be perceived as effective by this group of AAFSs in engineering.

Table 18 does show a high degree of matching within the most comprehensive categories, and a gradual decrease in matching in less comprehensive categories, with a few notable exceptions. This pattern suggests a perception of more comprehensive mentoring as offered by mentors of the same race or gender, but effective and useful mentoring across all boundaries. Tenenbaum, Crosby, and Gliner (2001) also argue that as psychosocial functions increase, satisfaction with the mentorship increases; however, in this study, these mentees identified satisfaction with the mentors of every category, despite in some cases a lack of psychosocial support (role model category). Importantly, the categories with expanded professional aspects do not indicate ineffective mentoring, but rather other effective mentoring types that meet a more expansive set of needs.

Table 18 Mentor Demographics

Category	Participant	Matched Demographics	Mentor Demographics
Guide	Lisa	2	AAF Prof
	Toni	2	AAF Prof & Research Advisor
	Vanessa	2	AAF Research Advisor
	Nicole	1	AAM Prof & Research Advisor
Proactive Supporter	Taylor	1	WF Research Advisor
	Michelle	1	WF Academic Advisor
	Erica	1	Middle Eastern Female Prof
Reactive Listener	Taylor	1	AAM[Haitian] Chair
	May	0	WM Prof & Dean
	Deborah	1	AAM Dept. Head
Nurturer	Deborah	2	AAF Program Director
	Shelly	2	AAF Program Director
Just In Time	Stefani	1	Female Intro Prof
	Stefani	0	Indian M Chair
	Erica	1	AAM Program director
Caring	Taylor	0	WM Prof
	Tiffanii	2	AAF Program Director
Role Model	Toni	1	WF Prof
	Danielle	1	Female Prof

These findings also reinforce intersectionality in that as African American women, shared experience was only identified as occurring with mentors of the same race and most often the same gender. Here, this work accomplishes its goal of shedding new light on the intersectional experiences of AAFSs and bringing some awareness to the multiplicity of their identities. It establishes their experiences as unique and non-indicative of every woman or African American; even within a single sample there are a number of varied experiences. Adding to the focus on intersectionality, it is important to look more specifically at how race and gender played roles within the different mentoring relationships. The following sections look at the characteristics of the mentors these students interacted with and provide some perspective on why these experiences might be a result of the intersecting identities of AAFSs within engineering.

5.3.1 Race

Although both race and gender were not always shared by the mentor and mentee in this data set, participants found other points of relation, including discipline and research interests. Mentees often sought their mentors because they knew that they could share specific advice from their own experience or experiences. This finding supports work by Shain (2002) that highlights that for women of color in engineering fields, shared cultural background may not be the key factor of a relationship with a mentor within their discipline. What the mentees in this study reveal is an appreciation of a relationship in which their mentor has an established understanding of what it is like to be an African American in engineering. This understanding, on many occasions, was realized in terms of issues mentees felt they did not have to explain with mentors who shared their experiences. A number of the mentees valued the ability to express concerns and challenges that they faced due to race on a daily basis on campus and in their classes without having to explain to their matched mentor the basis of the issue or why it was troubling to them. This expansion of the literature exposes the relevance of race in the student experience and the importance of having someone to express these topics to who can empathize.

The emphasis on race here aligns with the literature presented by Cole and Griffin (2013) suggesting that “students of color seek out minority faculty for support when navigating the challenging environments at Predominantly White Institutions,” (p. 597). Their work indicates that the shared racial minority status between the mentor and mentee is a vital aspect within an effective mentoring relationship for AAFSs. Within the category of Guide, each of the mentors is African American and serves as a tenured/tenure-track faculty within the mentees engineering discipline. The majority of these mentors are also female. This pattern suggests that the most comprehensive type of mentor tends to share racial and gender demographics, as well as field of study, with the mentee. However, the presence of an AA male within the category suggests that race and shared discipline may be more salient than gender to this group of AAFSs in engineering. This finding also indicates that in addition to minority status (African American or female) the shared discipline is also a salient component of an effective mentoring relationship. The African American program directors outside engineering, though an important set of mentors, addressed fewer aspects in their mentoring relationships with the participants, particularly related to engineering.

Although Cole and Griffin (2013) do not specifically define the aspects of a minority, in its common contexts, it includes both racial and gender minorities. In this data, the shared minority

status provided both empathy and a shared understanding of the challenges and stereotypes experienced on a daily basis, without the need for explanation. In this data, the mentees discuss the value they found in having someone in their department that looked like them and could understand the stereotypes they faced as an African American both inside and outside of the classroom. Although the mentees are both African American and female, it seems that their racial identity was the more salient aspect within the domain of engineering. However, shared racial minority status was not central in the next category, Proactive Supporter, as this category consists entirely of women, a gender minority within engineering

5.3.2 Gender

The categories of Proactive Supporter and Reactive Listener appear to be more gender-specific in that they consist entirely of females or males, respectively. Literature provides an explanation for this distinction in relation to the aspects that make up these two categories and the ways in which they are enacted. The data provides evidence that Reactive Listeners provide tangible opportunities to mentees based on personal knowledge about them. Covering a broader range of needs, the Proactive Supporter, who has a more personal relationship with the mentee, develops the mentee's skills to best prepare them for opportunities that they provide and are certain will benefit the mentee. In previous studies, female mentors tend to provide more psychosocial and personal support, where it is more common for men to be more connective and delegate responsibility to others. Power plays a large role in this dynamic, as males tend to hold positions of power, which, as Ragins and Cotton (1999) explain,

influences their ability to provide their protégés with such career development functions as sponsoring their protégés to high-ranking positions, protecting them from adverse forces, and giving them needed exposure. Ragins proposed that because majority mentors (i.e., male mentors) generally have more power in organizations than minority mentors (i.e., female mentors), they should be better able to provide career development functions and organizational outcome (p. 533).

In this study, however, the ability of female faculty in non-administrative roles to provide opportunities contradicts existing literature. Because much of the previous literature is reflective of corporate settings, the distinction between the power dynamics within academia provide a broader range of access and power to faculty members. Therefore, we see faculty, both women and minorities, providing opportunities to their mentees without being in administrative positions. While at many corporations rank dictates access, in academia faculty members at all levels have ready access to resources like research opportunities, internships, committees and the like, not just those with more administrative roles like department heads/chairs and deans. This distribution of power can be seen in the data in the tenured/tenure-track faculty members who are able to provide tangible opportunities to their mentees in the same ways as administrators.

At the same time, on many fronts mentoring research has pointed to a greater desire and need for psychosocial support among women than among men. Within this work the most comprehensive relationships are perceived to consist of a wide range of both personal and professional aspects, which also challenges existing literature. Previous literature (K. Kram, 1985; Scandura & Pellegrini, 2007) argues that as psychosocial functions increase, satisfaction with the mentoring relationship increases, whereas this work argues that participants perceive all of these mentoring relationships to be effective and satisfactory including those that lack in psychosocial support.

Although the women in the Proactive Supporters group do provide more personal support, they were also perceived to provide more professional support than the men in this study who were experienced as Reactive Listeners. Therefore, although these administrators have access to opportunities and power, in this study the mentees believed that the women tended to invest more time both in preparing them for professional careers by developing their skills through challenging them, and in reinforcing their abilities through sponsorship and encouragement—functions identified by Kram (1985) as professional. These Proactive Supporters took the time to get to know their mentees and gain an understanding of their interests and goals. Certainly the literature supports that women most often provide more psychosocial functions; however, this work indicates female mentors can also provide more career/professional support than some men of higher rank, particularly within academic settings.

5.3.3 Position in the University

In addition to the race and gender of the mentors in each category, there was a clear distinction in the positions that they held at their respective university. Employee roles vary and can therefore lead to differing types of student-faculty interactions. Faculty roles ranged from minority program directors to administrators to tenured/tenure-track faculty, each with different responsibilities. As tenured/tenure-track faculty, many of these mentors served the mentees as both course instructors and research advisors. A number of the department heads or chairs were identified particularly as professional mentors. Finally, program directors served in administrative staff roles over minority programs at the college and university level. Departmental administrators tended to have limited interaction with students, particularly in comparison to administrative staff of student support programs. Some of the effects of that time dynamic are visible in the outcome space when looking at the amount of personal support provided by these types of faculty. The role of each of the faculty in this study seemed to contribute its own types of benefits to the type of relationship they formed despite possible time restrictions, as described in more detail in the following sections.

Program Directors: Program directors, whose job descriptions often focus on providing a broad range of support for students, are perceptibly fulfilling that responsibility given that participants described them as meeting both personal and professional needs. Lee (2015) suggests that program directors' goals include providing interventions and improving retention, actions which are supported by this study. However, shared experience again becomes relevant in the lack of shared field between the mentors and mentees in the Nurturer category. Although this group of mentors share race and gender with the mentees, their lack of experience within engineering seemed to limit their ability to relate to the experiences of the student as well as the level of advice and opportunities that they can provide. Therefore, most of the aspects participants experienced with these program directors were of a personal more than a professional nature. These types of faculty play a vital role in this outcome space as a group that can and is willing to provide a different range of benefits from outside of the field of engineering. It is important to note, however, that some institutions, student support program staff are engineers, and thus might fall into different mentor categories.

Administrators: Although, the administrative demands of a department head or chair may not have enabled them to be actively involved with undergraduate students in ways that provide

comprehensive personal support or investment, the findings of this study suggest that they can still play a valuable part as mentors. The data here shows a number of administrators who served as Reactive Listeners. These mentors are connected to a wealth of resources that can aid in the professional development and experience of a mentee.

Tenured and Tenure-Track Faculty: The most comprehensive mentor role within this study was filled by a non-administrative tenured or tenure-track faculty members. These faculty, who at a research intensive university must juggle course loads, research, and service, somehow also managed to provide all of the mentoring aspects to this group of women - an activity that is encouraged, but not necessarily rewarded in the promotion and tenure process. It should be noted, however, that a number of these faculty mentors also served as research advisors to these undergraduates, potentially allowing a greater opportunity to spend time with and get to know these students in a capacity that does align with promotion and tenure (Reddick, 2011). Research was not the only route to such alignment; a number of these tenured/tenure-track faculty mentors found ways to incorporate mentoring into other activities. For example, a number of the mentees spoke about being involved in not only research, but community service (presenting and volunteering at local schools, participating in cancer walks, etc.) with their mentors, which could be considered as part of a faculty member's service requirements. These types of interactions demonstrate a number of possibly non-traditional ways of building mentoring relationships with students that allow both the mentor and mentee to benefit from the relationship. Literature has certainly always supported the fact that effective mentoring relationships are beneficial to both parties (T. D. Allen & Eby, 2007; Cole & Griffin, 2013; Jacobi, 1991; Johnson, 2007), and when faculty can combine mentoring with research and service activities, those benefits are more easily realized.

5.4 Intersectionality

As described in Chapters 1 and 2, this population of engineering students was chosen because of the unique experiences they have due to their multiple identities. The results of this study further highlights the impact the intersections of race and gender have on their experiences. The framework of intersectionality focuses on three ways in which race and gender intersect for African American women: structurally, politically, and representationally (Crenshaw 1991), creating a unique set of experiences. Within this work each of these dimensions became apparent

within their faculty mentoring relationships. At the same time, Crenshaw (1991) emphasizes that the ways in which these identities intersect varies by domain, and therefore these students' engineering identities also contribute to their experiences.

5.4.1 Structurally

The structure of engineering has always been dominated by White males. The structural implication of intersectionality emphasizes “the ways in which an individual’s legal status or social needs marginalize them” Shield (2008, p. 304) and therefore makes them less likely to receive the resources they need. As both African American and female, the participants in this study found themselves as double minorities within this domain, representing only 2% of the undergraduate engineering population nationally. This minority status is also mirrored among the faculty with AAFB representing less than 1% of all engineering faculty. As a result there are a limited number of fully matched mentors that these women had access to. The implications of this can be seen in the experiences of Hope, who was unable to find a mentor based on her definition of a mentor as being fully matched. A number of the mentors within this study serve as mentors to more than one of the participants. There were actually only five effective AAFB mentors and two others with the potential to be effective out of the 26 mentoring relationships, as defined by the participants. Alternately, only three of the mentors identified in this work were African American female tenured/tenure-track faculty in engineering. This indicates the level of responsibility and time that minority faculty often play, serving as mentors to multiple minority students. The results argue that African American faculty are best able to provide shared experience with their mentees, but the lack of access to these matched mentors limits mentees ability to have their needs met. Fortunately, as shared experience was found to be provided by faculty of shared race and field, there is potential for this level of support to be available through African American male faculty (1.6% engineering faculty).

5.4.2 Politically

Shields (2008) defines the political aspects of intersectionality as highlighting “the different and possibly conflicting needs and goals of the respective groups from which an individual draws her or his identity” (p.304). These mentees were in search of support as a woman, an African American, and an engineer. Although a number of these participants were able to find

support for all three of these dimensions of their identity through mentors who served as guides, other mentees were not as fortunate. While many of the participants had academic/professional support (Reactive Listener and Just in Time), support from women (Proactive Supporter), and in some cases racial support, for the majority of the participants the multiplicity of all of those needs were not able to be met within their academic departments. As a resolve, some mentees sought support from outside of their departments through minority support programs. As engineering students, there was certainly a need to succeed academically, which already has its own extensive time commitments. But as African American women, there seemed an aspect of nurturing and familial support that was needed as well that seemed to come from out of department entities, like the minority support program directors identified in this study. It seems really telling that many of the women in this study had multiple mentors, which is surprising when thinking about the amount of time that it may take to develop each relationship. Yet, of the 13 women with effective mentors, 5 had more than 1 –more than a third of them. And among the 8 who had only 1 effective mentor, 3 of them also had ineffective mentors. So in conjunction with the amount of time that may be required to form these relationships, both in and out of the department, there is also the risk that these established relationships may be ineffective in the long run for the mentee.

5.4.3 Representationally

It seemed most common in this study that participants were looking for a representative to emulate, and as suggested by the demographic data, full representation was difficult to find. For some mentees it came at the role model level, watching women faculty whom they perceived as professional, well-dressed, and in positions of power despite negative male opinion. There was some desire to gain perspective from a fully matched mentor, as one mentee pointed out her mentor's characteristics as non-African American, while still acknowledging that there was still much that she gained from this mentor. However, as all of the mentees perceived their mentors as examples, it seems that these women were looking for more than just same-race and same-gender examples to emulate.

Additionally, within this data set, although three of the fully matched mentors were represented in faculty positions, none served as administrators and therefore lacked a dimension of possible success to be displayed to these students. That is, students saw representations of themselves in faculty, but not in leadership roles within their disciplines. This lack also ties back

to the structural dimension of intersectionality and the ability to provide mentees with the resources/visibility of those who look like them in the positions they aspire to. Half of the fully matched mentors in the study did serve as administrators, but outside of the mentees' field. Often noted for their maternal and familial tendencies, these mentors seem to enact the conception of African American women as "othermothers." Historically, othermothers are African American women who take up the care of individuals who are not their biological children. Socially, the practices represents a strong trend among many African American women to take on mothering roles for younger African Americans often sharing mothering responsibilities with the biological mother. These responsibilities can span temporary child-care, long-term care, or informal adoption (Collins, 2000a), which can certainly fall in line with the far from home experience of college. Although in many instance these women are present in the local community of the child as they grow, this work highlights how this role is present within the academic community as well. Collins (2000a) describes these othermothers as historical activist roles within the African American community, embodied by women who "[u]nlike the traditional mentoring so widely reported in educational literature... [go] far beyond that of providing students with either technical skills or a network of academic and professional contacts." (p.192). Although outside of the engineering community these program directors played a role within the institutions community that was a reflection of a role played by a number of African American women in the middle-class African American community. Deborah's reflection of her own struggles, and decisions she made to stay in engineering was because of her mentors who reflect the nature of the othermother by helping members of the community to "attain the self-reliance and independence essential for resistance" (p. 193).

The women in this study represent a variation of the AAFSSs in engineering and the experiences that they have. This investigation was able to shed some light on some of the ways that these women navigate and find the support that they need from faculty mentors in relation to their multiple identities as an African American women in engineering. This work shows that no one mentor can best provide for these needs, but rather that a multitude of faculty mentors is capable of providing all of those needs. While these mentees seem to look for women in the field to serve as an example of what it looks like to be a woman in engineering, there is also a need to find a racially matched mentor, to help navigate the structure and culture of the field, and develop in order to be successful themselves.

5.5 Summary of Results Discussion

The experiences of these AAFs demonstrate mentoring experiences that include a number of salient aspects delivered by a diverse group of faculty through distinct actions. Although the professional aspects are inclusive of many of the functions identified previously in literature, this work is less distinct in classifying those aspects as being distinctly career or psychosocial in nature. A distinction that further emphasizes the unique experiences of African American women in engineering. Additionally, this dissertation highlights the variety of ways a mentee can receive different types of support from a diverse array of faculty. At the same time it points to a need for multiple mentors for this population in order to garner all of the aspects of support that they need. Overall, the functions documented for White male populations through mentoring do compose many of the aspects salient to this African American female population, however, the value of knowing which type of faculty tend to be most capable of providing those aspects and how they are able to successfully deliver those functions further informs the academic community of what it takes to help these women succeed in engineering, at least the undergraduate level.

Although this work supports a great deal of the previous literature on mentoring. A second significant contribution of this work is the perspective that relationships with varying degrees of career and psychosocial support and with both matched and unmatched mentors can be perceived as positive and effective to AAFs in engineering. This study argues that there are a range of aspects that are salient to this population that can be provided by a number of faculty members who vary in diversity.

Although much like the literature before suggesting that race and gender were the most salient aspects of mentoring relationships, this work argues that what is salient in matched relationships is the perception of shared experience by the mentee, which to some degree also includes shared academic discipline. This work suggests that mentors of different races and genders can develop these comprehensive relationships by establishing a point of shared experience with their mentee. As the mentoring categories build in comprehension, a number of factors contribute to their success: race, gender, position, professional aspects, and interpersonal aspects are each important in their own way. Different interpersonal aspects support different levels of mentoring, and levels or categories developed in this study do not clearly or neatly fall into career or psychosocial functions defined in previous literature. This work has provided a deeper understanding of some specific interpersonal actions that support many of the functions

identified in previous literature. The unique distinctions among each of the categories in this study shed a new level of insight on what aspects make up the mentors that these students perceive as performing each of these roles.

5.6 Implications

The findings of this dissertation provide a number of implications for stakeholders within academia. The initial desire was to provide faculty insight on ways that they can be effective mentors to AAFSs within engineering. Therefore I will first provide implications applicable for faculty, then administrators and finally for potential mentees.

5.6.1 Faculty

1. **Finding a way to connect and identify areas of shared experience** with a student can occur beyond race or gender. Shared research interests can be starting points for relationship development. Allowing students to find ways of connecting come from some knowledge about the faculty. Overall, these relationships tended to initiate informally because there is a perception by the student and in some cases the mentor of some ability to connect and share knowledge that will benefit the mentee.
2. **Communicate accessibility and care** by talking with students about personal research interests, inviting them to office hours, learning their names may be the indication that a student needs to form connections and make faculty appear accessible. Unfortunately, the students allow some self-employed barriers to inhibit the growth of the relationship. A number of the mentees in this study spoke of their beliefs of the busyness and lack of time of their mentors which prevented them from going to them sooner or more frequently, potentially limiting the depth and potential benefits in their relationship.
3. **Invest time in reinforcing student's ability to succeed and providing them guidance in areas that they need to improve in.** Although proactive support tended to be reflected in female relationships, this work gives some suggestion that **feedback and confirmation of skills** are key to this type of mentoring.
4. **Identify personal strengths and actions that are comfortable and offer them to the students as things that can be provided.** The foundational theories of mentoring, although they tended to be based in business and focus on male-to-male relationships,

provide a set of functions that are in line with a number of the things perceived to occur in the effective mentoring relationships of these AAFSs. Essentially, a lot of what we know about mentoring is relevant for this population as well.

5. **Find ways to incorporate students into research and service** as an access point to further build personal relationships. Providing different spaces for student-faculty interaction can expose other areas that you may be able to connect on.
6. **Be aware that students may consider you a mentor despite limited one-on-one interaction.** Being a faculty member dictates a level of success that students may admire and look to emulate, and therefore may be paying close attention to the things you say and do.

5.6.2 Administrators

1. Varying roles within the university create different levels of time to provide students with mentoring, but even **taking a few short moments** to take the time and hear a student's interests and make connections for them or share own experiences and wisdom can be invaluable in their decision making and success.
2. **Find ways to encourage faculty to mentor a wide range of students and ways to reward faculty for these efforts** to increase the amount of time and effort they put into the much needed mentoring of students. Encourage them to involve students in their research and service.

5.6.3 Future Mentees

1. **Take the time to get to know more about faculty**, the work that they do, how they got where they are and generally about who they are. Time is not the sole key to an effective relationship.
2. Be aware that having **multiple mentors may be necessary** in order to have a greater number of needs met.
3. **Be willing to form relationships with faculty across-race and gender** in order to have more needs met.
4. Recognize that **shared experience takes a number of forms** (race, gender, discipline, research and personal interests, culture, etc.)

5.7 Limitations

Although this study produced a number of valuable findings, there are limitations to keep in mind when considering the results. First, the data collected is only reflective of the students' perspectives of their faculty mentoring relationships. Therefore, it cannot be confirmed that faculty would identify their actions in the ways described by the mentees. However, the results faithfully reflect the students' perspectives of effective faculty mentoring relationships. Second, as the data is from the student perspective, the mentor aspects and demographics are based on student reports. In several cases the researcher was able to identify the described mentor (named directly or identified as 'the only' in a specific department) and confirm in some cases gender, and title. Finally, this data is reflective of a specific population of AAFSs at a single research intensive PWI. Therefore these results are not generalizable to all AAF undergraduate engineering students nor do they represent the experiences of all AAFs within engineering. Additionally, because I recruited for understanding of successful relationships, although I identified several ineffective relationships, the results do not fully account for why students don't find mentors or why faculty mentoring relationships fail. This work clearly indicates a variation of experiences within this single sample and supports the principles of intersectionality that the experiences of African American women are unique among the population and the individual.

5.8 Future Work

As AAFs, the participants in this study had a much broader definition of mentoring – mentors ranged from Role Models and Just in Time to full blown relationships. These students indicated the potential for faculty to be a mentor without constant interaction with students. Throughout their interviews, aside from discussing their mentoring relationships, they articulated the impact their race and gender had on their day to day interactions with peers, faculty and staff. Often as they described their definition of mentoring, it reflected a desire to have someone who could relate to their experience as an AAF in engineering. Although few found someone who could completely fulfill that level of understanding, they all certainly greatly valued those who came close in understanding, at least one aspect of their identity. In future works I look forward to deciphering what, if any, other shared aspects are salient enough to build these highly comprehensive relationships.

A second unexplored issue that arose frequently in many of the interviews was that of racial profiling of the students on and around campus and the awareness of stereotypes held by their faculty and peers. Rarely were connections made between these daily struggles and their mentoring relationships, aside from acknowledgment that faculty of other races would certainly not understand or be able to do anything about these issues. However, it seems beneficial to inquire whether non-minority faculty consider these topics when mentoring minority students and what types of approaches they take in having these sorts of conversations with students. Hopefully, future work of this type will be able to further inform majority faculty and minority students on ways to counteract discomfort that might come with cross-race mentoring. The data from this study provides some preliminary areas to explore, specifically what types of faculty AAFSs are comfortable sharing their stories of discrimination with and why.

Third, through quantitative methods, I would like to develop a survey from these findings that can extend and refine these results among other AAFSs in engineering at other PWIs. IN addition, cross case analyses of these findings with those from an HBCU could shed some light on any variation that may be occurring at these differing institutions. Results from those works could further inform faculty of effective practices for mentoring diverse students at any institution.

Finally, to provide some benefit to future mentees, a portion of the interview around the type of advice these participants would give to a fellow AAFS is an area that I would like to analyze next. These senior perspectives offer a great deal of information that could be highly valuable to incoming freshman and other underclassmen seeking support. It is my desire to be able to produce a concise format that can be shared with African American freshman females across the country.

5.9 Conclusion

The experiences of AAFSs are a vital component of engineering education as they represent a group that can greatly contribute to diversifying and broadening the perspective and expanding the innovation that we constantly desire in the field. Despite a number of interventions to recruit, retain and produce more African America's in engineering, the reality is that the numbers are still devastatingly, low especially among AAFs. Unfortunately, because the number of AAFs in engineering has remained low, particularly at the highest levels (PhD faculty), it comes as no surprise that young AAFs who do not see themselves in engineering are not seeking or completing degrees in engineering. It is clear that some significant progress has been made in

admitting a number of these women, yet often they are lost along the undergraduate degree process. In an attempt to better understand how these challenges can be overcome, I sought out the success stories, AAFSs who were nearing completion in their undergraduate degree programs, and I sought to explore their faculty support systems.

What I uncovered in this process was that for each of these young women, their racial and gender identities played a significant role in their mentoring relationships. It became clear that their perceptions of faculty who shared their race held a unique position in their lives both personally and professionally. These mentees believed that their ‘guides’ shared their understanding of what it meant to be African American in engineering and in a number of relationships what it meant to be an AAF in engineering specifically. Although this shared experience came out of a category with matched mentors, it is the belief of this researcher that this type of relationship can be developed with faculty of unmatched race and gender. The basis of shared experience within the category of ‘guide’ heavily emphasized racial and gender empathy, which might be assumed a quality only accessible to the African American population. However, this assumption suggests that faculty of other races and gender can have no empathy for diverse perspectives and experiences. This work shows that beyond race, these mentees were able to be positively supported by a wide range of mentors who were able to show these women that they cared. Although each mentor may not have had a deep understanding of the AAFS perspective and experience, they put forth the effort to aid these women in their success as engineering students.

It is my hope that from this work, faculty of all rank and title will have a new level of understanding of the mentoring experiences of this population of AAF engineering students. Although every finding within this study may not be generalizable to the experiences of every AAF in engineering, these results shed some new light on aspects that had not previously been considered. Knowledge of salient aspects can be a valuable resource for faculty who seek to broaden their influence and mentor a diverse population of students. One must be clear that the experiences of all students are not the same, and in turn different actions should be taken to support them. This work shows that mentors of all walks of life can be valuable; not every individual can provide for every need, but certainly many mentors are needed to provide for all.

References

- Akerlind, G. (2005). Learning about phenomenography: Interviewing, data analysis and the qualitative research paradigm. In J. Bowden & P. Green (Eds.), *Doing developmental phenomenography* (pp. 63). Melbourne: RMIT University Press.
- Åkerlind, G. (2005). Phenomenographic methods: A case illustration *Doing developmental phenomenography* (pp. 103-127).
- Allen, T. D., & Eby, L. T. (2007). *The Blackwell handbook of mentoring: A multiple perspectives approach*. Malden, MA: John Wiley & Sons.
- Allen, W. R. (1992). The color of success: African-American college student outcomes at predominantly White and historically Black public colleges and universities. *Harvard Educational Review*, 62(1), 26-45.
- Allen, W. R., Epps, E. G., & Haniff, N. Z. (1991). *College in Black and White: African American students in predominantly White and in historically Black public universities*: SUNY Press.
- Amenkhienan, C. A., & Kogan, L. R. (2004). Engineering students' perceptions of academic activities and support services: Factors that influence their academic performance. *College Student Journal*, 38(4), 523-540.
- Austria, A. M., & Austria, M. A. M. (2010). Enhancing Capabilities of Women and Ethnic Minorities. In C. Rayburn, F. L. Denmark, M. E. Reuder & A. Austria, Miteria (Eds.), *A Handbook for Women Mentors: Transcending Barriers of Stereotype, Race, and Ethnicity* (pp. 129-196): ABC-CLIO.
- Bell, A. E., Spencer, S. J., Iserman, E., & Logel, C. E. (2003). Stereotype threat and women's performance in engineering. *Journal of Engineering Education*, 92(4), 307-312.
- Blackwell, J. E. (1989). Mentoring: An action strategy for increasing minority faculty. *Academe*, 75(5), 8-14.
- Bowden, J. (2000). The nature of phenomenographic research. In J. A. W. Bowden, Eleanor (Ed.), *Phenomenography* (pp. 1-18). Melbourne: RMIT University Press.
- Ceglie, R. (2011). Underrepresentation of Women of Color in the Science Pipeline: the Construction of Science Identities. *Journal of Women and Minorities in Science and Engineering*, 17(3).
- Cohen, & Steele, C. M. (2002). A barrier of mistrust: How negative stereotypes affect cross-race mentoring *Improving academic achievement: Impact of psychological factors on education* (pp. 303-327).
- Cohen, C. C. d., & Deterding, N. (2009). Widening the net: National estimates of gender disparities in engineering. *Journal of Engineering Education*, 98(3), 211-226.
- Cohen, N. H. (1995). The principles of adult mentoring scale. *New directions for adult and continuing education*, 1995(66), 15-32.
- Cole, D., & Griffin, K. A. (2013). Advancing the Study of Student-Faculty Interaction: A Focus on Diverse Students and Faculty. In M. Paulsen (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 128, pp. 561-611). NY: Springer.
- Collins, P. H. (2000a). Black Women and Motherhood *Black feminist thought: Knowledge, consciousness, and the politics of empowerment* (10 ed.). New York: Psychology Press.
- Collins, P. H. (2000b). Mammies, Matriarchs and Other Controlling Images *Black feminist thought: Knowledge, consciousness, and the politics of empowerment* (10 ed., pp. 69-96): Psychology Press.
- Crenshaw, K. (1989). Demarginalizing the intersection of race and sex: A Black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics. *U. Chi. Legal F.*, 139.
- Crenshaw, K. (1991). Mapping the margins: Intersectionality, identity politics, and violence against women of color. *Stanford law review*, 1241-1299.
- Crenshaw, K. (2005). Mapping the Margins: Intersectionality, Identity Politics, and Violence against Women of Colour''(1991). *Stanford Law Review*, 43, 1241.

- Creswell, J. W. (2009). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*: SAGE Publications.
- Crisp, G., & Cruz, I. (2009). Mentoring college students: A critical review of the literature between 1990 and 2007. *Research in Higher Education*, 50(6), 525-545.
- Daly, S. R. (2008). *Design across disciplines*. Purdue University, ProQuest (3343992)
- Daly, S. R., Adams, R. S., & Bodner, G. M. (2012). What does it mean to design? A qualitative investigation of design professionals' experiences. *Journal of Engineering Education*, 101(2), 187-219.
- Davis, M., Dias-Bowie, Y., Greenberg, K., Klukken, G., Pollio, H. R., Thomas, S., & Thompson, C. L. (2004). "A fly in the buttermilk:" Descriptions of university life by successful Black undergraduate students at a predominately white southeastern university. *Journal of Higher Education*, 75.
- Fisher, A., & Margolis, J. (2002). Unlocking the clubhouse: the Carnegie Mellon experience. *ACM SIGCSE Bulletin*, 34(2), 79-83.
- Fleming, J. (1985). *Blacks in College. A Comparative Study of Students' Success in Black and in White Institutions*: ERIC.
- Ginorio, A. B., & Grignon, J. (2000). The transition to and from high school of ethnic minority students. *Access denied: Race, ethnicity, and the scientific enterprise*, 151-173.
- Hall, R. M., & Sandler, B. R. (1982). *The Classroom Climate: A Chilly One for Women?* Association of American Colleges.
- Hurtado, S. (1992). The campus racial climate: Contexts of conflict. *The Journal of Higher Education*, 539-569.
- Jacobi, M. (1991). Mentoring and undergraduate academic success: A literature review. *Review of educational research*, 61(4), 505-532.
- Johnson, W. B. (2007). On being a mentor: A guide for higher education faculty (pp. 166-177). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.
- Kram, K. (1985). *Mentoring at work: developmental relationships in organizational life*. Glenview, Ill: Scott, Foresman.
- Kram, K. E. (1983). Phases of the mentor relationship. *Academy of Management journal*, 26(4), 608-625.
- Kram, K. E. (1988). *Mentoring at work: Developmental relationships in organizational life*: University Press of America.
- Larsson, J., & Holmström, I. (2007). Phenomenographic or phenomenological analysis: does it matter? Examples from a study on anaesthesiologists' work. *International Journal of Qualitative Studies on Health and Well-being*, 2(1), 55-64.
- Lee, W. C. (2015). *Providing Co-Curricular Support: A Multi-Case Study of Engineering Student Support Centers*. Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Levinson, D. J. (1978). *The seasons of a man's life*: Random House LLC.
- Lichtenstein, G., Chen, H. L., Smith, K. A., & Maldonado, T. (2014). Retention and Persistence of Women and Minorities Along the Engineering Pathway in the U.S. In A. Johri & B. M. Olds (Eds.), *Cambridge Handbook of Engineering Education Research*. New York, NY: Cambridge University Press.
- Lönngren, J. (2014). Engineering Students' Ways of Relating to Wicked Sustainability Problems.
- Marton, F. (1986). Phenomenography: A research approach to investigating different understandings of reality. *Journal of thought*, 21(3), 28-49.
- Marton, F., & Booth, S. A. (1997). *Learning and awareness*: Psychology Press.
- Maton, K. I., & Hrabowski III, F. A. (2004). Increasing the Number of African American PhDs in the Sciences and Engineering A Strengths-Based Approach. *American Psychologist*, 59(6), 547.
- McCall, L. (2005). The complexity of intersectionality. *Signs*, 30(3), 1771-1800.

- NSF. (2010). *National Science Foundation, National Center for Science and Engineering Statistics, special tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, 2010*.
- NSF. (2013). National Science Foundation, National Center for Science and Engineering Statistics. 2013. Women, Minorities, and Persons with Disabilities in Science and Engineering: 2013. Special Report NSF 13-304. Arlington, VA. Available at <http://www.nsf.gov/statistics/wmpd/>.
- Ong, M. (2005). Body projects of young women of color in physics: Intersections of gender, race, and science. *Social Problems*, 52(4), 593-617.
- Ong, M., Wright, C., Espinosa, L. L., & Orfield, G. (2011). Inside the double bind: a synthesis of empirical research on undergraduate and graduate women of color in science, technology, engineering, and mathematics. *Harvard Educational Review*, 81(2), 172-209.
- Ornek, F. (2008). *An overview of a theoretical framework of phenomenography in qualitative education research: An example from physics education research*. Paper presented at the Asia-Pacific Forum on Science learning and teaching.
- Packard, B. W. L., Walsh, L., & Seidenberg, S. (2004). Will that be one mentor or two? A cross-sectional study of women's mentoring during college. *Mentoring & Tutoring: Partnership in Learning*, 12(1), 71-85.
- Paretti, M. C., & Smith, C. (2013). *Negotiating Masculine Spaces: Attitudes and Strategies of First-Year Women in Engineering*. Paper presented at the American Society for Engineering Education Annual Conference, Atlanta.
- Patton, L. D. (2009). My sister's keeper: A qualitative examination of mentoring experiences among African American women in graduate and professional schools. *The Journal of Higher Education*, 80(5), 510-537.
- Patton, L. D., & Harper, S. R. (2003). Mentoring relationships among African American women in graduate and professional schools. *New Directions for Student Services*, 2003(104), 67-78.
- Pembridge, J. J. (2011). *Mentoring in Engineering Capstone Design Courses: Beliefs and Practices across Disciplines*. (Ph.D.), Virginia Polytechnic Institute and State University, ProQuest.
- Ragins, B. R., & Kram, K. E. (2007). *The handbook of mentoring at work: Theory, research, and practice*: Sage Publications.
- Rayburn, C. (2010). *A Handbook for Women Mentors: Transcending Barriers of Stereotype, Race, and Ethnicity*: ABC-CLIO.
- Reddick, R. J. (2011). Intersecting identities: mentoring contributions and challenges for Black faculty mentoring Black undergraduates. *Mentoring & Tutoring: Partnership in Learning*, 19(3), 319-346.
- Roberts, A. (2000). Mentoring revisited: A phenomenological reading of the literature. *Mentoring and Tutoring*, 8(2), 145-170.
- Scandura, T. A. (1992). Mentorship and career mobility: An empirical investigation. *Journal of organizational behavior*, 13(2), 169-174.
- Scandura, T. A., & Pellegrini, E. K. (2007). Workplace mentoring: Theoretical approaches and methodological issues. *The Blackwell handbook of mentoring: A multiple perspectives approach*, 71-91.
- Schunk, D. H., & Mullen, C. A. (2013). Toward a conceptual model of mentoring research: integration with self-regulated learning. *Educational Psychology Review*, 25(3), 361-389.
- Scisney-Matlock, M., & Matlock, J. (2001). Promoting understanding of diversity through mentoring undergraduate students. *New Directions for Teaching and Learning*, 2001(85), 75-84.
- Shain, C. H. (2002). *Revisiting the problem of engineering school persistence in African-American women students*. Teachers College, Columbia University.
- Shields, S. A. (2008). Gender: An intersectionality perspective. *Sex Roles*, 59(5-6), 301-311.
- Stanley, C. A., & Lincoln, Y. S. (2005). Cross-race faculty mentoring. *Change: The Magazine of Higher Learning*, 37(2), 44-50.

- Steele, C. M. (1997). A threat in the air: how stereotypes shape intellectual identity and performance. *American Psychologist*, 52(6), 613.
- Tenenbaum, H. R., Crosby, F. J., & Gliner, M. D. (2001). Mentoring relationships in graduate school. *Journal of Vocational Behavior*, 59(3), 326-341.
- Trigwell, K. (2000). A phenomenographic interview on phenomenography. In J. Bowden & E. Walsh (Eds.), *Phenomenography* (pp. 62-82). Melbourne: RMIT University Press.
- Tsui, L. (2007). Effective strategies to increase diversity in STEM fields: A review of the research literature. *The Journal of Negro Education*, 555-581.
- Walsh, E. (2000). Phenomenographic analysis of interview transcripts. In J. Bowden & E. Walsh (Eds.), *Phenomenography* (pp. 19-33). Melbourne: RMIT University Press.
- Weber, L. (1998). A conceptual framework for understanding race, class, gender, and sexuality. *Psychology of Women Quarterly*, 22(1), 13-32.
- Williams, M. R., Brewley, D. N., Reed, R. J., White, D. Y., & Davis-Haley, R. T. (2005). Learning to read each other: Black female graduate students share their experiences at a White research I institution. *The Urban Review*, 37(3), 181-199.
- Yoder, B. L. (2013a). Engineering by the Numbers. *American Society for Engineering Education*, Washington, DC. <http://www.asee.org/papers-and-publications/publications/collegeprofiles/2011-profile-engineering-statistics.pdf>.
- Yoder, B. L. (2013b). Engineering by the Numbers. *American Society for Engineering Education*, Washington, DC. <http://www.asee.org/papers-and-publications/publications/collegeprofiles/2012-profile-engineering-statistics.pdf>.
- Zey, M. G. (1984). *The mentor connection: Strategic alliances in corporate life*: Transaction Publishers.

Appendix A: Recruitment Email

Dear

Students,

My name is Courtney Smith, and I'm currently conducting a research study on the mentoring experiences of African American female students in engineering, and I need your help!

Because students' experiences are, in many ways, the most important part of understanding "good mentoring", I would like to invite you to meet with me for a 60-minute interview about your experiences of faculty mentoring. Importantly, your responses are completely confidential; published results will include only summaries of the responses, and neither your mentors nor faculty will have access to information about who chooses to participate.

If you have any questions about this study, please feel free to contact me at css1509@vt.edu or [757-646-9553](tel:757-646-9553).

If you are willing to participate, please **first complete the questionnaire (qualtrics link)** to ensure you are a qualified candidate. If you are selected I will contact you and we can set up a time to meet. I am completely flexible in terms of timing.

Sincerely,

Courtney

Appendix B: Personal Profile Questionnaire

Welcome

Your Invitation to Participate

The purpose of this questionnaire is to provide background information about participants in the Mentoring Experiences of African American Undergraduate Women in Engineering Dissertation study. The goals of this research are to better understand the mentoring experiences of undergraduate African American women in engineering who have faculty mentors. Anticipated benefits of this research are to better inform faculty of the mentoring needs and desires of these students as means to increase retention and inclusion within the field.

The survey will take about 5 minutes to complete.

Other information about the study:

- Responses in this questionnaire will be utilized to select participants for interviews. If selected to participate in an interview it will take 45-60 minutes.
- The data will be stored electronically in a password protected location. Only the research team will have access to the raw data.
- It is possible that the Institutional Review Board (IRB) at Virginia Tech will view this study's collected data for auditing purposes. The IRB is responsible for overseeing the protection of human subjects who are involved in research.
- If you have any questions about the survey please contact Courtney Smith at css1509@vt.edu.

Please indicate whether or not you give consent for participating in the study.

- ☐ I GIVE CONSENT to include my responses in the research study and I AM WILLING TO PARTICIPATE IN AN INTERVIEW. (1)
- ☐ I DO NOT GIVE CONSENT for the research study. (2)

Q2 Please provide the following Information:

First Name (1)

Last Name (2)

Email (3)

Q3 Which race do you identify with?

- ☐ African American/ Black (1)
- ☐ Hispanic (2)
- ☐ Other (3) _____

Q4 Gender

- ☐ Male (1)
- ☐ Female (2)

Q5 What is your current major?

Q9 What school do you currently attend?

Q10 Have you ever transferred schools? If yes, when?

- ☐ No (1)
- ☐ Yes (2) _____

Q6 What year of school are you currently in?

- ☐ 1st (1)
- ☐ 2nd (2)
- ☐ 3rd (3)

- ☐ 4th (4)
- ☐ 5th or more (5)

Q12 What is your current GPA?

Q11 What is your MOTHER'S highest degree attained?

- ☐ High School Diploma/ GED (1)
- ☐ Associates (2)
- ☐ Bachelors (3)
- ☐ Masters (4)
- ☐ PhD (5)
- ☐ Other (6) _____

Q16 What is your MOTHER'S current profession?

Q15 What is your FATHER'S highest degree attained?

- ☐ High School Diploma/ GED (1)
- ☐ Associates (2)
- ☐ Bachelors (3)
- ☐ Masters (4)
- ☐ PhD (5)
- ☐ Other (6) _____

Q17 What is your FATHER'S current profession?

Q7 Where did you attend high school? (name, city, state)

Q18 Do you have a Faculty Mentor?

- ☐ Yes (1)
- ☐ No (2)

If No Is Selected, Then Skip To End of Survey

Q19 What do you believe your mentor's gender to be?

- ☐ Male (1)
- ☐ Female (2)

Q20 What do you believe your mentor's race to be?

- ☐ African American/ Black (1)
- ☐ White/Caucasian (2)
- ☐ Hispanic/ Latino (3)
- ☐ Asian (4)
- ☐ American Indian or Alaskan Native (5)
- ☐ Other (6) _____

Q21 What department is your mentor in?

Q24 What is your mentor's title? (i.e. Assistant Professor, Department Head, Instructor, Advisor, etc.)

Q22 Is there anything else you would like to share about yourself?

Appendix C: Student Interview Protocol

Introduction:

Thank you for participating in this study. As you know, I am interested in exploring the mentoring experiences of African American women in engineering. As this is a phenomenographic study, which focuses on the variation of experience of a phenomenon (mentoring), I am going to be focused on trying to gain a full understanding of your experience particularly through specific examples. Therefore, I may ask a lot of “why” and “could you elaborate” questions to ensure that I am understanding your experience.

I want to assure you that your responses will be kept anonymous and at this time if you would like to choose a pseudonym for your name you may do so. This name will be used to identify you in both verbal and written presentation of my findings. Also I will record the interview in order to transcribe your responses later. Is that ok?

You may stop at the interview at any point if you feel it is necessary. Do you have any questions?

[Complete letter of Consent & Pseudonym]

Interview Questions:

[Define Phenomenon]

1. How would you define mentoring? I.e. what are the essential components of mentoring?
 2. Which components are most important in your mentoring relationship and why?
 3. How did you become a mentee? (i.e. formal or informal)
 - i. Who initiated the relationship?
 4. Can you share an example of an experience in your mentoring relationship that really stood out to you?
 5. What were the most meaningful behaviors that your mentor conveyed to you?
 - a. In what ways has your mentor supported you? What things do they do to help you?
- [Personal Gains]
6. What are the fulfilling aspects of being a mentee? Are your expectations and needs being met?
 7. What have you learned/ gained from being mentored? *Can you give specific examples* What did the mentoring relationship mean to you

[Challenges/Underrepresentation Affects]

8. Have you had a mentoring relationship that didn't work out?
9. Did being an AAFS affected your mentoring relationship?
 - a. Do you think AA women have different mentoring experiences?
10. Do you have experience discussing issues related to underrepresentation in engineering with your mentor? Did you feel comfortable?
 - a. Did you have the opportunity
 - b. Do you prefer to avoid
 - i. If so, can you give an example?
 - ii. If not, would you have liked to and if so, why and what about?

[Recommendations]

11. What advice would you give a fellow AAFS who is seeking a mentor? What advice would you give to a faculty seeking a mentee?
12. What should faculty members know about your experience?
13. Is there anything else that you want to add about your mentoring experience?
14. Do you think you will seek mentors in the future and what will they look like?

Thank you again for your participation. If you have any questions or think of anything else you want to share please feel free to contact me.