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First Generation College Students In Engineering: A Grounded Theory Study Of Family Influence On Academic Decision Making

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FIRST GENERATION COLLEGE STUDENTS IN ENGINEERING: A GROUNDED THEORY STUDY OF FAMILY INFLUENCE ON ACADEMIC DECISION MAKING

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ABSTRACT

This work develops a constructivist grounded theory describing the influence of family and those that serve a role similar to family on the academic decision making of undergraduate first generation in college (FGC) students majoring in engineering. FGC students, in this study, are students with neither parent having attained a bachelor's degree.

FGC students are an untapped talent pool with the potential to diversify and increase the number of engineers, which are both urgent national priorities. Much is known about FGC students with respect to their academic preparation, transition to postsecondary education, and progress toward degree attainment. However, the literature provides little insight about the college experiences of FGC *majoring in engineering*, their academic decision-making during college, or the influence of families on the same. The analysis of existing data from exploratory studies of 22 FGC students showed that this may be vital missing knowledge as family appeared to be a significant influence on FGC students' academic decision-making.

To address this missing knowledge, the constructivist grounded theory methodology was applied to develop a theory of the family (termed "kin") and those that serve a role similar to family (termed "fictive kin") and their influence on the academic decision-making of undergraduate FGC students in engineering. The critical incident technique (CIT) was adopted and used to create a specific, semi-structured, interview guide to elicit the kind of rich, thick data needed to develop a theory grounded in the data. Twenty interviews were conducted and coded using a constant comparative method to analyze the data.

Though the purpose of the research was to probe for kin and fictive kin influences, the major influence within the data was from parents, in particular from mothers. The theory that emerged from this research is as follows:

In explaining how they are shaped and/or molded by kin and fictive kin, participants primarily describe parents who urge them to seek happiness regardless of career choice. Based on their life and work experiences, parents convey advice to participants and influence their approach to doing things including how they make decisions. In areas where "college knowledge" is required, parents pose questions to participants and then offer advice based upon the responses. In such exchanges it seems kin, mostly parents, reflect back to participants what is important. Participants see themselves as ultimately responsible for making academic decisions, however. Though parents offer little, if any, specific academic information, they are providing significant emotional support and are reminding participants of specific expectations. Whereas an engineer parent may provide specific influences related to selecting courses, how to study, and explaining the career choices in each engineering discipline, parents of FGC students are influencing their children by telling them to be happy, have a good career, and make them proud.

This theory has implications for key stakeholders, including researchers and practitioners. By translating this innovative research into practical guidance and by initiating calls for reform targeting persons and entities influencing the academic decision-making of first generation college students majoring in engineering, this study and the resulting grounded theory can be used to create novel concepts for educating the engineers of the 21st century. While the implications discuss many influential entities and programs, *priority can be considered for high school and college teachers and institutional outreach, recruitment, and retention and higher education efforts.* In addition, this theory uncovers the need for future research to include

investigating the influence of FGC students majoring in engineering on kin, especially siblings and parents, and fictive kin.

DEDICATION

Determining to whom I wished to dedicate this work was a most difficult decision. The persons who provided me with assistance, spiritually, emotionally, and professionally were many in number, unyielding and wide-ranging in their encouragement, and included my own influential kin and fictive kin. At an early age, I was perhaps regarded as a bit of a daydreamer, a habit with a long history and which I now regard as one of my greatest gifts. Indeed, some would say I prefer to live in my head. While perhaps not the most relevant of gifts in certain vocations, for that of a scholar, however, daydreaming is perhaps indispensable. I love to think, and I love to analyze; it is fun for me.

I believe it will come as no surprise that I have always embraced people who shape my thinking. In many ways my mentors have allowed me a different view of myself. And it is to these individuals that that this dissertation is dedicated.

To those who saw within me that innate and unyielding desire to succeed, who saw beyond the mere surface and encourage me to broaden my horizons, and who provided me with a sense of relentless optimism when at times I felt despair of ever completing this dissertation, my gratitude is both heartfelt and profound.

The list of supporters who overlooked my flaws and met my needs, who provided me with wise counsel with their most patient and gentle presence, and who greatly advanced my development as a Christian, woman and scholar, I honor you. My great-grand mother, grandmother, mother and godmother, were my first and perhaps in many ways, my best mentors. It is you who collectively gave me the gifts, which are intangible and priceless: resourcefulness, self-reliance, responsibility, teamwork, womanliness, commitment,

trustworthiness, discipline, respectability and spirituality. I am grateful to have you in my life. I stand tall and walk confidently because of you.

Respectfully, I wish to dedicate this work to Flossie "Mama" Rutledge. I feel your presence daily, and I know that your pride is truly unbounded. You are the source of my spiritual heritage, and the model for who I have become and all that I have yet to be. In matters of faith, I have had many conversations with my spiritual fathers, Rev. Wilmar Burroughs and Bishop Terry McCaskill, who shaped my relationship with Christ. To my spiritual mother, Rev. Linda Burroughs, and spiritual sisters, I thank you for listening and holding me accountable. It is because of you all that I have indeed MADE IT and I am loving life.

To my parents, Carl and Estelle Simmons, who with both trepidation and the utmost optimism brought me to Clemson University in 1986 to obtain the undergraduate education needed to prepare for an engineering career. It is because of you, with your hopes, dreams and trust for my future that I stand where I am today. To my brothers, Darrell, Carl Jr. and Lorenzo, and sister-in-law, Carrie, who keep me grounded and love me unconditionally, I can only say that as siblings are concerned, there are none better. To my cousin, Gail Washington, I thank you for being consistently present and reliable. To my girlfriends who have been like sisters: Cheryl Hopson, Tonja Brown, Therese Griffin, Tonia Patterson, Valerie Henderson, Mammie Price, the members of "girls' weekend," my PhD 'sistas' (Jamelle Ellis, Jocelyn Caldwell and Darlene Booth-Bell) and to my extended family (Norman Hopson, Barbara Whitten and John Whitten), your advice in times of uncertainty, and your friendship and positive expressions of support as I completed my studies have been of inexpressible value to me.

I wish to also dedicate this work to Dr. Lansford Bell who told me that I would make a great professor, and urged me to pursue PhD study, and to Mr. Warren Darby, who told me there was no reason I could not rise to the executive level of [a Fortune 500] company! Also warmest thanks to Drs. William Baron and Steve Sanders, who allowed me to see professors as actual individuals. Dr. Baron taught me to drive using his car and barely batted an eye when, during the first lesson, I lurched the car forward over the curb and toward the doors of Lowry Hall. After I stopped the car, he coolly yet firmly informed me, 'now, Denise, you must pay attention. Put the car in reverse.' Dr. Sanders opened the doors of his home to me and he and his family became to feel like a second family. And to Dr. Frankie Felder, who was the final, yet most punctuated, voice in a chorus urging me to think of my career in the broadest of terms.

I also wish to express my deepest gratitude to my peers and colleagues in the Social Capital (SoCap) research group, Engineering Sustainable Solutions (ESSo) research team and the Graduate Engineering Education Consortium for Students (GEECS). I appreciate you all as classmates, colleagues and friends.

Finally, I wish to dedicate this work to Sue Lasser, a 25-year relationship that has provided me more guidance and confidence than I can articulate. Only my mother has had a more profound impact upon me. Sue was the first person to tell me I should pursue a doctorate and the reason I returned to Clemson University. I will always remember her for such heartfelt encouragement, and the respect I have for Sue make those sentiments all the more meaningful. Today I regard her like a mother, and indeed, I often refer to her as my godmother. Sue, I thank you for always telling me the truth in love.

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It is with great pleasure that I acknowledge the efforts and input, both large and small, of all who made this dissertation possible. First, to my Heavenly Father, Who set me on a path of service to my community, my family, and my peers and Who gave me the moral compass to humbly accomplish my goals in this life. All that I am, I am because of Him.

To my dissertation chair, Dr. Julie Martin, whose encouragement, supervision and support from the preliminary to the concluding level enabled me to develop an understanding of the subject. By providing me with discerning and penetrating advice and assistance, she both enhanced and validated my ideas on which this dissertation is based. Dr. Martin also greatly enhanced and expanded my development as a scholar and helped me establish a positive reputation in the engineering education community. She provided the perfect balance of challenge and support for me through her warm approach. Few possess the keen intellect and rapid ability to process concepts as Dr. Martin, combined with such a vibrant dynamism, in both the personal and professional realms. Julie, I thank you for your patience and unwavering support. I feel fortunate to know you and to have you as a mentor, teacher and friend.

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I also wish to express my gratitude to the early and most relevant input from Dr. Steve Sanders, who supported the proposal upon which my research is based. I am also truly indebted and thankful for his continued interest in my personal and professional development, which has been shaped over a period of nearly 18 years. Also, to his wife, Dr.

Sharon Sanders, goes my deepest appreciation. Without her guidance in assisting me to enhance both the clarity and depth of my writing, this dissertation would be a mere sketch of the actual finished project. To the faculty in the department of Engineering & Science Education, Drs. Benson, Hazari, Potvin, Appling, Bhattacharyya and, interim chair, Dr. Melanie Cooper, who provided feedback on the methods in this study, and made recommendations for improvement.

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CHAPTER 1 INTRODUCTION

Background

The case for increased and broadened participation

Institutions across the United States (US) do not produce enough engineers to meet the demand for the engineering workforce in the US; therefore, the need exists to significantly increase both the quantity and diversity of engineers to support that workforce demand and to develop a strategic asset for the nation (Atkinson, 1990; Babco, 2001; Jackson, 2002; Chubin, May, and Babco, 2005; NAE 2007; NAE, 2011; PCAST, 2012). The dates of the references clearly indicate the call for increased and broadened participation of a diverse group of students, a fact well known for more than half a century. Indeed, though the NAE (2011) report states the importance of science and engineering workforce to the US, critical issues remain unresolved. Therefore, additional effort is necessary. Because the populations most underrepresented in engineering are increasing the fastest, we as a nation must better utilize the "vastly underused resource and a lost opportunity" (NAE, 2011) of recruiting and retaining underrepresented students in engineering education to strengthen our engineering workforce.

Many argue the "business case" for diversity, which relies on the idea that diversity of thought is necessary to engineer creative solutions to society's complex problems, thereby maintaining America's economic security and global competitiveness (Jackson, 2002; NAE 2007; NAE, 2011; PCAST, 2012). Others have argued persuasively the case for social justice. In 2010, Ruth Simmons, the first African American president of an Ivy League institution, said of women's underrepresentation in engineering, "Engineers literally design and build

much of the human environment. Women must not accept so marginal a role in so important a field." The same argument can be made for other underrepresented groups in engineering.

Besides diversity, the shortage of engineers is also a concern. Unless the science, technology, engineering, and mathematics (STEM) labor market becomes more representative of the general U.S. workforce, the nation may likely face severe shortages in STEM workers (CAWMSET, 2000; Jackson, 2002; NAE 2007; NAE, 2011; PCAST, 2012). PCAST points to the need to produce approximately 1 million more college graduates in STEM fields than projected over the next decade. Though retention is not the sole aim of this study, increasing the retention of students in engineering from 40% to 50% (PCAST, 2012) can achieve 75% of the 1 million goal over the next decade. The PCAST report translates many research based teaching strategies into practice and posits reforming teaching methods as the key to both preparing students to succeed in engineering and improving the retention of students in engineering. The report states, "retaining more students in STEM majors is the lowest-cost, fastest policy option to providing the STEM professionals that the nation needs for economic and societal well-being …".

The CAWMSET report goes on to assert that if underrepresented groups in STEM were represented in the STEM workforce, similar to their percentages in the total workforce population, this shortage could largely be solved. There are many consequences for failing to meet the number and diversity of engineers required for the workforce. PCAST (2012), NAE (2011) and Jackson (2002) state that failing to act and develop strong, talented, and innovative science and technology workforce could:

- Erode national competiveness, enterprise and innovation capabilities;

- Increase the migration of high-wage science and engineering jobs overseas;
- Dislocate the economy if our source for the future science and technology workforce is uncertain; and
- Undercut public support for U.S. research and development.

African Americans, Hispanics, and American Indians are severely underrepresented in the STEM disciplines (CAWMSET, 2000; National Science Board, 2008; NAE 2007; NAE, 2011; PCAST, 2012). According to a study of entering first-generation college students at four-year institutions over the last 35 years, the ethnicity of FGC students include Latinos, African Americans, Asians or Asian Americans, Native Americans and Whites (Saenz, et al., 2007).

In order to improve the quantity and diversity of the necessary engineering talent, funders and researchers have placed an intense focus on recruitment and retention of underrepresented groups in STEM discipline. One of the National Science Foundation's (NSF) strategic outcome goals, for example, involves preparing a diverse, globally engaged STEM workforce (NSF, 2006). However, the engineering education literature and the NAE report that recruitment and retention of underrepresented groups in engineering is a dire concern, dilemma and a "crossroads" issue (Chubin, May, and Babco, 2005; Jackson, 2002; NAE 2007; NAE 2011) despite the focus of funders like NSF. Jackson (2002) emphasizes social and cultural constraints as one set of barriers that limit the participation of all underrepresented groups. According to data compiled by the National Science Board, graduate and undergraduate student populations in engineering remain below levels reached in the early 1990s (NSB, 2008).

Engineering education literature has examined perceptions of and reasons why students choose engineering. Ohland, et al. (2008) describe engineering as a "closed club" to which students not majoring in engineering find impossible to access.

Mannon and Schreuders (2007) found that the family occupational background is the most important influence on a student's choice of college major and used the term "occupational inheritance" to describe such family influence. The authors of that study further state that because many engineering students, particularly females, have one parent who is an engineer, they inherit the occupation from that parent accordingly (Mannon and Schreuders, 2007). Because FGC students do not have an engineer parent, understanding the family influence is important to both their recruitment and retention in the engineering disciplines.

FGC students in higher education literature

While little is known about FGC engineering students, an emerging focus of research in higher education involves the study of FGC students. According to Pascarella, et al. (2004), this research falls into three general categories:

1. Studies that typically compare first-generation and other college students in terms of demographic characteristics, secondary school preparation, the college choice process, and college expectations.
2. Studies that attempt to describe and understand the transition from high school to postsecondary education.
3. Studies that examine the persistence of FGC students in college, degree attainment, and early career labor market outcomes.

A review of the higher education literature most relevant to this work is necessary to further describe these studies, the review of which fits into one or more of the general categories noted above.

The higher education literature confirms that when compared to non-FGC students, FGC students face unique barriers that result in a low graduation percentage. Chen (2005) and Pascarella, Pierson, Wolniak, and Terenzini (2004) found that compared with students whose parents attended college, first-generation students consistently remained at a disadvantage upon entering postsecondary education: they completed fewer credits, took fewer academic courses, earned lower grades, needed more remedial assistance, and were more likely to withdraw from or repeat courses they attempted. As a result, the likelihood of attaining a bachelor's degree was lower for first-generation students compared to their peers whose parents attended college (Chen, 2005). According to Chen (2005), 45 percent of first-generation college students drop out of school, a figure more than double that of non-FGC (continuing generation) students.

Research also indicates that students whose parents did not earn a four-year college degree are less academically prepared for college than their continuing generation counterparts, have less knowledge on how to apply for college and for financial assistance, and have more difficulty in adjusting to college upon enrollment (Hsiao, 1992; Thayer, 2000; Choy, 2001; Vargas, 2004). In one such college attainment study, researchers determined that even after considering many related factors, including students' demographic backgrounds, academic preparation, enrollment characteristics, credit production, and performance, FGC students were still less likely than students with college-educated parents to earn a bachelor's degree (Chen, 2005).

According to higher education literature, family is a major educational decision-making influence for FGC students, the influence of which is either a hindrance or a help depending upon the family dynamic. FGC students are more likely than continuing

generation students to report parental encouragement as a very important reason for going to college (Saenz, et al., 2007). Despite the contribution made by peers, teachers, and counselors on the academic decision-making process of FGC students, parents still play the most significant role in a student's decision to pursue undergraduate study (Olson and Rosenfeld, 1984; MacDermott, et al., 1987).

Olson and Rosenfeld (1984) found that when FGC students experience positive parental support of their college attendance decision, the result is often parental involvement in the entire educational process. Such involvement includes discussions about whether to attend college, as well as which college to attend. Conversely, FGC students who perceive less support from their families for attending college have many obstacles to overcome (Thayer, 2000). Terenzini, et al. (1995) found that FGC students experience a direct and negative impact when receiving a lower level of encouragement to attend college from family than those students who receive such support. When parents oppose their college attendance decision, FGC students question the purpose of a college education, experience alienation from family support to the point that the family relationship becomes strained, feel divided loyalties between family and school, are susceptible to doubts about their academic and motivational abilities, which in turn reinforces the negative stereotype that they are not "college material" (Justiz and Rendon, 1989; York-Anderson and Bowman, 1991; Hsiao, 1992; Terenzini, et al., 1994; Brown, 1997; Fallon, 1997; Striplin, 1999). Navigating the college process with limited support is perhaps the greatest hindrance that many FGC students fail to overcome (Brown, 1997), with predictably dismaying results; students suffering either academically or dropping out of college entirely.

FGC engineering students in engineering education literature

FGC engineering students are an understudied population in engineering and are significant because, as previously stated, they have the potential to augment both the diversity and number of engineering students prepared to meet future US workforce demand. The engineering education literature, however, is limited in its focus on FGC engineering students. Trenor (2009) asserted that FGC students are both a "growing and vital part of the potential engineering talent pool" and, therefore, have the ability to positively impact the number and diversity of engineers in the US. Studies that include FGC engineering students (Trenor, et al., 2008) and a pilot qualitative study (Fernandez, et al., 2008) conclude that these students are indeed faced with unique challenges. For instance, in their qualitative investigation of barriers to academic plans, Fernandez, et al. (2008) reported the following six barriers as the most prevalent encountered by FGC engineering majors:

1. Lack of understanding of the admissions process.
2. Financial constraints.
3. Difficulty of engineering coursework.
4. Lack of engineering role models.
5. Role conflicts between the demands of school, home, and/or work.
6. Parents who do not understand the demands of an engineering degree and/or higher education.

The US is facing a talent development crisis in engineering at the same time when the recruitment and retention of engineers in college remain disappointingly low despite the efforts of funders and researchers for more than twenty years. Further, FGC students, especially those majoring in engineering, are known to face unique academic challenges but are not well studied. The study of FGC students majoring in engineering is most imperative because of their potential to greatly mitigate this talent development crisis in engineering.

Though FGC engineering students perceive both positive and negative influences from their families in making academic- related decisions, regrettably the details of these influences are not well known. No one has studied FGC students majoring in engineering and the influence of families on their academic decision-making.

Summary

The US needs more and diverse engineers to support its workforce demand. The recruitment and retention of underrepresented groups in engineering remain a critical need despite the focus of funders and researchers for more than half a century, and the consequences of not responding to this need are well documented.

The literature offers diverging student viewpoints of engineering as a major. The pursuit of an engineering major is described as an "occupational inheritance" – inherited often from an engineer parent – for some choosing to major in engineering, and a "closed club" that others, wishing to matriculate into engineering, find impossible to access. Because FGC students do not have an engineer parent, describing the family influence is most imperative to their recruitment and retention in the STEM disciplines.

The study of first generation in college (FGC) students is important because FGC students are understudied, but significant because they represent a potential talent pool to augment both the diversity and number of engineering students prepared to meet workforce demand. Further, though the population of Latinos, American Indians & Alaska Natives, Pacific Islanders and African Americans is increasing in the US (Hussar and Bailey, 2006), they remain poorly represented in engineering disciplines; therefore, they represent an available talent pool. For engineering students, though family is identified as a major

educational decision-making influence, for FGC engineering students, family influence is both a barrier and a support.

Problem and purpose of the study & research questions

As stated in the background, the problem is the dire need to increase and broaden the participation in engineering in the US, the associated perils of not responding to the need, the lack of research on FGC students in engineering, and the potential for FGC students to fill the need for more and diverse engineers.

Under the dissertation structure, the purpose of this study is to develop a constructivist grounded theory that relates how FGC students majoring in engineering perceive the role of their family and "like family" on their academic decisions grounded entirely in the data collected. The influence of family members and those that serve a similar role as family, termed "fictive kin", were studied. A number of researchers reported that having a parent or family member who is an engineer was an influencing factor for students, particularly females, in their selection of engineering as a college major (Seymour and Hewitt, 1997; Mannon and Schreuders, 2007; Trenor, 2009). Yet, the academic and career choices of students without an engineering or college-educated role model are not well understood.

In that the premise of this study was to only interview undergraduate FGC students currently majoring in engineering, all participants shared the following characteristics:

- Generational status: FGC
- Major: Any engineering discipline
- Classification: Undergraduate, specifically juniors and seniors

The research questions addressing students' experiences with family and "like family" influences are motivated by the dearth of empirical studies addressing the academic

influences of FGC students majoring in engineering. The specific research questions that guided this study were:

1. How do undergraduate first-generation college (FGC) students describe their kin's (or family) influence on their persistence as engineering students and/or in making academic decisions related to engineering?

2. How do undergraduate first-generation college (FGC) students describe their fictive kin's (or "like family") influence on their persistence as engineering students and/or in making academic decisions related to engineering?

Significance of study

Much is known from the higher education literature about FGC students with respect to their *academic preparation*, *transition to postsecondary education*, and *progress toward degree attainment*. Similar aspects are rarely studied for FGC students in the engineering education literature, however. Further, little is known about the college experiences of FGC engineering majors, their academic decision-making during college or the influence of family (kin) and "like family" (fictive kin) members on the same. **This study is unique in its focus on FGC students majoring in engineering and results in a theory about how kin and fictive kin influence these students' academic decisions**. The resulting insights inform recruitment and retention strategies for FGC students into the field of engineering.

Definition of terms

The terms defined below clarify concepts upon which this study was based.

Academic decision – the act of taking a position or making a judgment after consideration on a matter relating to college. Such matters include:

- College attendance,
- Choice of major,

- Selection of courses,
- Interaction with advisor and professors,
- Reaction to grade on a test or assignment,
- Response to curriculum overload,
- Decisions related to studying (i.e., where, how much, when, how),
- Time management,
- Weighing financial issues relating to completing degree,
- Determining and/or expressing interest and disinterest in courses and major,
- Communicating with professors and TAs,
- Feelings of confidence or doubt in completing degree, and
- Finding help for a course (tutoring, study groups), etc.

Critical incident technique – a well-established qualitative research method that is useful in exploring significant experiences in order to better understand resulting behavior (Flanagan, 1954; Woolsey, 1986; Grant and Trenor, 2010).

Fictive-kin – fictive kin is a term used to refer to individuals that are unrelated by either birth or marriage, who have an emotionally significant relationship with another individual that would take on the characteristics of a family relationship (Tierney and Venegas, 2006). Another way to think of this term is "like family".

First-generation college students – students whose parents have attained less than a bachelor's degree (Choy, 2001).

Grounded theory – a methodology that guides researchers in developing theory out of data, thus making the theory "grounded" in the data (Charmaz, 2008).

Overview of the chapters

This study is organized into five chapters. Chapter 1 explains how the problem came to be identified and the need for the research. The chapter includes the background, purpose

statement, research questions, significance of study, definitions of terms, and an overview of the chapters. Chapter 2 provides a review of the literature as it relates to a review of the fundamentals of qualitative research, elements of developing a qualitative research study, grounded theory methodology, and critical incident technique to foster a deeper understanding of the methodology and concepts used to guide this study. Chapter 3 specifies the methods and design used to conduct the study, includes a description of the grounded theory research design and procedures, and explains data collection and analysis and perspective of the researcher. Chapter 4 discusses the theory that emerged from the data. Chapter 5 sets forth the study's recommendations with implications for key stakeholders and future research.

CHAPTER 2 REVIEW OF LITERATURE

One purpose of a literature review in a dissertation is to share the results of studies similar to that being proposed or just completed. Another use of a literature review entails defining concepts. As supported in Chapter 1, this study makes a unique contribution in that it has no similarities in existing engineering education literature. Though not the exclusive use, a qualitative study can be useful when the subject is exploratory in nature; therefore, little is known about the topic (Creswell, 2003). A review of literature in such studies is not used to set the stage, but instead to support the problem and/or need for the study (Creswell, 2003). In this case, the literature review should be placed at the start of the dissertation. In a grounded theory study, the literature review can also be used to compare and contrast the emerged theory with existing theories (Creswell, 2003). In this case, the literature review can be placed at the end of the dissertation. No theories exist on the roles families play in the academic decision making of first generation college students majoring in engineering. Creswell (2003) advises that literature review placement should also be based on the audience for the project.

The nature of this dissertation does not lend itself to the placement of a literature review in a single location. For this study, the best placement of a review of the literature is integrated in Chapter 1 to frame the problem *and* in this chapter to define concepts. The previous chapter integrates a review of the literature on FGC students and FGC students majoring in engineering. In this chapter, a review of the fundamentals of qualitative research, elements of developing a qualitative research study, grounded theory methodology, and critical incident technique is discussed to foster a deeper understanding of the methodology and concepts used in this study.

Fundamentals of qualitative research

Qualitative research involves the careful planning of a research design that encompasses all aspects of the study, from research questions, to sampling, to data collection and analysis (Borrego and Douglas, 2009). A distinguishing feature of qualitative research is the emerging and interpretive nature of the data collection process (Denzin and Lincoln, 2005). Rigid sample sizes and objective measures are not consistent with the evolving nature of qualitative research. The hallmarks of qualitative research include: (a) an interest in naturalistic inquiry such that researchers go to participants in their natural setting, (b) an interest in capturing complex processes, and (c) a view of data analysis and interpretation that is emergent from the data itself (i.e., an inductive process) (Charmaz 2008; Denzin and Lincoln, 2005). Qualitative research methods can be used to better understand any phenomenon about which little is yet known, to gain new perspectives on things about which much is already known, or to gain more in-depth information that may be difficult to convey quantitatively (Corbin and Strauss, 2008). Research problems tend to be framed as open-ended questions that will support discovery of new information.

Thusly, qualitative research uses a naturalistic approach that seeks to understand phenomena in context-specific settings while quantitative research uses experimental methods and measurements to test hypothetical generalizations. Each represents a fundamentally different inquiry paradigm, and researcher actions are based on the underlying assumptions of each paradigm (Corbin and Strauss, 2008). Further, qualitative researchers can establish the trustworthiness of their data by assuring credibility (analogous to internal validity), applicability (analogous to external validity), consistency (similar to reliability) and confirmability (similar to objectivity) (Tonso, 1996). In explaining the difference between

quantitative and qualitative research, Borrego, Douglas and Amelink (2009) provide four issues to compare: assumed nature of truth, the role of theory, sampling and generalizability and transferability. The following provides a summary of the four comparative issues (Borrego, Douglas and Amelink, 2009):

1. **Assumed nature of truth.** The assumed nature of truth in quantitative research is constructed from the post-positivist perspective, a position supporting the existence of absolute truth that can never be confirmed. In qualitative research, however, the interpretivist perspective, an approach that constructs an experience from the viewpoint of those who live it, is used.
2. **The role of theory.** In quantitative studies and research designs, stated hypotheses are based on an established theory and are used to select appropriate measurement instruments. Qualitative research, however, employs a theory to provide a perspective through which to view findings. Timing of theory application also differs: quantitative research involves it early in the study while qualitative research only employs it whenever deemed necessary and then, if necessary, late in the study.
3. **Sampling.** Quantitative studies emphasize large, representative samples while qualitative research focuses on smaller groups. Instead of descriptions that can broadly apply to a number of situations, the aim of qualitative research is narrower and deeper in its focus favoring thick, rich descriptions of a particular situation.
4. **Generalizability and transferability.** The hallmarks of generalizability in quantitative research are large population independent of context and predictions based on reoccurring observations. Qualitative research focuses on thick, rich descriptions of a particular situation that enable the readers of the descriptions to

make comparisons between the particular situation and their own situation. "In short, quantitative research places the burden of demonstrating generalizability on the researcher, while qualitative research places the burden of identifying appropriate contexts for transferability on the reader" (Borrego, Douglas and Amelink, 2009).

Elements of developing a qualitative research study

When completed at the start of a study, carefully considering epistemology, theoretical perspective, methodology and methods as it relates to the research design improves the rigor of a study. Figure 1 shows the relationship among the four elements and keywords associated with each.

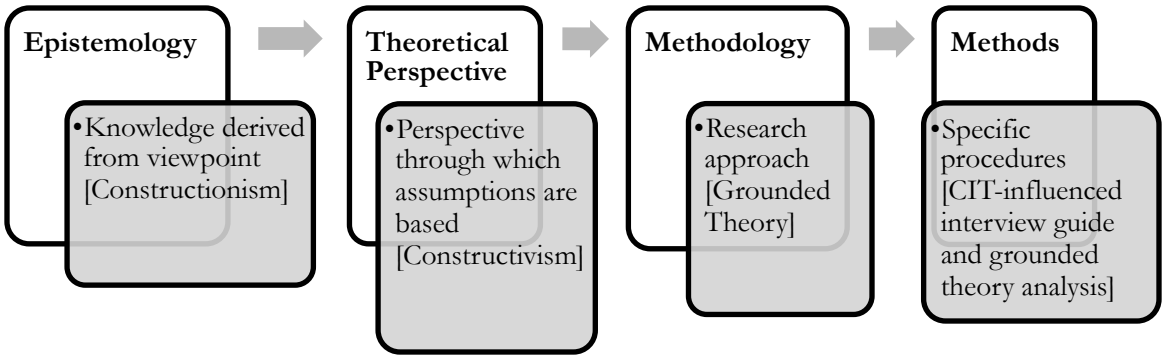


Figure 1. Four Elements of Developing a Research Study
(Source: based on Crotty, 2003)

Epistemology

Epistemology refers to what is considered knowledge and the basis for such knowledge. This study employs the constructionism view in which meaning is not discovered but constructed. Specifically, all knowledge is derived by observing the world through a single perspective, with each person possessing a definable and discoverable nature that is "concerned" with the dynamics of social interaction (Crotty, 2003).

Theoretical perspective

The perspective becomes the overarching guide for the design of the study's data collection and analysis methods. Constructivism, the perspective used by this study, embraces the idea that people actively make meaning of their experiences (Crotty, 2003). Constructivist inquiry starts with the experience and asks how members construct that experience. Constructivists aim to enter the experience through the participant's perspective, gain multiple views of it, and place it in a context as described by all participants. Constructivists acknowledge that their interpretation of the studied experiences and underlying phenomenon is itself a construction.

Methodology

When I began the study, the guiding research questions were:

1. How do undergraduate first generation college (FGC) students' families influence academic decisions related to engineering?
2. What influence do fictive kin provide?

During the study, the research questions were slightly modified. The reasons for the change and revised questions are discussed in the next section.

Corbin and Strauss (2008) state that the purpose of qualitative methodology is to better understand any phenomenon about which little is yet known. FGC students, especially those majoring in engineering, are not well studied and are known to face unique academic challenges. Further, qualitative studies yield results that are reflective of the descriptive experiences and feelings of the participants (Merriam, 1998). At this point, I knew a qualitative approach was appropriate and would be included in the research design.

To better understand and describe the family influence required exploring personal interactions between students and their parents in a way that the students' experiences could be completely chronicled in their own words. Therefore, the methods needed to include a rigorous data collection mechanism using an interview protocol where open-ended questions could be posed and followed with clarifying questions in order to completely understand the interaction. The specific methodology also required a process by which a theory would emerge from the data collected. After evaluating various qualitative approaches and weighing if mixed methods designs would benefit this study, the constructivist grounded theory methodology was selected as the approach best able to guide my research.

Constructivist grounded theory

The qualitative approach that guided this study was constructivist grounded theory methodology, which has its disciplinary roots in sociology. Grounded theory is a methodology that guides researchers in developing theory out of data, thus making the theory "grounded" in the data (Clarke, 2005; Mertens, 2005; Corbin and Strauss, 2008; Charmaz, 2008). The result of a grounded theory study is a description of relationships among concepts (theory) uncovered in the data (grounded) (Charmaz, 2008). While acknowledging the non-linear research process in the constructivist grounded theory, Charmaz (2008) advocates seven steps for the process: (1) collecting rich data, (2) coding the data, (3) memo writing throughout the study, (4) theoretical sampling, saturation, and sorting, (5) reassessing what theory means, (6) writing a draft, and (7) reflecting on the process. The data analysis does not follow a linear process, but involves the intertwining of emergent coding, memoing, and sorting as depicted in Figure 2.

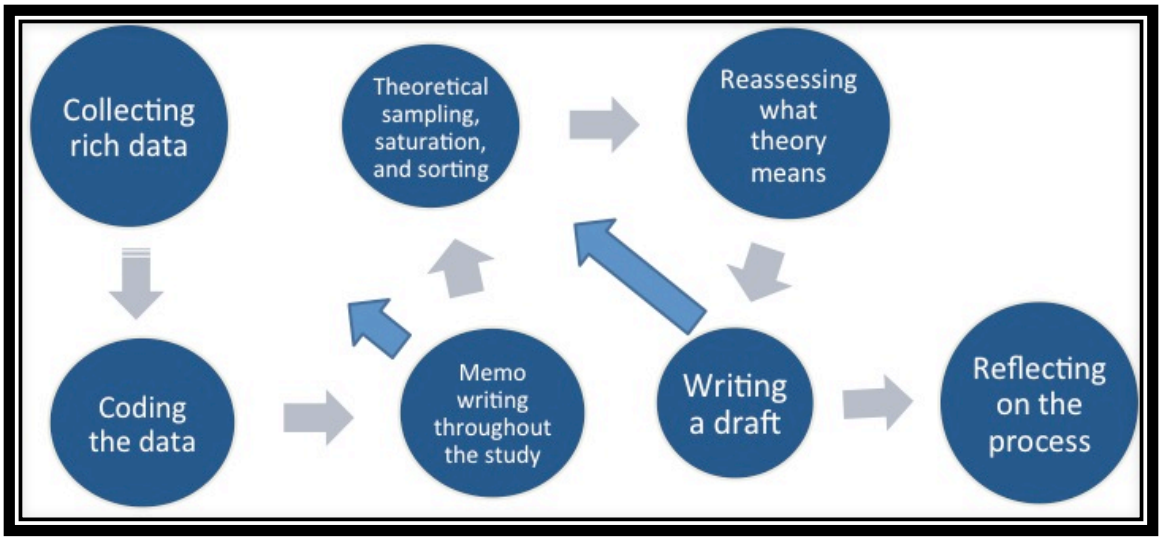


Figure 2: The Non-linear Steps of Constructivist Grounded Theory Research
(Adapted from: Charmaz, 2008)

Emergent coding involves initial, focused and theoretical coding. Data analysis begins with initial coding where important segments of data will be grouped into concise categories. Throughout the study, coding was revisited for comparison and updating, thusly allowing constant comparisons and development of new leads to explore throughout data collection. Focused coding allowed synthesizing of larger, significant data segments resulting in major categories. Finally, theoretical coding specified the relationship among categories and lead to constructing the initial theory.

Though the start employed inductive logic and analysis, the process moved toward conceptual development to theory emergence. Charmaz (2008) describes the method as a systematic, inductive, and comparative approach for conducting inquiry for the purposes of constructing theory.

Table 1. Data Collection Activities for Grounded Theory Methodology
(Adapted from: Creswell, 2007 – Table 7.1, pp. 120-121)

Data Collection Activity	Grounded Theory Approach	Activity Associated with This Study
What is traditionally studied?	Multiple individuals who responded to an action or participated in a process about a central phenomenon	Participant experienced family influence on their engineering-related academic decisions
What are typical access and rapport issues?	Locating a homogeneous sample.	Use of demographic survey to identify sample
How does one select a site or individuals to study? (purposeful sampling strategies)	Finding a homogeneous sample, a "theory based" sample, a "theoretical" sample	Use of demographic survey and selection strata from which to choose sample
What type of information typically is collected?	Primarily interviews with 20 to 30 people to achieve detail in the theory.	Plan to interview 20 - 30 participants; stopping with data saturation
How is information recorded?	Interview protocol, memoing	Critical Incident technique
What are common data collection issues?	Interviewing issues (e.g., logistics, openness)	Interviewing issues (e.g., logistics, openness, length of interview)
How information is typically stored?	Transcriptions, computer files	Transcriptions, computer files

Table 1 describes various data collection activities and specific approaches to support the grounded theory inquiry (Creswell, 2007). In Chapter 3, the specific methods and research plan supporting this study are extensively discussed. Creswell's activities for grounded theory are aligned with Charmaz's constructivist grounded theory. Table 1 also includes a column addressing the activities associated with this study. Refer to Chapter 3 for additional discussion.

Meaning of "theory"

In defining what is meant by theory, Charmaz (2008) presents two approaches from the social sciences: positivist and interpretive. According to Charmaz (2008), the positivist approach to constructing a theory is as a statement relating abstract, theoretical concepts. By using variables and giving concepts operational definitions, the resulting theory can be used in many fields and be adopted by authors of research textbooks (Charmaz, 2008). Such theories are explanatory and predictive. A positivist theory is described as that which "treats concepts as variables, specifies relationships between concepts, explains and predicts these relationships, synthesizes knowledge, verifies theoretical relationships through hypothesis-testing, and generates hypotheses for research" (Charmaz, 2008). However, an interpretive approach focuses on understanding and relies on the theorist's interpretation of the phenomenon under study, does not seek causality, assumes multiple, emergent realities, and emphasizes practices and actions (Charmaz, 2008). This study employs an interpretive approach in emerging and stating the theory of how families influence the academic decision-making of FGC engineering students. The use of an interpretive viewpoint is also consistent with my epistemology.

Critical incident technique

Developed from work in the U.S. Army Air Forces Aviation Psychology Program by Flanagan (1954) during World War II, the Critical Incident Technique (CIT) is a well-established qualitative research method used to explore significant experiences to better understand resulting behavior (Flanagan, 1954; Woolsey, 1986; Grant and Trenor, 2010). A critical incident is also described as that which makes a significant contribution, either

positively or negatively, to an activity or phenomenon (Bitner, Booms and Tetreault, 1990; Grove and Fisk, 1997). Flanagan (1954) emphasizes that "the critical incident technique ... should be thought of as a flexible set of principles which must be modified and adapted to meet the specific situation a hand."

Originally used to assess performance in professional practice, the CIT has recent usage in health care, the service industry, education, and minor league sports. For example, CIT is useful in examining complex sets of behavioral intentions, such as the decisive situations that influence spouses' support to patients with congestive heart failure in relation to the couple's sleep situation (Bostrom, Stromberg, Dahlstrom, and Fridlund, 2003) and in determining customer perceptions and reaction across a range of service industries (de Ruyter, Wetzels, and van Birgelen, 1999). Other applications include determining the success and failure of university students (Schmelzer, et al., 1987) and, in minor league sports, identifying which aspects of the spectator experience are most relevant to spectators at minor league sporting events, distinguishing aspects that satisfy customers from those that dissatisfy customers, and suggesting critical aspects that differ for customers of varied sports or demographic groups (Greenwell, Lee, and Naeger, 2007).

Though first used in psychological measurement and more recently in the industries noted above, CIT is now emerging as a tool for research and for building theories in engineering education (Pears and Daniels, 2008, Adams and Fincher, 2006; Walther, Kellam, Sochacka and Radcliffe 2011; Walther, Kellam, Radcliffe, and Boonchai 2009). One objective of CIT entails elucidating an understanding of an incident of interest to the researcher from the perspective of the participant, considering cognitive, affective, and behavioral elements (Chell, 1998). Such an approach is useful in a grounded theory study

where critical incidents become the source of thick, rich data used to gain an in-depth picture of individual's academic and career choice process. CIT allows the *participant to select which incidents are important to them as it relates to an activity under study*. In this study, CIT was used to develop a semi-structured interview guide. A discussion of that guide's development is presented in Chapter 3.

CHAPTER 3 METHODS

This chapter specifies the methods and design used to conduct the study, includes a description of the grounded theory research design and procedures, and explains data collection and analysis. The chapter also discusses my background and role as the researcher.

Ethical considerations

In order to proceed with the study, institutional approval was necessary. Approval was obtained from Clemson University's Institutional Review Board (IRB) to obtain initial data (IRB protocol # IRB2008-349) and to investigate the research questions in this study (IRB protocol # IRB2009-195). Confidentiality was maintained throughout the study through the use of a code, with all data and materials related to the research kept in a locked drawer and archived on a password protected computer. Transcripts will be retained indefinitely, but are only identifiable by a code assigned to each participant, with the key assigning the participant name to an identifying code destroyed at the end of the project. Participant identity *will not be revealed* in any publication that might result from this study. The information obtained in this study may be published in journals or presented at professional meetings. Participation in this study was done purely on a voluntary basis. Participants were made aware of the details of the study, time involved, risks and discomforts, confidentiality, the right to withdraw, and rewards associated with this study through the use of an Informed Consent (see appendix IV).

Research design

Qualitative research involves the careful planning of a research design that encompasses all aspects of the study, from research questions, to sampling, to data collection

and analysis (Borrego, Douglas and Amelink, 2009). The study began with an exploratory design, as Figure 3 depicts, in order to explore the academic barriers experienced by FGC students, develop significant research questions, and collect data for the dissertation study (Creswell and Plano Clark, 2007). Figure 4 depicts the research plan for this study and includes a general timeline.

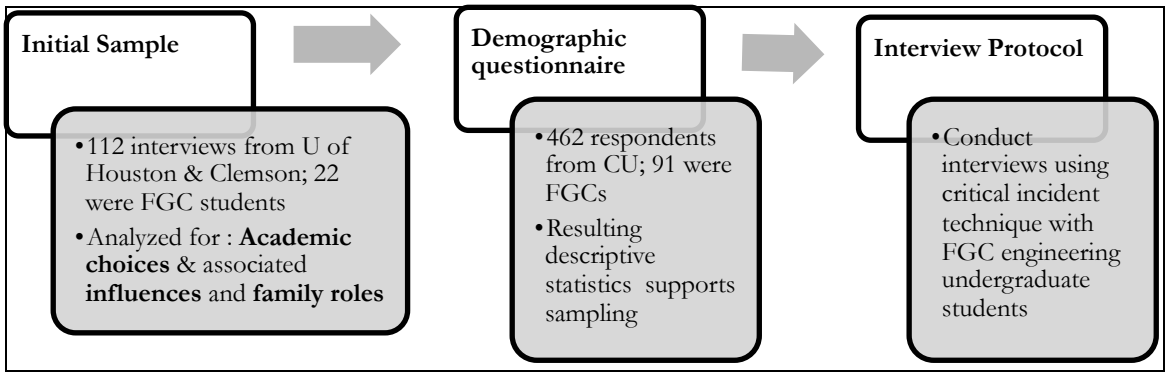


Figure 3: Initial Exploratory Design
(Adapted from: Creswell and Plano Clark, 2007)

Analysis of initial sample

Starting in the fall 2008, interview data from University of Houston and Clemson University (112 participants, 22 FGC students) were used to identify family roles impacting academic decision making and the information sources used to make college major choice decisions (Martin, et al., in preparation). I analyzed the transcripts from the University of Houston study (46 participants, 18 FGC students) and participated in the collection, coding and analysis of study data at Clemson University (38 participants, 4 FGC students). These studies influenced the development of specific and significant research questions that guided this study, a demographic questionnaire and a semi-structured, CIT interview guide.

Development of demographic questionnaire

To ensure the selection of FGC students majoring in engineering and to make the interviews more efficient, a brief demographic questionnaire using Survey Monkey was developed. This approach also limited the amount of demographic information that needed to be obtained in the interview. Once composed, the questionnaire was pilot tested with a focus group of approximately 25 entering freshman engineering students using a verbal protocol technique called a "think aloud". The think aloud session began with each student individually reading all items on the questionnaire. Readers then verbalized their internal thoughts while performing a specific task at hand – for my purpose, requesting participants to think about their response to each item on the questionnaire (van Someren, Barnard and Sandberg, 1994). The think aloud session also allowed the students to explain their thought-response process for each item, and then suggest necessary changes. As a result, changes were made to both the order and wording of several items on the questionnaire. Since these students would not be a part of the selection strata for the interviews supporting this study, bias introduction to the study population was avoided.

The questionnaire also underwent an informal review of access from various devices: PCs and other web-enabled devices such as Apple iPod touch, Apple iPhone, Black Berry and other so called "smart phones." An access issue with one device was discovered and reported to Survey Monkey. The customer service representative from Survey Monkey acknowledged that the access issue from the identified device was known and a fix was being

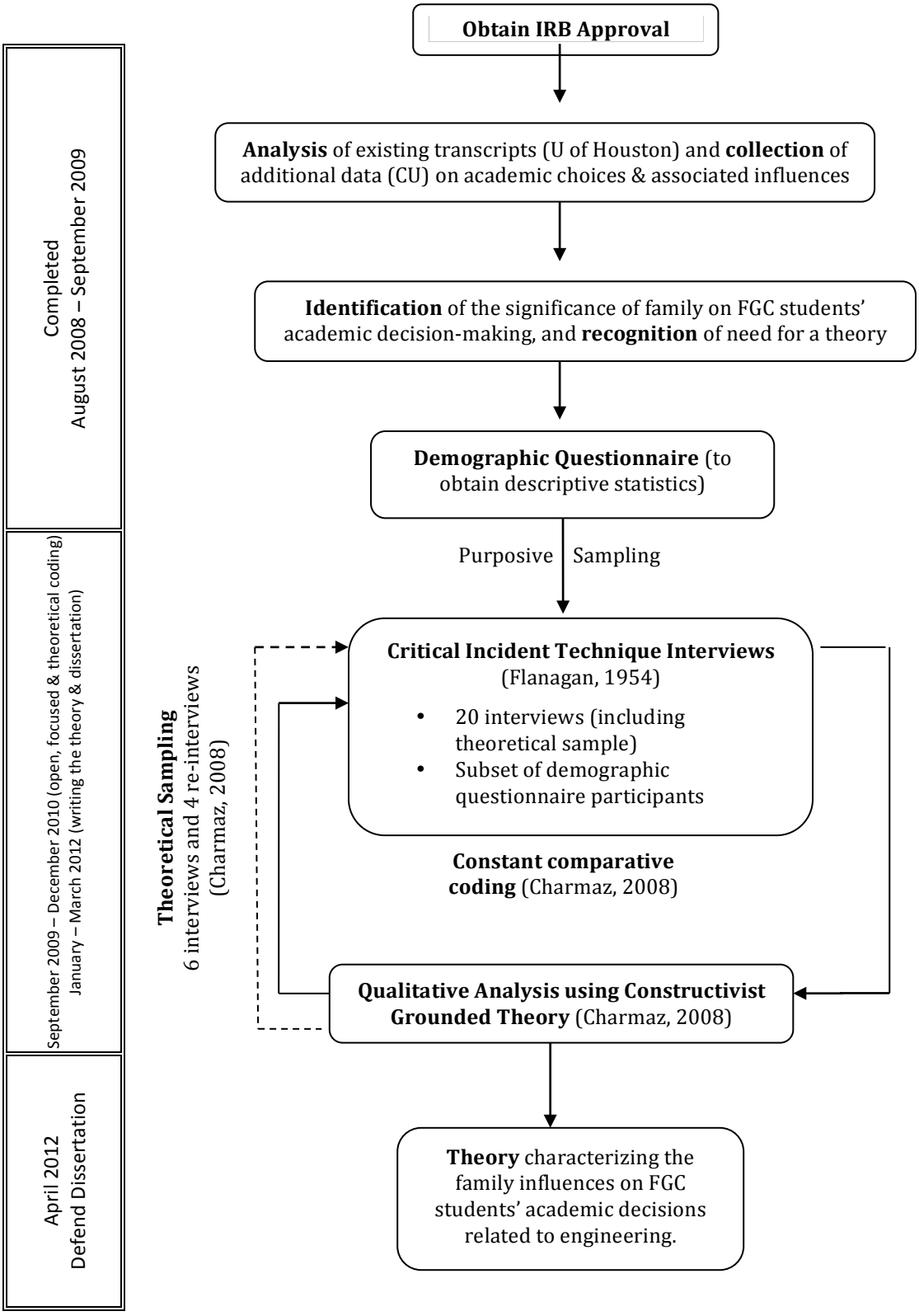


Figure 4: Research Plan (with timeline)

devised. The email solicitation letter disclosed the issue to participants in hopes of increasing their chances of completing the questionnaire while avoiding technology-based issues.

The questionnaire, which is in appendix I, was then ready for distribution via email in the Fall 2009 using listservs for any student group that included engineering majors. In order to obtain institutional approval, the study's interview guide was developed and submitted for approval.

Research context

The demographic questionnaire was distributed in fall 2009 at Clemson University, a four-year, research-based institution located in the southeastern United States. In fall 2009, the total undergraduate enrollment at the University was 15,346 (54% male, 46% female; 1.6% Hispanic, 1.7% Asian, 7% African American, 82.6% White) (Clemson University, 2009). The college of engineering and science had a total undergraduate enrollment of 5,466 (79% male, 21% female) (Clemson University, 2009). Appendix V provides the descriptive results of the 91 FGC students participating in the demographic questionnaire, which were used to purposively select 16 participants (56% male, 44% female; 13% Hispanic, 6% African American, 81% White, 1.7% Asian) for this study.

Development of interview protocol

An interview protocol was developed to guide the selection of participants and answer the research questions. The protocol was influenced by the CIT, which guided both the interview guide development and the facilitation of the interview.

Influence of the critical incident technique

In that the critical incident technique (CIT) is a useful method to explore significant experiences to better understand resulting behaviors, it substantially influenced my crafting of each question, and my approach to each interview. From the CIT perspective, certain interactions and thoughts are critical to understanding resulting actions and behaviors. Therefore, the interview was structured to support elicitation of these thoughts and actions. Example interview questions may be found in Table 2.

Qualities of interviews in qualitative research and purpose of interview guide

Interviews are most illuminating in providing access to perceptions and attitudes. Further, an interview guide that would elicit the kind of rich, thick data needed to develop a theory grounded in the data was imperative. Therefore, a guide supporting the stated needs and goals was developed, a copy of which is in appendix II. The interview questions were created to correspond to the research questions, and included queries about how academic decisions were made and the family influence on each decision.

The interview questions were framed as open-ended probes beginning with words such as "describe," "how," and "what" rather than "why." These question stems were deliberately chosen to elicit a descriptive narrative rather than justification for past actions (Kvale, 1996). Specifically, the goal of each interview was to discover several aspects of the family influence on the participant's engineering-related academic choice process. Table 2 shows each aspect or object along with discovery method and example.

Table 2: Example Interview Questions

Object of Discover	Discovery Method
Triggering factors	**Questions.** Example: Please tell me about a specific conversation with (a kin or fictive kin) about your *academic decisions*.
Critical steps	**Questions.** Example: As a result of your conversation with (kin or fictive kin), please explain what action or steps did you take?
Final outcomes and follow up, if any	**Questions.** Example: Did that action or step impact your academic decision making? If yes, tell me more.
Explore further the impact of influences on participant's decisions and/or actions	**Questions.** Example: Was one particular person most influential on your academic decision making? What academic-related things do you depend on (kin or fictive kin) for?

Solicitation of participants

An email solicitation letter (in appendix III) with a link to the demographic questionnaire was sent to the listserv managers of any group that included engineering majors. The email requested that the manager distribute the electronic invitation to members of their listserv. As the researcher, I did not send emails directly to potential participants and lists were not released to me. Up to two reminders were sent by the listserv manager. Care was taken not to send reminders to students who had already agreed to participate so they were not receiving unnecessary emails.

To comply with IRB age requirements for participants, the online survey first asked students indicate their birthdate. In addition, students were asked to disclose their major. Participants must have indicated that they were at least 18 years old and currently enrolled in any engineering major. Students were asked to meet these criteria before proceeding with the online survey. Students not meeting the stated criteria were thanked for their interest and

exited from the survey. The survey did include a prize for three participants. A random drawing for three $50 Amazon cards from survey participants was held and awarded.

Of the 462 students that completed the demographic questionnaire, 91 were identified as FGC. Participants' self-reported parental education levels were used to determine generational status in college. Appendix V provides the descriptive results of the FGC students participating in the survey. Descriptive results from the questionnaire were used to purposively select 16 initial participants for the interview phase of the study. The students were contacted by electronic mail and invited to schedule an interview appointment. Students that scheduled an interview were sent an electronic message 24 – 36 hours prior to the interview reminding them of the time and location of their appointment. The next section details how the sample was selected.

Participant selection

All participants were selected purposefully using the selection strata described below until which time theoretical sampling began.

Purposive sampling

To start the study, interview participants were selected purposively from those completing the online demographic questionnaire and invited to participate in a semi-structured interview. It was essential to seek samples that would provide insight and a depth of understanding of the subject matter under study (Jones, Torres, and Arminio, 2006). To explore issues related to family influences on their engineering-related academic decision-making, the sampling of student participants was guided by the goal of including diverse

perspectives on the study's research questions. I purposely selected participants using the following selection strata and invited each to an interview:

1. Majoring in an engineering discipline
2. First generation college students
3. Junior or senior university classification at time of interview

The participants selected were those best able to answer the interview questions. To ensure that all participants articulated the greatest possible depth of insight regarding the influence of their family on their decision to study engineering, only juniors and seniors were recruited. Purposive sampling began with the first interview and continued through the tenth interview.

Theoretical sampling

Theoretical sampling supported the elaboration and further refinement of categories in the emerging theory. When additional participants no longer offered new insights into family influences on their engineering-related academic decision-making, the sample was deemed saturated. Following the recommendation of Charmaz (2008) to engage in theoretical sampling later in the study to prevent forcing the data into codes and to prevent the data from being understudied, theoretical sampling began with the 11th interview and continued through the last interview.

Duration of study

From the start of the study until the last interview was conducted, 21 months elapsed, a span of time permitting adequate completion of the rigorous grounded theory research process. Table 3 summarizes the amount of data collected and Table 4 contains an overview of the study's participants.

Table 3: Overview of Data Collected

	Number of participants	**Duration of data collection (months with date of first and last interview noted)**	**Hours of interview**	**Pages of transcript**
Initial Coding	Overlaps with focused coding, at least 5	Nov 2009-July 2010	5:57	145
Focused Coding	Overlaps with initial and theoretical; at least 5	June 2010-Feb 2011	6:33	165
Theoretical Coding	Overlaps with focused coding; at least 10 including 4 re-interviews/second round	Feb-August 2011	10:10	283
TOTALS	**20 total: 10 purposive sample; 10 theoretical sample**	**21**	**22:40**	**593**

Table 4: Study's Participants

Participant #	**Engineering Major**	**Class Standing at time of interview**
CUD1	Electrical	Senior
CUD2	Industrial	Senior
CUD3	Civil	Senior
CUD4	Civil	1 month after
CUD5	Bioengineering	Senior
CUD6	Chemical & Biomolecular	Senior
CUD7	Civil	Senior
CUD8	Electrical	Senior
CUD9	Bioengineering	Senior
CUD10	Biosystems	Junior
CUD11	Mechanical	Senior
CUD12	Electrical	Senior
CUD13	Computer	Senior
CUD14	Chemical & Biomolecular	Senior
CUD15	Computer	Senior
CUD16	Electrical	Junior

Semi-structured interviews

Student interviews, of approximately one hour to ninety minutes in length, were face-to-face, in-depth, semi-structured conversations that were conducted on campus in a private office room. All interviews were recorded using a digital voice recorder. Each participant received a definition sheet on academic choice during the interview (see appendix VI). At the first meeting, participants learned more about the study and were provided an informed consent letter to review. Signed originals of the consent were filed and held according to the IRB's guidelines. The participants retained a copy of the consent for their records. In addition, each interview participant received a $30 Amazon card. The definition sheet provided a definition of academic choice and examples of research-based, positive and negative family influences on engineering-related academic choices. Participants were made to understand that the sheet contains examples only, that the examples are not all inclusive and that the participant may or may not have experienced the influences listed. The definition sheet was available to each participant for referral to throughout the interview.

The interview began with questions allowing the participants to convey their engineering-related academic choice process and the persons, including family members, with whom they discuss these choices. Participants were encouraged to reflect back on how they first learned about engineering as a college major, through the point at which they chose engineering as a major, and to their present-day engineering-related academic decisions. From these narratives, it was possible to learn various triggering factors and critical steps taken to enable each participant to make engineering-related academic decisions.

Once the participants explained how their family influenced their engineering-related academic decision making, they were asked about specific interactions with each family

member that were critical to the engineering-related academic decision making. To ensure incidents shared were important and relevant to the participant's engineering-related academic choices, they were asked to provide a link between the incident and a decision or decisions.

The questions were open-ended and allowed the participants to describe the behavior of the family member and relate the behavior to a particular engineering-related academic choice. Participants were also asked to tell how long they knew each family member, how frequently they engaged each family member in discussions about their engineering-related academic choices and to rank each family member from most influential to least influential according to the impact each had on their academic choices about engineering.

After the 16th interview, though the categories were saturated, the theory had yet to fully emerge. What remained to be explained was what motivated the parents to encourage the participants to "have a good future" and "enjoy career" and to support participants' decision to major in engineering. A new semi-structured interview guide was developed to investigate these theoretical aspects further. Six of the initial 16 participants were invited and subsequently four agreed to participate in a second interview. This approach is aligned with grounded theory methodology.

Data analysis

The interviews were recorded, professionally transcribed and checked for accuracy. Transcribed data from 20 interviews were collected and analyzed using a constant comparison process. Constructing Grounded Theory by Kathy Charmaz (2008) informs the

approach and each coding round: initial, focused and theoretical. Coding was facilitated by the use of qualitative data analysis software, NVIVO version 8.0. Due to the iterative nature of the methodology, data collection and analysis were intertwined. As data was collected and memos written, additional participants were recruited to investigate the appropriateness of the codes and to address the gaps in my understanding and resulting description of the emerging theory. The collected data was continuously reviewed for evidence of the emerging themes, all in accordance the constructivist grounded theory methodology.

Key to the emerging of the theory was theoretical agnosticism or subjecting the emerging theory to frequent criticism and analysis. Interrogating the data to determine the appropriateness of the developing themes and investigating the gaps in the description also supported the development of the emerging theory.

Memo writing

Throughout the coding process, memos were written about various aspects of the research process, for instance, the analytical process, questions about the data, the emerging theme, and new interview questions. The goal of memo writing is to review and sort previous codes and memos to obtain successively more abstract memos (Charmaz, 2008). This process provides an initial analytical framework for the emerging theory. According to Charmaz (2008), "As we proceed (through studying data, comparing them, and writing memos), our categories not only coalesce as we interpret the collected data but also the categories become more theoretical because we engage in successive levels of analysis."

Diagramming

Diagramming is important to the emergent theory process. As comparisons between categories were made, visual diagramming or clustering allowed a visible connection between these categories. By diagramming and memoing about connections perceived in the data and being curious about connections not yet perceived, subsequent interview questions could be written and asked resulting in additional data analysis that supported new lines of inquiry. Diagramming, also allows for questioning of what connections are possible and what may be possible.

Initial coding

Initial coding began with the first interview and continued through approximately the sixth interview. Initial coding is the classification of data and themes by looking for patterns and categories (Charmaz, 2008). During initial coding, each segment of data that reflects action is coded according to that action (Charmaz, 2008). Codes were kept precise during initial development. The first few interviews were ninety minutes in length because I conducted a broad interview and followed as many leads as the participants provided. During the initial interviews, it was unclear what was of significance to the participant, and it took approximately three interviews before it was possible to determine what the participants did indeed express as significant.

After receiving the transcript of each interview, action codes were developed using gerunds and, eventually, categories were identified based on the actions. For instance, actions related to verbal interactions or discussions with kin and fictive kin revealed the context and substance of conversations. Initial coding revealed several actions, activities and

discussions with kin and fictive kin that facilitated participants' academic decision making. The participants reported that their kin and fictive kin helped them identify and confirm their interests, allowed them to explore aspects of a career (e.g. through learning "toys"), helped set goals and chart a path for college completion, set expectations for them, caused them to pursue a college degree, helped with finding engineering-related summer employment, and worked to improve interview skills. Influences seemed to have created long-lasting impressions on participants that became a driving force and foundation upon which decisions were made. When reflecting upon his choice of engineering as a major, one participant credited his stepfather with getting him started and encouraging his interest. He explained "[my step father] actually was the one that started me on programming. I had my computer but I didn't know where to start and so he actually started me on that software engineering thing. He gave me some books, showed me a few things, gave me some examples and from there I took the programming from there … The way I got into it was I'd have a question about how something worked and then I'd try to figure it out and so I'd talk to him about it and he would say yeah it's a good thing." The participant credited his step-father's influence to "pushing me towards electrical engineering because the technical stuff he talked to me about [would] foster my brain about what I wanted to do. It's kind of hard to explain but it was definitely an indirect exposure but it's technically sound stuff we'd talk about."

Another participant linked her family influence to her drive to work smart, to knowing where to find Clemson admission criteria, to contacting a professor, to remaining in engineering, to finding engineers known to the family, and to steering her toward a career where she could financially support herself. The participant described family influences

conveyed through both conversations and her personal observations of her family. "You know, my parents are not college educated … they make good money in what they do, but I looked at that aspect [and asked myself] 'am I going to have to work like all my life to get to where they are?' I don't really want to have to do that … I'm a smart person, I can use my brain every day for something instead of going out and doing hard labor." She credits her mother with helping her understand Clemson University's admission criteria. She said her mom learned this information from Clemson's website. Her mom would tell her "you need to make sure you have this GPA plus you want to keep your [name of scholarship] and you need this, this and this …". After her mom alerted her to the criteria, the participant was knowledgeable about where to find admission criteria and began tracking and looking at the website independently. When the participant needed to speak with her professor regarding homework or help in a course, she sometimes felt uncomfortable.

Her mother encouraged her to personally visit the faculty member by saying, "well you're probably going to need to just get over there because if you need help you shouldn't be scared to ask for help." As a result, the participant said, "I guess so" and decided to at least send an email. When the participant changed engineering disciplines, her parents encouraged her to remain in engineering and to consider the financial aspects of an engineering career. Her mom told her of an engineer in their church and another that was a family friend and arranged job shadowing. Once the participant began searching for jobs, her mom helped by searching the want ads even though her mom was not sure what job would be of interest: "My mom is looking for [jobs for] me, she's like 'well, you're a little bit harder [then your sister to look for] because I don't exactly know what [you do] … well there's this car brand or there's this company or whatever' so she'll just kind of Googling

stuff or hearing things on the news and she'll relay the message". When evaluating job offers, the participant considered her salary versus her expenses based on many conversations she heard her family having.

Participants reflected on discussions with teachers, tours at local industries and construction sites, technology-based courses taken in high school and developing career interests by playing with computers and games. Participants also detailed their independent efforts, such as internet searches and reading books that helped them select a college major.

From the high school years into the college years, fictive kin provided vast and varied influence on the participants. Fictive kin was the source of specific academic influence. Fictive kin mentioned by participants included church friends, next door neighbors, peers in college, co-workers, friends of parent, high school and college advisors, friend's mothers, high school teachers, guidance counselors and programs, junior college advisors, general engineering program and pre-college programs, peer mentoring, peer-led groups and similar programs like minority engineering programs; and persons involved with institutional outreach, recruitment, and retention efforts and high education efforts.

One participant described the influence of his high school calculus teacher (fictive kin) as: "genius of a man, he was a really brilliant man. He did math, he majored in mathematics in Clemson and he was talking to me about it and I was telling him my interests and he was like well, you can do computer science which is programming, you know, computer engineering which is kind of a mix of both and then electrical engineering. And I started looking it up and looked into Clemson and they had an engineering program."

Another participant was able to fully explore specialties and careers in his major by speaking with professors "… you can talk with professors in different fields just to see what

they are like. I did research with the transportation professor so you could get involved in research at any level of your undergraduate career so you can get an experience in there and not have to have the full course knowledge to understand a little bit about the topic and decide that's really what you like or not like." In describing how professors helped, this participant said, "You could take different research courses with different professors that would give you a broader understanding of each topic and help you decide which ones you really want to take, while you're taking the ones you have to take." From faculty input and from relevant coursework, this participant arrived at a specialty in his major, which was of great relevance to his associated career choice.

Another striking example of the influence of fictive kin is one participant's anecdote of how a family friend, indeed an engineer had helped him gain access to tour a power plant. "There were a few people in my church who were engineers and my parents are friends with them, so you know, my mom's like well maybe you should talk to so and so because they're an engineer, they're this type of engineer. And I was like wait a minute, what? So, you know, my mom and dad just were like yeah, you know, go talk to so and so and I actually took a tour of a power plant with one of them, I was like ohhh, it was really cool." This participant spoke with her aunt and uncle regarding academic decisions, stating that "my family [lives in Clemson], my aunt and uncle, and they both went to Clemson, they've done the whole grad school, under grad everything, so it was easy to talk to them because they knew exactly what I was talking about." Subsequent to speaking with her uncle regarding switching majors, he suggested a change to industrial engineering saying, "IE is pretty cool … you're in groups and you know, you make things better." She later decided to switch her major accordingly.

Changes to research questions

When this study began, the guiding research questions were:

1. How do undergraduate first generation college (FGC) students' kin influence academic decisions related to engineering?
2. What influence do fictive kin provide?

As the research progressed, it became apparent that missing from the initial research questions were words signifying that the influence experience was from the perspective of the FGC student. Though such attitudes were desired from the start and indeed the study was planned accordingly, the words to connote such influences were missing from the research questions; hence the addition of the words "describe" and "making". The revised research question, noted below, is sufficiently expansive to include all participant experiences, and to further clarify the research focus, the word "persistence" was added.

The research questions guiding this constructivist grounded theory study are:

1. How do undergraduate first generation college (FGC) students describe their kin's influence on their persistence as engineering students and/or in making academic decisions related to engineering?
2. How do undergraduate first generation college (FGC) students describe their fictive kin's influence on their persistence as engineering students and/or in making academic decisions related to engineering?

Modifying interview guide

Upon analysis of each transcribed interview and diagramming, additional interview questions were composed and added to the interview guide. Though admittedly inelegant, these nascent diagrams, as shown in Figures 5 and 6, allowed a close visualization of the

influences on individual participants, the perceived impact of the influences and the outcomes of the influence. Essentially, these were crude, but highly relevant, diagrams of the critical incidents. Subsequent diagramming examined the decision making process of participants. Figure 5 depicts my initial attempt to diagram the experiences conveyed by one participant.

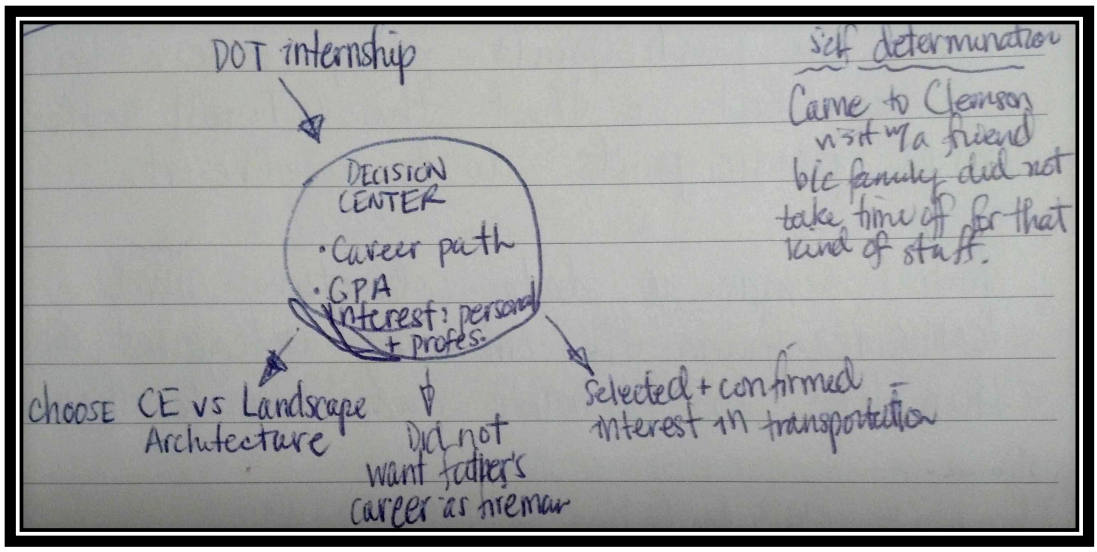


Figure 5: Sample Diagram 1 From Initial Coding

Figure 6 depicts attempts to diagram a decision making model to determine if the model was similar to what the participants were explaining. A few parallels were noted, but decision making models did not contain all the influences stated by the participants. Other theories and models (i.e., social cognitive theory and social cognitive career theory) were also examined, but none were completely aligned with the descriptions from the participants.

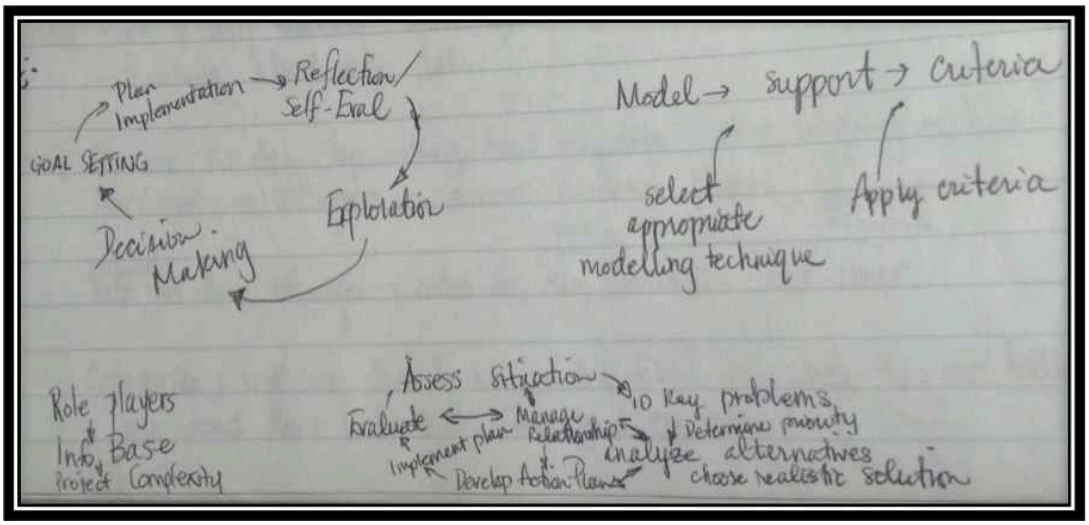


Figure 6: Sample Diagram 2 From Initial Coding

The new questions were informed by diagraming participant descriptions, as depicted above, observing what was missing from the categories and memo writing. The new interview questions were intended to:

1. Determine if and how the participants need for support to persist changed over time (i.e. did you (the participant) perceive your need for academic information change over time? If so, please explain.
2. Determine if participant experienced one influence as primary (i.e. did you have one kin or fictive kin you perceived to be more important to your academic decision making than another? If so, please explain.
3. Discover if participants experience their kin and fictive kin differently at each stage of their academic/college career (i.e. did the influence of (specific kin or fictive kin the participant mentioned) change over time? More involvement or less over time? Different type of influence needed over time?) If so, please explain.

The modified interview guide was then used during focused coding.

Focused coding

After initial coding, codes were reorganized from an action focus to a focus on kin and fictive kin influences. It was then possible to perceive the influences from the participants' descriptions, emerge the theory and begin to question the theory. Focused coding elevated the initial codes to major categories. Categories from focused coding lead to the development of the relationships among and between categories during theoretical coding, which then supported the writing of the initial theory. During this stage, constant comparisons of the data were undertaken to explore and understand which codes were significant from the transcribed interviews of participants. These codes were then developed into categories based on insights from the data. Focused coding began at about the seventh interview and continued to about the tenth interview.

Diagramming to make connections clear between ideas, codes or categories and to find gaps in descriptions supported the transition from initial-to-focused coding. By the tenth interview and through studying the emerging data, a coding summary developed. The initial theory was written and the interview guide revised accordingly.

Coding summary

Participants in the study conveyed the influence of influential kin and fictive kin interactions upon their decision making processes, perspectives, which did indeed figure positively in their subsequent choice of major. With the actions developed during initial coding, the analysis focus shifted to significant codes and to connecting and grouping codes to form categories. The categories derived from the data include "making decisions," "stating expectations," "providing unconditional support," "repeating a mantra," and "exploring college major."

Category: making decisions

Participants shared several interactions with kin and fictive kin that helped them make an academic decision. The participants experienced the influences as providing insights and information especially in considering the financial impact of decisions. Participants see themselves as being in control and responsible for making academic decisions and seek advice whenever they deem necessary. One particularly articulate participant most strikingly represented how the participants collectively experienced kin and fictive kin influence in making academic decisions. The participant summarized her academic decision making as both seeking and listening to the advice of kin and fictive kin and then making the decision accordingly. She felt entirely responsible to decide what was best for her. This participant first related how her mom influenced her decision making by first asking questions and then yielding: "a lot of it would be like [my mom asking] 'how much is [college] going to cost you to stay extra [semesters]?' And then [she would ask] 'do you feel like you can do that? How easy is that transition going to be? If that is what you want to do, then okay.' As long as it wasn't going to cost like a ton of money that [she] had to come out [of pocket] with or [take out] a ton of loans, she was okay [with me] making the best decision."

Another participant reinforced this concept, saying that "Yeah, I would [say that my parents] have the most impact [on my academic decisions], but like I said, I think most of it is I just kind of decided on my own and then just kind of reached out to them to just kind of confirm that maybe I was doing the right thing, or I had the right ideas. "

Though the participants were advised to weigh the financial impact of their academic decisions, they felt little pressure to pursue engineering study merely for the earning

potential. One participant described their experience thusly: "Well, yeah, my parents had definitely said don't just [do it for the money]. They saw all the listings [of many careers and] all the salaries of [these careers including] engineering. [Engineering careers] are one of the highest [salaries] and chemical engineering is one of the [highest among all] engineering majors. They told me don't do it for the money which I already knew not to do it for the money."

The general engineering office also helped the participant make decisions: "they gave me information about what complications I might run into with switching into [engineering from my current major] since it's usually like in the fall you take these classes, in the spring you take these, you're done with General Engineering and then you pick one [engineering discipline]. Well, since I'm coming in like a semester behind and I'm already like having certain credits and stuff there was kind of a mix-up with my schedule. So they helped me understand like what kind of classes I would have to take like how I might have to rearrange the curriculum to like fit me and I think they were really trying to make me understand like the challenge that went along with it because a lot of it was well, usually people switch out of engineering not into it. So like they made that very clear, too. But I still knew what I wanted to do."

In reflecting on how she selected an engineering discipline, she said, "I mean I took [all advice] in but I was just like that's not what I want to do like, because I would look at it and I would be like okay civil, yeah that sounds interesting but like I still don't want to put myself out of the running for like if I decide to go to medical school. So I was just like okay I'm not going to let myself do civil. Like electrical I just didn't like it so I just was not going to do it. I was very conscious and eventually it really did come down to between chemical

and Bio E and I was like okay Chem E people are saying I'm going to have to stay longer. Bio E is going to be cheaper for me so that's where I went."

She then conveyed the experience of her kin influencing her decision making processes regarding a career path. "Well, I have one uncle in particular that he's just kind of the type that's like go as far as you can go because I didn't type person. Like whenever I mention okay I think I want to like go into work for a little while and then like I don't want to give up on grad school because I still want more than my Bachelor's, his thing is oh, well if you're going to go, go straight through. And I'm like no, I want industry experience because part of my regret is not allowing myself the co-op experience so you know, I kind of want to get a feel for the industry and then maybe go back into grad school. And he's just like no, no because I took time off from college to work and I never went back and you're going to get used to the idea of making money, you're not going to want to go back. So that's just kind of like, okay whatever. But he's definitely the one that pushes me and it's like okay well I mean it's not like I know your field but if you recognize a good opportunity when you see one, if one is [located across the country]."

Another participant said simply that her parents expected that with the advice provided by them, that she would be able to make her own decisions: "… I've always had a really good relationship with my parents in that I could talk to them about stuff like that and stuff about academics and get advice up to a point and then they'd be like, you know, you've reached, you're 21 years old, you have to make your own decisions at some point."

Category: stating expectations

Participants stated that they experienced the unique influence of kin through interactions conveying specific expectations to attend and succeed in college and to enjoy

their career. During theoretical sampling, the motivation behind this influence of kin was explored.

One participant described the expectation to attend and succeed in college as self-imposed and rooted in wishing to disappoint neither her family and nor her peers. She said, "I do want to say this, that I feel like if I were to stop now, that I would feel kind of like I failed. Like I've made it this far and [failed]. I would feel like a failure because I didn't finish [and] I didn't live up to expectations that I set for myself and that [my family and others would] know. And that's not something I want to do. … I have to finish because I don't want to fail. I do enjoy doing it. … I can see myself as a mechanical engineer but I would just feel like a failure if I didn't finish and I want to say that."

Another participant recalls his father's advice to succeed and explains his father's rationale for wishing a better life for his son. "He came from a family who didn't have much when he was growing up," the participant said, "He's been able to work his way up and has really done a lot of good things so I think he is a great example to look for on how to do things the right way." In describing the resulting influence, the participant reflected that his father is "definitely an example to follow but just looking at the traits, the hard work and dedication and the main thing you need to be successful. I've definitely used that while going through school knowing there's been plenty of times when I've not wanted to study for a test or didn't like my professor or anything like that and [his influence has] helped me to get through it."

Many participants stated that their kin urged them to enjoy their college years and to obtain a degree, which would propel them towards a career they enjoyed. Statements included:

- "Oh, [my parents] were always happy for me. They were glad I'm learning new things and having fun. You know, they're always interested in to see what I'll make next."
- "… both of my parents have always encouraged me to do whatever made me happy."
- "[My parents were] happy for me that I was doing something that I love and they were really proud of me that I was moving forward especially my dad. … he had a big smile on his face and he was just like, you know, you gotta keep forward, you gotta make us all proud, you're the first one to go to college here. You know, keep saying things like that which I could tell that he was really happy about it. That I wasn't just going to end up like my brother and my sister just dropping out of college."
- "[My parents were] pushing me to do better. Or I mean just pushing me to continue doing well …"

Category: providing unconditional support

Codes supporting two categories while having a different meaning in each category, called *double codes,* are common in qualitative studies. The codes for "providing unconditional support" and "stating expectations" were double coded though unique quotes are shared below. In deciding between double coding versus combining the categories into a single category when analyzing, explanations were examined carefully for instances where two distinct experiences, in this case influences, are being conveyed by the participant's description. When analyzing "stating expectations" and "proving unconditional support," the participants were in many instances clearly describing both expectations and support – two distinct influences that were deemed related, but nonetheless distinct and significant enough to the participants to remain separate categories.

The participants perceived that their parents supported them in whatever they wanted to do including their academic decisions. This influence was unique to kin. Participants described this unconditional support as follows:

- "Emotional support seems like the biggest area that maybe my parents are providing instead of specific advice or content knowledge related to college,"
- "[My parents are] like 'those parents'… they're going to support whatever I do and I think I'd been doing crazy stuff … well not crazy, but what I wanted to do for a long time and I don't remember ever strictly discussing this with them,"
- "I would say [my mom provides not] just advice but [also] backup maybe. [I feel] a release [by] telling her how I feel about what I'm studying" and
- "… I mean family acts as the emotional, the drive, the ambition, ah, they're a home base for us all."

Category: repeating a mantra

Many of the participants stated that they would repeat certain aphorisms to enhance their motivation to persist in college and explain how they selected a major. Such mantras, which were used frequently throughout the interview by the participant, included:

- "I really wanted an engineering degree from Clemson,"
- "Having a broad knowledge base in [chosen major] is important",
- Thought it important to get the most out of college experience especially since she "got a full ride,"
- "Time is money." Does not like the idea of debt so made academic decisions based on finishing in 4 years or no more than 4.5 years to eliminate or minimize need for loans,
- "Money matters" – played into college selection,
- "Key to success: never give up,"
- "Push through and get done," and
- "I need to graduate"

When asked to explain how they developed the mantra, the participants credited their parent(s) and/or themselves.

Category: exploring a major

Participants described how they made the decision to major in engineering. With help from friends, experiences in high school including speaking with teacher, interacting with family friends and others, the participants selected the engineering discipline they believed most appropriate for their skills and interests. When asked how he selected a specific engineering major during his freshman year, one participant credited his peers: "well, I guess through friends, I had some friends who knew older people [who were engineering majors] … and [I knew] older guys who had been in engineering through my fraternity. [I was also] hearing the opinions from other friends who had moved on into their specific [engineering] discipline."

Another participant selected an engineering major that would permit her to undertake a medical career, should she find the study of either engineering onerous or irksome, and the influence of her high school in switching to engineering, which she indeed found to be quite rewarding: "well when I first came to Clemson I was [majoring in] Psychology and Chemistry because I wanted to be a doctor. And after my first semester here, psychology didn't really challenge me as much as I expected. I spent my last two years of high school at the Governor's School for Science and Math. So then I [decided to switch] into engineering partially because I wasn't as challenged [in my first major] and secondly because [I did not know what] psychology was going to do for me. [With my engineering major, I could still go to medical school]. Engineering kind of wraps it all up for me."

One participant credited conversations with his high school chemistry teacher with helping him decide on a college major. The participant spoke with his chemistry teacher "about what type of things chemical engineers do, what the curriculum consisted of, what

things I will be studying, how hard it would be, how extremely difficult it would be. And yeah, I mean, I definitely talked to her because I saw the passion that she had for the subject in general so I knew she would be the best place to go to get firsthand advice on if I went into chemical engineering, what would be expected of me. And then it came down to the decision I had to make to choose between one [engineering major] or the other, I still [kept] going back to my high school teacher [and] how passionate she was about chemistry and chemical engineering in general. [She] really made it seem like that will be something that I can make a career out of." This participant spoke with family friends about the rigors of college, and his suitability for the study of chemical engineering: "Well we have some family friends that work in an industrial setting, power plants, manufacturing and they all gave good insights as to the particular job market of a chemical engineer is usually highly sought after which is good nowadays. And [the persons – engineers] that knew me [said] that I would most likely make a good engineer because I wanted to think. … And then the family friend [the one that was] the engineer that I talked to out in the industry, said you're going to have to go through a lot before you get that money so you have to be prepared to be able to handle the coursework to get your degree and then to find a job."

Kin was most often credited with providing access to "things" that helped participants select the most appropriate college major; indeed a few kin, most particularly parents, assisted their children with college admissions process: "Oh, [my mom] would sit there with me right before college [started]. She was also getting into the financial aid, sending me links and stuff on scholarships. … She knows, you know, how the FAFSA works. She knows how financial aid functions. She dove right in once I got accepted and figured out how she could help a lot."

Many participants stated that their early life experiences were a direct influence upon the early selection of a college major. One participant, for example, selected biomedical engineering because of the illness of a childhood friend. Another credited a pre-college program for his interest in engineering (a camp at which he discovered that engineers do compelling and fascinating work). A third emphasized a focus on career (meaning the work of profession vs. the course work or desire to attend a specific college or university or the desire to follow an influential person into a specific career). Others, expressing a more socially conscious attitude (a desire to help others), formed an interest and selected a matching career accordingly. Participants described a strong identification with a career, believing their choice of engineering study as appropriate in that work done by peers, professors or practitioners in the field matched what they imagined and wished to pursue.

Diagram and initial narrative of theory

Models or theories were continually developed to describe the lived experiences of the participants. Figure 7 depicts efforts with diagramming categories with a few supporting codes using a decision making model. As the participants failed to convey to the interviewer certain components of the model, they were asked about these parts, particularly as regards to periods of reflection. While a few participants recounted how reflection improved study skills and test taking, for instance, this was not significant and not linked to any kin or fictive kin influence.

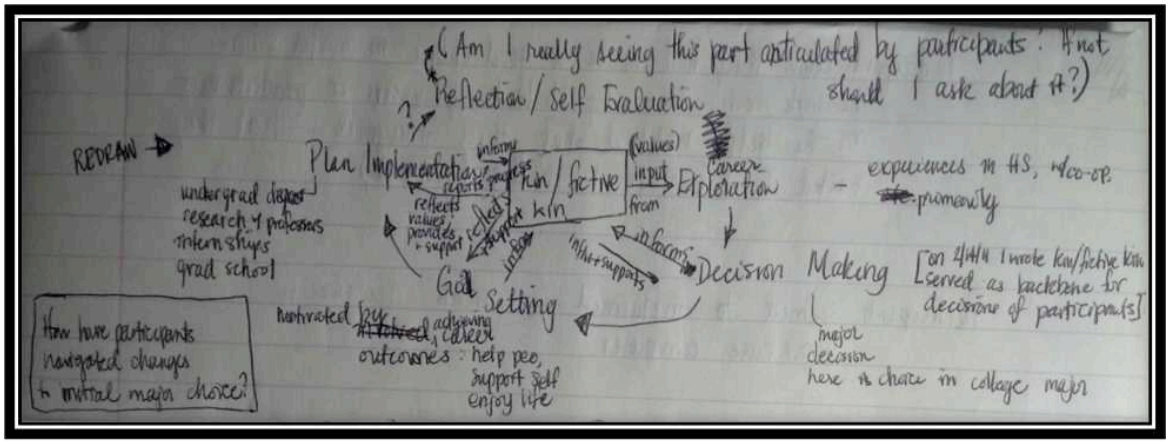


Figure 7: Sample Diagram From Focused Coding

After careful analysis of the accounts of the participants and multiple revisits of the data, a narrative theory emerged from the compiled data. Best stated as a narrative to accurately relate participant experiences, the theory is as follows:

Participants are experiencing kin and fictive kin as shapers or molders of their 1) initial choice to pursue engineering, 2) their approach to selecting and applying to college, 3) their decisions to persist in engineering and 4) their career choices. In explaining how they are shaped and/or molded by kin and fictive kin, participants primarily describe parents who urge them to seek happiness regardless of career choice. Based on their life and work experiences, parents convey advice to participants and influence their approach to doing things including how they make decisions. Participants see themselves as ultimately responsible for making academic decisions, however. Though parents are providing little, if any, specific academic information, they are providing significant emotional support and are reminding participants of specific expectations. Whereas an engineer parent may provide specific influences related to selecting courses, how to study, and explaining the career

choices in each engineering discipline, parents of FGC students are conveying influence by telling participants to be happy, have a good career, and make us proud.

Modifying interview guide

After analyzing transcribed interviews 1 through 10, the following questions were composed and added to the interview guide:

1. Who helped the participant make decisions to go into engineering and decisions to remain in engineering? (Changed wording from a previous question.)
2. Will participants resonate with emerging theory? Test the initial narrative theory with future participants. The narrative theory was read to each participant to determine if the theory captured his or her experience with kin and fictive kin. The feedback was analyzed and used to refine the narrative.
3. Are any kin or fictive kin being overlooked? Ask specifically about other kin and fictive kin.
4. Is influence different for:
    a. Males vs. females
    b. Different majors
    c. Different ethnicities

Theoretical sampling and coding

This stage of the research was enhanced via workshop information, specifically that of grounded theory and theoretical sampling and coding, as taught by Dr. Kathy Charmaz, the preeminent scholar on constructivist grounded theory research (May 2011, Champaign, IL).

Focused coding supported the development of a narrative of the initial theory describing the participants' experience. The narrative provided a detailed, theoretical account of how the participants experienced the academic influences of kin and fictive kin. During theoretical coding, substantive categories were examined to determine their relationship to each other and checked repeatedly against the narrative of the emerging theory.

Charmaz (2008) recommends engaging in theoretical sampling later in the study to prevent "forcing" the data into codes and to avoid early termination of the analysis. Theoretical sampling was used to support theoretical coding. Theoretical sampling is about categories rather than demographics, meaning that grounded theory requires no demographic similarities between participants. Theoretical sampling is done until no new categories were identified. During this stage of the research, all categories were scrutinized to ensure they remained valid under additional sampling. Data was again analyzed during coding and participants were re-interviewed to yield a richer analysis. Charmaz's stated benefits of theoretical sampling include:

a. More inclusive categories
b. More useful memos
c. More firmly grounded analysis
d. Stronger connections between data and analysis

In this study, theoretical coding began with the eleventh interview and included member checking (Mertens, 2005). Theoretical sampling was used to again analyze data, to refine categories, and to firmly ground the analysis and resulting theory in the data. Similar to the purposive sample, the first theoretical sample was taken from the FGC students that

responded to the demographic questionnaire. This sample contained six participants. The second theoretical sample was composed of four previously interviewed participants. An interview guide was specifically written for each participant in the second theoretical sample (see appendix VII).

First theoretical sample

Beginning with the eleventh participant, interviews were conducted in which each participant was read the narrative of the emerging theory, and asked to respond as a way to member-check. The following quotes represent the feedback received from the participants:

- "I would definitely agree with that. In terms of my case I would say I kind of made the decision on my own and then [sought] advice from friends and family, but I don't really know of anything that I would add to that. I think that's a pretty accurate statement."
- "I think it's *molders* … that is a word that definitely could be used right there. I don't know, I can't think of anything right off the top of my head and maybe I would add just that maybe the influences can serve as a backbone for your decision. Something to fall back on."
- "[Concerning parents reflecting back goals of participants] I would say I definitely wanted, kind of had [goals] in my head that I wanted to do like whatever makes me happy but knowing that my parents were perfectly fine with [my goals] definitely made it easier [for me to act]."
- "[My parents] helped me with the parameters of decision making. They don't want me to make a spontaneous decision because you know, just think it out and you know, just don't let one thing get you down and make, you know, because if you drop the major now it's going to have huge, a huge impact on what's going on in your life and not just that one class but that's going to extend your college and extend the amount of money they're spending which in turn affects me because I don't like them having to spend that much money and it just, you know, think of all the, like you said parameters that go into a decision rather than just this class is hard. You know, they're just big time reminders of stuff like that."
- "I'd definitely say that people have helped, helped influence my path towards my career."

- "I completely agree."

Based on the feedback, the narrative related to the influence on career was refined. In particular, part of the theory was changed from "… their decisions to persist in engineering and their career choices" to "… their decisions to persist in engineering and their path leading toward a career." And the narrative changed from "so they're helping to reflect back to you as well what you said" and refined to "kin and fictive kin serve further as a touchstone or home base providing emotional support, reflecting back to participants their previously stated goals and urging them to seek enjoyment in their career."

The participants in the first theoretical sample punctuated the experience of participants as responsible for their own decision. Indeed, one participant perceived he had more control over his career because his parents were not engineers or college educated. He said, "[one of my friends has an] engineer parent … her mom was like very, very controlling and [told her] you do this and this and this because I'm this engineer and you're going to be this type of engineer. And where [my parents are not engineers] and because they didn't do college, once I got past a certain point I'm in control of everything. And I like that a lot. Like I talk to [my parents] but I make all the decisions."

Data was continually coded, still employing a constant comparative analysis, through the sixteenth transcript. From the fourteenth through the sixteenth transcript, no new categories were identified, thusly indicating a possible saturation plateau. One question nonetheless remained unanswered, and coding continued into the second theoretical sample.

Second theoretical sample

At this point, an understanding emerged regarding how kin and fictive kin influence the academic decision making of participants. What remained was an additional refinement

of the emerged theory to better describe how participants perceived their family's motivation to instill certain values (e.g. "enjoy what you do"). Participants were expressing specific influences from their kin related to stated expectations, expectations that directly impacted the academic decision making of the participants. Kin may be infusing family values with a statement like "enjoy what you do" and urging participants to seek enjoyment in their career and life. Because it was as yet unknown why kin were so motivated to make such statements, theoretical sampling was continued to investigate these motivations from the participants' perspective. Specifically, determining how the participants' explained their kin's motivation for stating the expectations was of particular interest. An interview guide was developed to support this objective.

After interviewing the sixteenth participant, the transcripts for participants eleven through sixteen were reviewed to develop new questions and to prepare for the second interviews. Six previous participants were initially selected to invite to a second interview. Again, email communication was used to invite each to an interview. Interviews were scheduled with four participants who responded and agreed to a subsequent meeting.

Upon analysis of the fourth interview, the answers sought were received and data saturation was confirmed. Of the two remaining participants invited to a second interview (of the original six), one participant responded after two weeks to decline, stating that her schedule prevented her from an interview. The other did not respond at all.

Questions were focused, specific and probing. Each interview guide was specifically developed for the participant based on his or her responses during the first interview. The common questions were developed to allow the participant to elaborate and further refine what motivated the parents to encourage the participants to "have a good future" and "enjoy

career" and to support participants' decision to major in engineering. Questions were patterned as "you mentioned _____ during your interview. Can you explain what motivated this?" Specific questions for one participant may be found in appendix VII.

Credibility

To ensure trustworthiness and control for biases, verification procedures were employed throughout the study. My dissertation chair reviewed the initial two transcripts and my associated coding. Detailed feedback from the chair was used to improve the remaining interviews and analysis. Memoing was used as a placeholder to note any concerns with data collection or analysis, concerns which were resolved with the dissertation chair who provided a source from which to receive an answer. Sources included books, refereed articles and other qualitative researchers. At the stage in the research when the theory had emerged, the chair critiqued the findings and posed probing questions to ensure that the data had not been forced and all critically important lines of inquiry had been explored.

Member checking ensured that the theory made sense to the participants and that the theory accurately reflected their experiences with their kin and fictive. This technique is key for establishing credibility (Lincoln and Guba, 1985).

After the analysis was complete, data was shared in two separate presentations of note where methods and results were critiqued, an approach with invited rebuttal to strengthen all subsequent research. Both presentations included a question and answer period. The audience in the first presentation included faculty members experienced in methods of qualitative inquiry, including the dissertation chair, and another member of the dissertation committee. The second audience, all members of the committee, included

faculty members in civil engineering and the director of a program serving first generation college students. This audience focused on and provided feedback particularly on the implications of this study.

Role of researcher

In qualitative inquiry, especially in undertaking a constructivist grounded theory study, the researcher is but an instrument of that inquiry (Patton, 2002). My background and my theoretical frame prepared me to undertake this constructivist grounded theory study.

The first in my family to earn a college degree, my career aspirations since childhood have shifted between engineering and education. After earning an MS degree in civil engineering, I spent 14 years in the energy industry, gaining my Professional Engineer certification. Subsequent to work as a technical trainer with my company, I taught part-time at local colleges and technical schools while maintaining my job in industry. In 2004 on the strength of having a master's degree and being a registered Professional Engineer, I was hired as a tenure-track faculty member at a teaching-focused Historically Black College and University (HBCU). In 2007, I became director of the Savannah River Environmental Sciences Field Station (SRESFS), which is aimed at recruiting and retaining underrepresented groups in environmental science and engineering and in natural resources-related fields of study. I have a real passion for recruiting and retaining underrepresented groups in science, technology, engineering and math (STEM) disciplines, a passion that also influenced the study upon which this dissertation is based.

I recall a combination of childhood experiences including college and job experiences as well as mentors that shaped my thinking and development. As a young girl

growing up in South Carolina, my mother told me that I could be anything I wished to be. While an obviously simple philosophy, my mother's early support still fills me both with the wonder and unassailable belief in myself that – *I CAN BE ANYTHING*. The women in my family, my first mentors: my great-grand mother, grandmother, mother and godmother, collectively instilled in me the traits of resourcefulness, self-reliance, responsibility, teamwork, womanliness, commitment, trustworthiness, discipline, respectability and spirituality, all of which shaped the formation of my own character and led me to value the time and guidance of all mentors.

As a result of participating in many summer programs in middle school that expanded my knowledge of science and math, I pursued engineering as a major and career, selecting civil engineering because it offered the specialties, courses and resulting career options that I found most appealing.

I believe my background and passions influenced me in selecting the research questions guiding this study and kept me engaged throughout. Careful to continuously monitor and memo about my assumptions to reduce bias, I also questioned myself when categories related to my own experience to ensure that my own belief systems and experiences were not prejudicing the research.

CHAPTER 4 EMERGED THEORY

Though the purpose of the research was to probe for family (kin) and "like family" (fictive kin) influences, the major influence within the data was from parents, in particular from mothers. Though other kin mentioned included aunts, uncles, spouses, sisters, and brothers, the most influential fictive kin was the high school teacher followed by the college professor. Participants are experiencing kin and fictive kin as molders of their 1) initial choice to pursue engineering as a college major, 2) their approach to selecting and applying to college, 3) their decisions to persist in engineering and 4) their path leading toward a career.

Family influence (kin)

In areas where "college knowledge" is required, parents pose questions to participants and then offer advice based upon the responses. In such exchanges it seems kin, mostly parents, reflect back to participants what is important. Kin also infused values with statements such as "having fun in career is important." Most often, participants said parents (kin) would support the career and educational decisions of their children, particularly emphasizing enjoyment of a chosen profession, which would yield a secure future. It seemed participants adopted these values as their own. Participants explained that parents were motivated to state these values because of their belief in what a career in engineering can provide, specifically:

1. Financial stability,
2. Pursuit of opportunities unavailable to their parents because they lacked the requisite education, and

3. The status of being a member of what is perceived as an "elite" profession.

Participants acknowledge that parents, especially mothers, as their biggest influence upon their career choice, even though they offered no specific academic advice to their children. Indeed, a mother's influence was associated with providing emotional support that greatly encouraged and comforted the participants. In all interviews, participants repeatedly expressed the ability of their mother to listen, advise, and provide room for autonomous thought and action. Indeed the statement of "mom had my best interests in mind" was the sentiment most often ascribed to mothers by the participants. With that foundation established, participants spoke openly with their mother about academic decisions, knowing indeed that the interest of their children were paramount.

Based on their life and work experiences, it was determined that while parents conveyed advice to participants and influenced their manner of doing things including how they made decisions, participants saw themselves as the arbiters of their academic careers. **Whereas an engineer parent may well have offered specific influences related to selecting courses, how to study, and explaining the career choices in each engineering discipline, parents of FGC students conveyed influence by telling their children to be happy, have a good career, and make them proud.**

Like-family influence (fictive kin)

When fictive kin was mentioned as providing influence, it was often a high school teacher in a STEM subject. Other fictive kin mentioned included church friends, next door neighbors, peers in college, co-workers, friends of parents, high school and college advisors, friend's mother, high school guidance counselors, graduates in my major, certain high school

programs, junior college advisors, and general engineering and pre-college programs. The influence of fictive kin on the academic decision making of the participants was vast and varied. As a result, the results detailed in this dissertation is expected to be useful for high school programs and vocational schools; high school teachers; high school guidance counselors; parents (pre-college, in college recruitment and orientation session and during college); pre-college programs; junior college advisors; college professors and academic advisors; co-op/internships including research internships; study groups; peer mentoring, peer-led groups and similar programs like minority engineering programs; and persons involved with institutional outreach, recruitment, and retention efforts and high education efforts. The influence and implications for each of these persons and entities are discussed in the following chapter.

While non-FGC students majoring in engineering may also benefit from the influence of fictive kin in similar ways as FGC, the influence is more critical for FGC students because these students do not have college educated parents or other academic influences that may be readily available to non-FGC students majoring in engineering.

CHAPTER 5 IMPLICATIONS AND FUTURE RESEARCH

Overview

This chapter sets forth the study's recommendations with implications for key stakeholders, including researchers and practitioners, and future research. By translating this innovative research into practical guidance and by initiating calls for reform targeting persons and entities influencing the academic decision-making of first generation college students majoring in engineering, this study and the resulting grounded theory can be used to create novel concepts for educating the engineers of the 21st century.

Implications – Translating research to practice

The study has implications for high school programs and vocational schools; high school teachers; high school guidance counselors; parents (pre-college, in college recruitment and orientation session and during college); pre-college programs; junior college advisors; college professors and academic advisors; co-op/internships including research internships; study groups; peer mentoring, peer-led groups and similar programs like minority engineering programs; and persons involved with institutional outreach, recruitment, and retention and high education efforts. Implications inform how these entities and programs can be structured to increase self-efficacy of undergraduate, FGC students majoring in engineering. The ordering of the implications is tied to the timing of the influence: precollege influences placed first followed next by influences occurring throughout college. Though impossible to determine the importance of one program or entity over another, two reports can provide some insight regarding such prioritization. In both the NAE 2011 and PCAST 2012), the *priorities on high school and college teachers and institutional outreach, recruitment,*

and retention and higher education efforts are quite clear. The guidance stated in the following sections is based on participant experiences and my knowledge of this study, the literature, and professional experiences.

High school programs and vocational school

Some participants stated that they received negative messages from high school programs, including such programs did not prepare them for college – in terms of the amount of study necessary, the difficulty of courses, for example – which while not emphasizing the need to obtain a four year degree, did emphasize studying for a trade via apprenticeship or a two-year technical school. Participants further stated they received positive messages from participating in both advanced placement courses to gain college credit and in vocational school to gain experience in a career.

Recommendations

It is recommended that high schools host forums that bring presenters to speak to high school students about the difference between college graduates and high school graduates and opportunities beyond high school. The objective of such forums would be to convey opportunities available to students upon graduating from high school. Focus on naming specific opportunities (i.e., colleges, trades, jobs) with references as to the present and future action students must take in order to succeed. Vocational programs could focus on applying engineering knowledge and skills and evidence based teaching practices in its courses.

Standards for K-12 Engineering Education? (NAE, 2010) acknowledges that there is relatively *limited experience with K-12 engineering education* in U.S. elementary and secondary

schools. Many resources exist that could fill this limited experience with K-12 engineering education by providing engineering educational material, for example websites like Engineer Your Life (http://www.engineeryourlife.org/) and Engineering Interact (http://www.engineeringinteract.org/) have teaching resources. Additional online resources targeting teachers can be found in the next section.

High school teachers

Participants who stated that they experienced early positive influences on their academic decision-making, including selecting a college and college major, most often mentioned high school teachers as the source of that influence. In interviews, participants stated that their high school teachers supported them in their college and career decisions by

- Recommending a specific college,
- Providing college recommendation letter,
- Conducting hands-on experiments that made topic fun/appealing,
- Discussing options within specific careers,
- Discussing how college can open career doors,
- Stressing the importance of focused study while in school,
- Encouraging them to be proactive in study (i.e. apply yourself and seek knowledge outside of the classroom), and
- Conveying to them the opportunities lost without a college degree.

<u>Recommendations</u>

Recommendations for high school teachers include:

- Actively talking to students about need to attend college,
- Having one-on-one sessions with students regarding college major choice and career options,
- Mentoring students to direct them to specific HS classes,
- Telling students about your college experience, and
- Listening to students and their discussion of interests

For high school teachers to fill such roles, they must be knowledgeable about the engineering field, have confidence to answer students' questions about engineering and discuss engineering career options, and increased efficacy to teach engineering topics in formal learning environments. Though there is presently a lack of trained teachers qualified to deliver engineering instruction at the post-secondary level (NAE, 2010) the urgent need to emphasize such teacher preparation is now being addressed (NAE, 2011).

The NSF funds Research Experiences for Teachers (RET), for example, in order to bring knowledge of engineering, computer science, and technological innovation into teachers' classrooms. The NSF (http://www.nsf.gov/news/classroom/engineering.jsp) and Worcester Polytechnic Institute (http://www.wpi.edu/academics/stem/resources.html) maintains a list of resources for teachers, students and their families. One such website is eGFI: Engineering, Go For It! which has teacher and student resources (http://teachers.egfi-k12.org/). Such resources will support teachers in delivering engineering content that is engaging, informative, and connected to engineering principles and disciplines (NAE 2009, 2010, 2011).

High school guidance counselors

Participants' experiences with high school counselors were either non-existent or positive. Counselors can support the success of FGC student majoring in engineering by implementing programs that specifically assist each student make informed career decisions. Such programs should present various paths, including college attendance, and provide structured support of each student to develop and implement the steps to achieve his/her career goals.

Recommendations

In regard to students interested in attending college, counselors can assist with completing college applications, selecting a college major selection, critiquing and finalizing college essay, and student forming successful college habits and strategies including seeking study groups, course assistance, and interactions with college professors. Guidance counselors can also maintain an accurate list and inform students about summer, pre-college programs. The PCAST report (2012) calls for the Department of Education to sponsor summer STEM learning programs for high school students.

Parents

FGC students face "profound challenges at each level" of the educational system due to lack of parental experience with the process (Choy, 2001; Gibbons and Shoffner, 2004). In this study, parents – more specifically mothers – were cited as the biggest influence on participants' academic decision making. Participants experienced parents as emotional supporters of their academic goals and as urging the pursuit of a college education.

Recommendations

Parents may be unaware of their influence on their children's academic decision making. The recommendations are aimed at raising this awareness and better equipping parents to be academic influencers.

Parents: pre-college

To support the future success of FGC students while still in high school, parents can talk about their job, discuss why they encourage college attendance and the benefits they perceive, encourage discussions with high school teachers about college and careers and

provide toys, games, computers, etc. that introduce technology, science and/or engineering at an early age. Online resources may help parents better understand engineering as a profession.

College recruitment and orientation sessions for parents

Special sessions are often held with parents during college recruitment visits and orientation. Such forums offer an opportunity to put to use research-based practices to equip parents to support FGC students during their college years. Since much of the parental influence in this study was conveyed through conversations, parents can be advised on the typical college stressors and the type of messages that may best encourage their son or daughter. A website entitled Engineers: How Are You Changing the Conversation? (http://www.engineeringmessages.org/) contains messages about engineering informed by Changing the Conversation (NAE, 2008).

Parents: during college

While FGC students are enrolled in college, parents can encourage them to put forth their best effort, work hard, complete what you start, find an enjoyable career and let that guide your choice of major, be successful at what you do, be financially stable and able to support a comfortable life and support a family, and take full advantage of the opportunity to attend college.

Pre-college programs

Pre-college programs allow students to preview a college campus, experience campus life and interact with students, faculty and other campus representatives.

Recommendations

Such programs should convey to students the advantages, disadvantages and provide information on the type of careers associated with various engineering majors. Pre-college programs can also inform students about peer-based programs, undergraduate research and available co-op or internships. Such early information can help students make decisions about the major they wish to pursue, what academic resources may be useful, and what careers may best fit them.

Junior college advisors

Junior college advisors can assist FGC students in the development of meaningful educational goals while enrolled at junior college that would extend through transfer to a four-year institution.

Recommendations

Advisors can support FGC students majoring in engineering by inquiring of their desire to transfer to a four year institution and, if so, guiding the student through the process. Specifically, junior college advisors must be knowledgeable of the following criteria, which they must correctly relate to FGC students:

- Courses at junior college that transfer to desired four year institution,
- Course of study while enrolled in junior college that would best match major at desired four year institution,
- Curriculum requirements of the institution where they wish to transfer, and
- Career/occupation information on the field of study selected by the FGC student.

These recommendations are in keeping with the PCAST report (2012), which calls for the Department of Labor Program and an NSF program to expand or develop programs that foster pathways from two-to four-year institutions.

College professors and academic advisors

Not infrequently was a participant's academic advisor also the instructor of a course in which the participant was enrolled. Participants found faculty and academic advisors to be reliable, honest and knowledgeable information sources for subject matter support (concepts, homework, etc.), academic advice (course selection, decisions on internships, etc.), career goals, and locating other resources. Both professors and academic advisors can aid students in accomplishing educational, career, and personal goals through the use of the full range of institutional resources.

Recommendations

Institutions and academic departments should establish a process to identify which students are FGC. FGC students majoring in engineering experience faculty as significant fictive kin. The recommendations include making faculty aware of this academic influence and equipping them to be better fictive kin to these FGC students. The advice to college faculty and advisors includes speaking with students one-on-one about specific opportunities (research, course, internship, graduate school, etc.), making it clearer to students what they would actually 'do' with degree, providing simple and clear course enrollment advise (demystifying the course catalog), committing to being a role model, reminding students of academic deadlines, making yourself available to communicate with student, getting to know students, sharing of personal stories to convey personal experiences, inviting guest speakers

to share personal experiences, and pointing out programs that fit the participant where various career options can be experienced. Both faculty and advisors should facilitate such experiences and serve as an agent of referral to other campus, life and career agencies as necessary.

Another challenge for college faculty entails the preparing the next generation of engineers to succeed in a world facing many challenges. Educating the engineer for 2020 and beyond is one the National Academy of Engineering (NAE) grand challenges and the subject of a book (NAE, 2005). Also, the PCAST report (2012) recommends the adoption of empirically validated teaching practices and discovery-based research courses.

Co-ops and internships

Without early engineering role models, learning about the field can be delayed. Co-ops and internships – both research and working – can be effective in providing such role models. Participants experienced co-ops and internships as a way to gain hands on experience in engineering and know what work is done in a typical day, to be exposed to research, to add to their resume, to use modern laboratory equipment in the discipline, to be able to connect theory to the practice of engineering, and to understand the various jobs that can be done in the profession. FGC students lack career-specific information and would benefit from any experience where their decision making related to life and/or career goals can be clarified.

Recommendations

This dissertation has no specific advice for sponsors of co-ops and internships; however, it does include recommendations for other entities and programs to influence FGC students majoring in engineering to seek such experiences.

Study groups

Participants experienced study groups as a trusted, reliable and easy to access source for help with course assignments and studying for exams. Participants involved themselves in groups with established meeting times and places and those that were ad hoc – called when needed and no established membership. Participants report that study groups allowed the ability to accomplish the work in the class in a realistic way. Participants used networking to find groups, remained with same group for multiple semesters, and received motivation (positive peer-pressure) to complete course. The study groups included FGC students and continuing generation students. That mix allowed FGC students to have access to students with college knowledge.

Recommendations

The recommendations include supporting the formation of such groups on campus and for entities and programs to urge FGC students majoring in engineering to join such groups.

Peer mentoring and peer-led groups

Peer mentoring and peer-led groups include minority engineering programs, professional societies, and programs targeting FGC students. *Participants particularly valued interactions and advice from peers.* From such interactions, FGC students were inspired to

mentor other FGC students, gained knowledge of what living away from home is like, learned of effective study habits, were urged to succeed in college, were told of the rigor of college, were able to speak about stressors and receive encouragement, discovered career options including graduate school, and learned the difference between master's degree and a PhD. FGC students also trusted the information received from their non-FGC (continuing generation) peers and realized these peers had college educated parents. Such groups offer a unique vehicle through which to influence FGC students.

Recommendations

In an environment at higher education institutions where budgets are declining and competition for remaining funds are climbing, it is urgent that institutions recognize the importance and maintain funding for peer mentoring and peer led programs at levels sufficient to ensure sustained, productive operation. After teachers/instructors, such programs serve a vital fictive kin role for FGC students majoring in engineering. The next section further details the necessity for such funding.

Institutional outreach, recruitment, and retention & higher education

Recommendations

FGC students seem to lack knowledge of major's career options, how to study, and how to find and sustain study groups. Persons involved with institutional outreach, recruitment, and retention efforts can design and implement programs that encourage FGC students majoring in engineering to:

- Participate in co-op and internships including research,
- Seek and/or form study groups,
- Engage in peer-led programs, and

- Discover what they find fun, appealing and stimulating (for example: explore creative inquiry and iTiger programs).

Such organizations can also provide confidential individual sessions with students to provide detailed and specific advice (e.g. informing them as to how their unique talents can benefit a particular research project)

Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads (NAE, 2011) calls undergraduate retention and completion one of its highest priorities. The main strategy for retaining such students must be one of providing financial support for students and programs that simultaneously integrate academic, social, and professional development. Examples of such programs at Clemson University are Programs for Engineering Enrichment and Retention (PEER), FIRST, a program assisting first-generation college students in reaching their career goals in STEM majors, Society of Hispanic Professional Engineers (SHPE) and National Society of Black Engineers (NSBE).

Implications – Methods

One implication for engineering education research emerging from this study entails the use of the Critical Incident Technique (CIT) to elicit dense data containing numerous examples of specific incidents and behavior. CIT is used in many other fields of study, is an emerging tool in engineering education research and, as supported by recent studies, is useful for constructing theories in engineering education. In this study, the CIT was useful in guiding the interviewer's approach to conducting the interviews, helped the participants to relate descriptive experiences, and resulted in data necessary to construct the theory.

Though memoing is a part of grounded theory methodology, in considering the impact of this method, it may well been benefit researchers using other methodologies. In this research, memoing was most useful in the written recording of planned and undertaken processes, chronicling doubts about the research approach, archiving questions of any kind that arose and logging pure analytical notes. Memos that clearly document the milestones in and natural progression of this study were written throughout the study. Memo writing can benefit all researchers in that such writing would support rich descriptions in scholarly articles submitted regarding the study. Though as a researcher, it is often possible, indeed quite likely to recall the broad steps necessary to acquire a distinct core of results, what is often lost are finer details of such data that may have been inconclusive, analytical ideas that occurred as the study progressed, and even thoughts about future research.

As evidence of the benefits of memo writing, I can relate a portion of my dissertation writing experience. What was initially written was a sound version of the dissertation from memory. After the dissertation chair posed several questions requiring a revisit of the finer details of my study, I returned to and analyzed my memos, which contained nearly three years of written notes! Consequently, the next version of the dissertation was clear, detailed and included enriched reflections, reflections that would have been lost if not memorialized though memoing.

Limitations of study

There are several limitations related to this study. The study was designed to explore the perceptions of each participant. All experiences stated by the participant were collected and analyzed. While all influences may not have been conveyed, all similar studies have this

limitation. Unless one is able to conduct a longitudinal study, a snapshot is all that is possible. A longitudinal study was not possible under the structure of the dissertation; however, a critical snapshot was captured of participants' experience and description of their kin and fictive kin influence on their academic decision-making. For this study a snapshot is important because nothing is known about the family and "like family" influence of the academic decision making of FGC students in engineering. Though the family viewpoint was not studied because it was outside the scope of the study, in future work this would be a useful perspective to add.

Another limitation involves the sample demographics. No differences were noted in the experience of participants based on gender or major, and the sample prevented any determination of the differences based on ethnicity. The sample demographics are in line with the demographics of the university where the study took place. If this study was conducted in a setting with different student body demographics, the results may possibly be different.

Though attempts were made to contact students who had switched from engineering to non-engineering majors, called non-persisters, they did not respond. As a result, the sample included only participants that persisted in engineering. Also, the participants were limited to only those that volunteered to be interviewed. Any study can only use the data from persons that volunteer because everyone solicited cannot be made to participate. Non-persisters and those not electing to volunteer may have related a different experience.

Finally, I recognize that in qualitative inquiry, especially in undertaking a constructivist grounded theory study, I am a research instrument. As such, I have the potential to introduce bias. Grounded theory methodology allows at least one method

where such bias can be expressed and questioned: memoing. I was careful to continuously monitor and memo about my assumptions to reduce bias. I also questioned myself when categories related to my own experience to ensure I was not simply seeing myself. In fact, the researcher as instrument is seen as a positive attribute in grounded theory research. In an effort to be transparent and forthright about my role, I have also explained my role as researcher in a separate section in this work.

Recommendations for future research

In addition to the contributions above, this research also raises questions for future endeavors, which must seek to determine if participants with different demographics (ethnicity, type of school, gender, major) undergo different experiences. Specifically, elucidating the perspective of family and non-persisters would be most relevant as a subject for future work. Also, this emerged theory should be tested in other settings and compared against any future theories.

Grounded theory methodology advises that as "things" in the data become available that are interesting but not necessarily analogous with the question under study, it is best to make detail notes for future use. Though several compelling items of note within the data unrelated to the research questions emerged from this endeavor, perhaps the most interesting was the impact of these participants on their kin and fictive kin. A small picture of this influence was glimpsed in this study, but not enough to report any conclusions. Future research must involve determining the influence of FGC students majoring in engineering on kin, especially on siblings and parents, and fictive kin.

APPENDICES

APPENDIX I: DEMOGRAPHIC QUESTIONNAIRE

How Students Choose Engineering as a College Major and Career

1. Introduction

Thank you for agreeing to take the online questionnaire. Please be reminded that you must be 18 years old or older and be majoring in an engineering discipline or intending to major in an engineering discipline in order to take the questionnaire and be included in the prize drawing. These are the only qualifications. Qualified participants of this initial online questionnaire will be entered into a random drawing to receive one of three $50 gift cards from Amazon. You may decline to answer any question(s) in the questionnaire without losing or reducing your chance to win.

Approximately 20-25 students that complete the questionnaire will be asked to participate in a personal interview with me. I anticipate that the interviews will last approximately 75 minutes to two hours. Since interviews may take until spring 2010 to complete, interview participants will be notified starting September 2009 through April 2010. Everyone who participates in an interview will receive a $30 gift card from Amazon. You may decline to answer any question(s) in the interview without losing compensation. Your participation will be kept confidential and your name will never be directly associated with your interview responses. Your identity will not be revealed in any publication that might result from this study.

This project has been reviewed by the Clemson University Office of Research Compliance: 864-656-6460. If you have any questions about this study, I can be reached at deniseg@clemson.edu. Click on the "Next" button below to begin the questionnaire.

Best Regards,

Denise S. Grant
PhD Student, Civil Engineering
Department of Engineering and Science Education

How Students Choose Engineering as a College Major and Career

2. Birthdate

*** 1. Is your birth date before 10/01/1991?**

- ◯ Yes
- ◯ No

How Students Choose Engineering as a College Major and Career

3. Age & Major

*** 2. When is your birth day (two digit month/two digit date/four digit year)? * You must be 18 years of age or older to participate.**

MM DD YYYY

Date ☐ / ☐ / ☐

*** 3. Your major as of today is:**

- ◯ Bioengineering
- ◯ Biosystems Engineering
- ◯ Ceramics and Materials Engineering
- ◯ Chemical and Biomolecular Engineering
- ◯ Civil Engineering
- ◯ Computer Engineering
- ◯ Electrical Engineering
- ◯ General Engineering
- ◯ Industrial Engineering
- ◯ Mechanical Engineering
- ◯ I am an engineering major, but do not see my major listed
- ◯ I am not currently majoring in engineering, but plan to switch my major to engineering
- ◯ I am not currently majoring in engineering nor do I intend on majoring in engineering

How Students Choose Engineering as a College Major and Career

4. Background

4. Please rate the following question.

	Very Unlikely	Unlikely	Likely	Most Likely	Definitely
How likely do you think you are to graduate in your chosen major?	◯	◯	◯	◯	◯

5. As of today, this is your ____ year at Clemson

- ◯ First
- ◯ Second
- ◯ Third
- ◯ Fourth
- ◯ Fifth
- ◯ Sixth
- ◯ Greater than sixth

6. What is your university grade level/classification?

- ◯ Freshman
- ◯ Sophomore
- ◯ Junior
- ◯ Senior
- ◯ Graduate student (pursuing master's degree)
- ◯ Graduate student (pursuing PhD degree)
- ◯ Other (please specify)

How Students Choose Engineering as a College Major and Career

7. What level of engineering courses are you currently taking? (Select all that apply)

- [ ] 100 level
- [ ] 200 level
- [ ] 300 level
- [ ] 400 level
- [ ] Graduate level
- [ ] I am co-oping or interning this semester
- [ ] Not currently taking engineering courses
- [ ] Other (please specify)

How Students Choose Engineering as a College Major and Career

5. Education & Influence

8. What is the highest level of education that your parent(s) or guardian(s) have attained?

	Highest Level of Education Attained
Mother/Female Guardian	
Father/Male Guardian	

9. Prior to starting college, did you know anyone employed as an engineer or anyone you considered an engineer?

- ◯ Yes
- ◯ No

10. Do you have a parent or guardian who is an engineer?

- ☐ Yes: Mother/female guardian
- ☐ Yes: Father/male guardian
- ☐ No

11. What is the highest level of education you plan to obtain?

- ◯ bachelors
- ◯ masters
- ◯ doctorate
- ◯ Other (please specify)

How Students Choose Engineering as a College Major and Career

12. Which of the following persons or events provided positive and/or negative influences on your choice of engineering major? (Check all that apply)

- [ ] Employer(s)
- [ ] Middle or high school teacher(s)
- [ ] High school counselor(s)
- [ ] College or university advisor(s)
- [ ] College or university classes
- [ ] University "open house," campus visit day or other event
- [ ] College Career Center
- [ ] College engineering society
- [ ] Science or engineering camp, program, or contest
- [ ] Family member or friend who is an engineer
- [ ] Internet
- [ ] Parent(s)
- [ ] Grandparent(s)
- [ ] Brother and/or sister
- [ ] Uncle and/or aunt
- [ ] Other family member(s)
- [ ] Other (please specify)

How Students Choose Engineering as a College Major and Career

6. Demographic

13. How do you describe yourself? (Mixed racial heritage should be indicated by checking more than one category.)

- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Hispanic or Latino
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White
- ☐ Other (please specify)

14. Are you studying at Clemson on an international student visa?

- ◯ Yes
- ◯ No

15. Gender:

- ◯ Female
- ◯ Male

How Students Choose Engineering as a College Major and Career

7. Name & EMail Address

16. Please type your name and email address below.

Qualified participants of this initial online questionnaire will be entered into a random drawing to receive one of three $50 gift cards from Amazon. You may decline to answer any question(s) in the questionnaire without losing or reducing your chance to win. Participation in this study is completely voluntary. If you are selected for the follow-up personal interview and you choose to participate, the interview questions will ask about factors that influenced your decision to major in engineering as well as your career choices.

In case you are selected to receive one of the cash prizes for participating in this questionnaire and/or you are selected for the personal interview, I need a method by which to contact you. Please provide your name and email address below. Your name and email address will be used only for the stated purpose.

Name (First Name Last Name):

EMail Address:

APPENDIX II: CRITICAL INCIDENT TECHNIQUE SEMI-STRUCTURED INTERVIEW GUIDE

1. Tell me how you selected your major. Why did you select this major?
2. Tell me with whom in your family or "like family" you discuss your academic choices?
3. What did your family think of your major choice?
4. Tell me about your career plans. Why did you select this career plan/path?
5. Tell me with whom in your family or "like family" you discuss your career choices?
6. What did your family think of your career plans?

The following questions will be asked in a loop equal to the number of persons mentioned to determine influences of each person mentioned.

Focus on your interaction with _____.

7. How frequently have you sought the guidance of ____ in making academic decisions? Career decisions?
8. How frequently does ____ provide guidance on your academic decisions? Career decisions?
9. Tell me about a specific conversation with ____ on your academic decisions and describe what was said.
10. In what ways did the discussion influence your academic choices?
11. How did you use the guidance provided?
12. How did the situation work out?
13. Tell me about a specific conversation with ____ on your career plans/decisions and describe what was said.
14. In what ways did the discussion influence your career plans/decisions?
15. How did you use the guidance provided?
16. How did the situation work out?
17. Please describe a particular incident or incidents that your _____ did that had a significant positive influence on your academic decision. Like … what would say was the best guidance provided related to an academic decision? Career decision?

18. Please describe a particular incident or incidents that your _____ did that had a significant negative influence on your academic decision. Like … what would say was the worst guidance provided related to an academic decision? Career decision?

    After discussing the influence of each family member, now examine which was the most profound positive and negative influence.

19. What action, by any family or "like family" member, did you find most affirming and helpful in making a decision on your *academic choice*? Describe action and tell why it was affirming and/or helpful. How did you use ___?
20. What action, by any family or "like family" member, did you find most puzzling or confusing in making a decision on your *academic choice*? Describe action and tell why it was puzzling and/or confusing. How did you clear the confusion?
21. What action, by any family or "like family" member, did you find most affirming and helpful in making a decision on your *career decision*? Describe action and tell why it was affirming and/or helpful. How did you use ___?
22. What action, by any family or "like family" member, did you find most puzzling or confusing in making a decision on your *career decision*? Describe action and tell why it was puzzling and/or confusing. How did you clear the confusion?
23. At what moment/point/period, since you started here at _____, did you feel most engaged with your *major*? Describe that moment/point/period. What made you feel engaged? Did you share these feeling with a family member? If yes, describe how your family member responded.
24. At what moment/point/period, since you started here at _____, did you feel least engaged with your *major*? Describe that moment/point/period. Did you seek guidance from a family member? If yes, describe how you went about seeking that guidance and what guidance your family member provided. What did you do as a result of the guidance provided? What was the result?
25. At what moment/point/period, since you started here at _____, did you feel most sure about your *career path and*

choices? Describe that moment/point/period. What made you feel sure? Did you share these feeling with a family member? If yes, describe how your family member responded.

26. At what moment/point/period, since you started here at _____, did you feel least sure with your *career path and choices*? Describe that moment/point/period. Did you seek guidance from a family member? If yes, describe how you went about seeking that guidance and what guidance your family member provided. What did you do as a result of the guidance provided? What was the result?

APPENDIX III: EMAIL SOLICITATION LETTER

An Invitation for Participate in a Study
***Please disregard if you have already responded to the survey. Thanks*!**
I'm writing to invite you to participate in a research study I am conducting with engineering students at Clemson. The purpose of the study is to learn more about why and how students choose engineering as a college major and career. As you may know, our nation is facing a shortage of engineers and there are many efforts across the country to better understand how we can attract more students like yourself into the field. Therefore, your experiences are very important to me. The results of the study will be used to improve outreach and recruitment efforts for Clemson's pre-college engineering students.

Participation consists of first completing a brief online questionnaire. It is estimated that the questionnaire takes less than 5 minutes to complete. The questionnaire may be found at https://www.surveymonkey.com/s.aspx?sm=a3_2fj8fu8GZJQTi_2fjK6Dpyw_3d_3d. Please note that the questionnaire does not work well with Blackberry phones. Any Mac, PC or Apple iphone/ipod touch will work just fine. Also, you must be 18 years old or older and be majoring in an engineering discipline or intending to major in an engineering discipline in order to take the questionnaire and be included in the prize drawing. These are the only qualifications. **Qualified participants of this initial online questionnaire will be entered into a random drawing to receive one of three $50 gift cards from Amazon. You may decline to answer any question(s) in the questionnaire without losing or reducing your chance to win.** Approximately 20-25 students that complete the questionnaire will be asked to participate in a personal interview with me. I anticipate that the interviews will last approximately 75 minutes to two hours. Since interviews may take until spring 2010 to complete, interview participants will be notified starting September 2009 through April 2010. **Everyone who participates in an interview will receive a $30 gift card from Amazon. You may decline to answer any question(s) in the interview without losing compensation.** Your participation will be kept confidential and your name will never be directly associated with your interview responses. Your identity will not be revealed in any publication that might result from this study.

If you would like to participate, please go to https://www.surveymonkey.com/s.aspx?sm=a3_2fj8fu8GZJQTi_2fjK6Dpyw_3d_3d **to complete the initial questionnaire. Winners of the $50 gift cards from Amazon will be notified by email by September 30, 2009.**

Participation in this study is completely voluntary. If you choose to participate, the interview questions will ask about factors that influenced your decision to major in engineering as well as your career choices. You may decline to answer any question(s).

This project has been reviewed by the Clemson University Office of Research Compliance: 864-656-6460. If you have any questions about this study, I can be reached at deniseg@clemson.edu.

I hope you will consider participating in this important study!

Best Regards,

Denise S. Grant
PhD Student, Civil Engineering
Department of Engineering and Science Education

APPENDIX IV: INFORMED CONSENT

Consent Form for Participation in a Research Study
Clemson University

Student Perspectives on Selecting Engineering as a College Major and Career

Description of the research and your participation
You are invited to participate in a research study conducted by Dr. Julie Trenor and Denise Grant in the Department of Engineering and Science Education. The purpose of this research is to better understand why and how students to choose engineering as a college major and career.

Your participation will involve an interview with Denise Grant, which we estimate will take about 75 minutes to 2 hours. If you agree, the interview will be audio recorded. Our questions will focus on your perceptions, motivations, attitudes, and experiences related to selecting engineering as a major.

Risks and discomforts
There are no known risks associated with this research.

Potential benefits
You will not benefit directly from participating in this study. However, we hope that this basic research, when applied to practice, will help to facilitate the diversification of engineering

Incentives
Upon completion of the interview, you will be given a $25 Visa cash card. You may decline to answer any question or chose to withdraw from the study without losing this compensation.

Protection of confidentiality
Your identity will never be attributed to your responses. The audio recordings will be kept in Denise Grant's password protected hard drive and will be destroyed once they have been transcribed. Transcripts will be retained indefinitely, but will only be identified by a code that will be assigned to each participant, and the key assigning your name and identifying code will be destroyed at the end of the project. Your identity *will not be revealed* in any publication that might result from this study.

Voluntary participation
Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study. A decision to participate or not or to withdraw your participation will have no effect on your academic standing or treatment by engineering faculty and staff.

Contact information
If you have any questions or concerns about this study or if any problems arise, please contact Dr. Trenor at Clemson University at 864-656-4321 or Denise Grant. If you have any questions or concerns about your rights as a research participant, please contact the Clemson University Office of Research Compliance at 864-656-6460.

Consent (this section is optional)

I have read this consent form and have been given the opportunity to ask questions. I give my consent to participate in this study.

Participant's signature: _____ Date: _____

A copy of this consent form should be given to you.

APPENDIX V: DEMOGRAPHIC RESULTS FOR 91 FGC STUDENTS

How Students Choose Engineering as a College Major and Career

1. Is your birth date before 10/01/1991?

	Response Percent	Response Count
Yes	100.0%	91
No	0.0%	0
answered question		91
skipped question		0

2. When is your birth day (two digit month/two digit date/four digit year)? * You must be 18 years of age or older to participate.

	Response Percent	Response Count
Date	100.0%	91
answered question		91
skipped question		0

3. Your major as of today is:

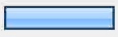
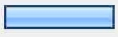
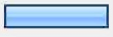
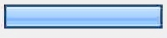
	Response Percent	Response Count
Bioengineering	7.7%	7
Biosystems Engineering	0.0%	0
Ceramics and Materials Engineering	0.0%	0
Chemical and Biomolecular Engineering	6.6%	6
Civil Engineering	24.2%	22
Computer Engineering	3.3%	3
Electrical Engineering	**25.3%**	**23**
General Engineering	18.7%	17
Industrial Engineering	3.3%	3
Mechanical Engineering	7.7%	7
I am an engineering major, but do not see my major listed	3.3%	3
I am not currently majoring in engineering, but plan to switch my major to engineering	0.0%	0
I am not currently majoring in engineering nor do I intend on majoring in engineering	0.0%	0
	answered question	**91**
	skipped question	**0**

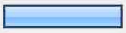
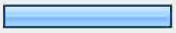
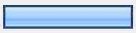
4. How likely do you think you are to graduate in your chosen major?

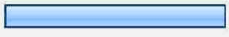
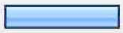
	Response Percent	Response Count
Very Unlikely	5.5%	5
Unlikely	3.3%	3
Likely	13.2%	12
Most Likely	19.8%	18
Definitely	**58.2%**	**53**
answered question		**91**
skipped question		**0**

5. As of today, this is your ____ year at Clemson

	Response Percent	Response Count
First	**27.5%**	**25**
Second	17.6%	16
Third	20.9%	19
Fourth	15.4%	14
Fifth	12.1%	11
Sixth	4.4%	4
Greater than sixth	2.2%	2
answered question		**91**
skipped question		**0**

6. What is your university grade level/classification?			
		Response Percent	Response Count
Freshman		20.9%	19
Sophomore		20.9%	19
Junior		19.8%	18
Senior		**30.8%**	**28**
Graduate student (pursuing master's degree)		4.4%	4
Graduate student (pursuing PhD degree)		3.3%	3
Other (please specify)		0.0%	0
	answered question		**91**
	skipped question		**0**

7. What level of engineering courses are you currently taking? (Select all that apply)			
		Response Percent	Response Count
100 level		23.1%	21
200 level		29.7%	27
300 level		**33.0%**	**30**
400 level		25.3%	23
Graduate level		5.5%	5
I am co-oping or interning this semester		2.2%	2
Not currently taking engineering courses		5.5%	5
Other (please specify)		0.0%	0
	answered question		**91**
	skipped question		**0**

8. What is the highest level of education that your Mother/Female Guardian has attained?			
		Response Percent	Response Count
Did not finish high school		4.4%	4
High school diploma or equivalent		**42.9%**	**39**
Some college but did not complete degree		30.8%	28
Completed an associate's degree (A.A., A.S., etc.)		22.0%	20
Completed a bachelor's degree (B.A., B.S., etc.)		0.0%	0
Completed a master's degree (M.A., M.S., M.B.A., etc.)		0.0%	0
Completed a doctoral degree (Ph.D., J.D., M.D., etc.)		0.0%	0
Don't know		0.0%	0
	answered question		**91**
	skipped question		**0**

9. What is the highest level of education that your Father/Male Guardian has attained?			
		Response Percent	Response Count
Did not finish high school		8.8%	8
High school diploma or equivalent		**46.2%**	**42**
Some college but did not complete degree		24.2%	22
Completed an associate's degree (A.A., A.S., etc.)		20.9%	19
Completed a bachelor's degree (B.A., B.S., etc.)		0.0%	0
Completed a master's degree (M.A., M.S., M.B.A., etc.)		0.0%	0
Completed a doctoral degree (Ph.D., J.D., M.D., etc.)		0.0%	0
Don't know		0.0%	0
	answered question		**91**
	skipped question		**0**

10. Prior to starting college, did you know anyone employed as an engineer or anyone you considered an engineer?			
		Response Percent	Response Count
Yes		**52.8%**	**47**
No		47.2%	42
	answered question		**89**
	skipped question		**2**

11. Do you have a parent or guardian who is an engineer?		
	Response Percent	Response Count
Yes: Mother/female guardian	0.0%	0
Yes: Father/male guardian	6.6%	6
No	**93.4%**	**85**
answered question		**91**
skipped question		**0**

12. What is the highest level of education you plan to obtain?		
	Response Percent	Response Count
bachelor's degree	30.0%	27
master's degree	**43.3%**	**39**
doctorate	22.2%	20
Other (please specify)	4.4%	4
answered question		**90**
skipped question		**1**

13. Which of the following persons or events provided positive and/or negative influences on your choice of engineering major? (Check all that apply)

	Response Percent	Response Count
Employer(s)	27.5%	25
Middle or high school teacher(s)	**50.5%**	**46**
High school counselor(s)	34.1%	31
College or university advisor(s)	23.1%	21
College or university classes	33.0%	30
University "open house," campus visit day or other event	11.0%	10
College Career Center	2.2%	2
College engineering society	6.6%	6
Science or engineering camp, program, or contest	16.5%	15
Family member or friend who is an engineer	26.4%	24
Internet	33.0%	30
Parent(s)	**50.5%**	**46**
Grandparent(s)	20.9%	19
Brother and/or sister	18.7%	17
Uncle and/or aunt	18.7%	17
Other family member(s)	7.7%	7
Other(s) (please specify)	8.8%	8
	answered question	**91**
	skipped question	**0**

14. How do you describe yourself? (Mixed racial heritage should be indicated by checking more than one category.)

	Response Percent	Response Count
American Indian or Alaska Native	0.0%	0
Asian	1.1%	1
Black or African American	23.1%	21
Hispanic or Latino	2.2%	2
Native Hawaiian or Other Pacific Islander	0.0%	0
White	**74.7%**	**68**
Other (please specify)	0.0%	0
	answered question	**91**
	skipped question	**0**

15. Are you studying at Clemson on an international student visa?

	Response Percent	Response Count
Yes	0.0%	0
No	**100.0%**	**91**
	answered question	**91**
	skipped question	**0**

16. Gender:

	Response Percent	Response Count
Female	36.3%	33
Male	63.7%	58
answered question		91
skipped question		0

17. Please type your name and email address below. Qualified participants of this initial online questionnaire will be entered into a random drawing to receive one of three $50 gift cards from Amazon. You may decline to answer any question(s) in the questionnaire without losing or reducing your chance to win. In case you are selected to receive one of the cash prizes for participating in this questionnaire and/or if you are selected for the personal interview, I need a method by which to contact you. Please provide your name and email address below. Your name and email address will be used only for the stated purpose.

	Response Percent	Response Count
Name (First Name Last Name):	100.0%	87
EMail Address:	100.0%	87
answered question		87
skipped question		4

APPENDIX VI: ACADEMIC DECISIONS DEFINITION SHEET

To help you understand what I mean by academic and career decisions, I offer the following definitions and examples:

- College attendance,
- Choice of major,
- Selection of courses,
- Interaction with advisor & professors,
- Reaction to grade on a test or assignment,
- Response to curriculum overload,
- Decisions related to studying (i.e., where, how much, when, how)
- Time management,
- Weighing financial issues relating to completing degree,
- Determining and/or expressing interest and disinterest in courses and major,
- Communicating with professors and TAs,
- Feelings of confidence or doubt in completing degree, and
- Finding help for a course (tutoring, study groups), etc.

Career decisions: the progression of your work or professional life; what you plan to do beyond earning an undergraduate degree; professional goal(s).

Examples:

- pursuing graduate degree(s),
- preparing for job interviews,
- selecting an employer,
- selecting a job and/or deciding among multiple job offers,
- appeal of career options, etc.

I will ask you to describe particular incidents. In trying to recall incidents, think of conversations with and actions by family members, older siblings, friends, extended family and those persons who are "like family". Examples include: family member, older siblings, friends, extended family member or persons who are "like family":

a. researched different majors, schools, and camps
b. talked to you often and said college is something that is expected
c. supported engineering, but wanted you to get out because of the high cost of tuition
d. faced a lot of hardships and some of them couldn't move up in various companies and wanted you to have a better life
e. directed you back on the correct path when you got stressed out
f. wanted you to do something other than engineering, such as becoming a teacher, doctor, or lawyer
g. could not understand why you wanted to spend money on school, and they could not understand the importance of a college education
h. expected you to send money home while in school
i. did not support internships and co-ops, because they feel as though you may enjoy the "working life" and drop-out of school or doing so will lengthen your time to graduation

APPENDIX VII: INTERVIEW GUIDE FOR THEORETICAL SAMPLE

The interview guide for each participant in the theoretical sample was personalized for each participant and focused on follow up questions and questions about their perspective on parental motivation. The following questions were asked to one participant.

- What does your mom do? Did your parents make a conscious choice not to go to college or did they not have the opportunity? Why or why not?
- Said you wanted to follow in your father's footsteps but he didn't advocate going into the military- why did you want to follow in his footsteps, and what did you perceive your options to be? (tech school/electrician)- did you see eng as an alternative to being an electrician? "Electricity is a family trade?
- Dad basically forbade you go into military- tell me about that? You also said that you are still debating between work, grad school or military- still considering military? Which are you leaving toward? Who is giving you info about these options?
- What did your parents think about your choice of electrical eng? Did they make alternative suggestions for a career path or major?
- You talked about how your parents had some views about what college was like from movies- what stereotypes did they have and how did you dispel them?
- What do you think your parents want for you in terms of a career- (to be happy, to make money, etc.?) How do you think your parents define success for you?
- What opportunity do you think you have that your parents didn't? What do you think your parents think?
- Wanted to return after your medical leave because "quitting is such a big problem in my family"- tell me about that
- Do you feel family pressure to finish? Be successful in career?

- Got help from counselor in filling out forms for college- did you get help from anyone else or know anyone else who could help?
- Did a lot of vocational competitions in HS- did your HS emphasize "vocations" over professions? Did you take electrician classes at school?
- Why do you describe your HS as being low income?
- You said you associated engineering with being hands on- where did this idea come from?
- Tell me about wanting to make your parents proud
- What did you like about the classes you attended at Clemson during Wise Choice?
- What happened during that time that solidified you choice of engineering or EE in particular?
- Did you have a realistic expectation about college before you attended WISE choice and met your Big sister? How did that change?
- Tell me about your study groups
- Do you think your peers gave you support that your parents couldn't?

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