A phenomenological inquiry of the major choice processes of an overlooked demographic: First generation college students in engineering

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Abstract*: This paper describes a phenomenological study of the experience of selecting engineering as a college major. Twenty four "first generation" college students—that is, students who do not have a parent with a four-year college degree—and 22 "continuing generation" college students attending a large, urban university in the U.S. were interviewed for the study. Through preliminary data analysis of interview transcripts, the author identified five major themes related to the experiences of first generation college students choosing engineering as a college major. Analysis of the continuing generation students' transcripts, as well inter-rater comparison with an additional researcher is ongoing.*

Introduction

Much attention been has focused on recruitment and retention of engineering students in recent years, and with good cause. In the U.S., the impending retirement of the "Baby Boom" generation, an increased need for a technological workforce and declining engineering enrollments combine to cause significant concerns about the country's ability to meet workforce demands. Numerous studies have reported on students' reasons and influences for entering the field of engineering. In many cases, it has been reported that having a parent or family member who is an engineer is an influencing factor for students—particularly females—to choose engineering as a college major (e.g. Seymour & Hewitt, 1997; Mannon & Schreuders, 2007). Consequently, the concept of "occupational inheritance" has been associated with engineering (Mannon & Schreuders, 2007).

In contrast to much of the extant literature in engineering education, this author's work is primarily concerned with engineering students who are among the first generation in their family to attend college. Not only do first generation college (FGC) students lack the influence of an engineer parent, they may not have any college-educated role models to assist with their academic and career choices. Published studies in general higher education have been overwhelmingly consistent in their assertion that first generation college students in the U.S. face significant and multiple educational barriers compared to their "continuing generation" counterparts (e.g. Chen, 2005; Choy, 2001; Pascarella, Pierson, Wolniak, & Terenzini, 2004). Additionally, FGC students are statistically more likely to be Black or Hispanic (Chen, 2005)—two rapidly growing populations in the United States.

The author views FGC students as a growing and vital part of the potential engineering "talent pool," and contends that their increased participation in engineering studies has the potential to contribute to both the number and diversity of engineers joining the workforce. To date, first generation college students have been an overlooked demographic in the engineering education literature.

The author's recent results from a mixed-methods study of ethnically diverse female engineering students (Trenor, Yu, Waight, Zerda & Sha, 2008) and a pilot qualitative study (Fernandez, Trenor, Zerda & Cortes, 2008) of eight FGC students indicated that FGC students faced increased barriers and lowered supports for their engineering college and career plans. Furthermore, differential social capital emerged as a salient theme in these interviews as other research questions were being explored (Trenor, Yu, Waight & Zerda, 2008). Therefore, a larger qualitative-driven study has been undertaken to further investigate the major choice decisions and undergraduate transition experiences for FGC and continuing generation college (CGC) students.

Research questions

1. Who or what are the primary influences and sources of information used by first generation college students in choosing engineering as a college major, and how do these differ from continuing generation college students?
2. What experiences related to university admissions and transitions to undergraduate engineering studies distinguish FGC students from CGC students?

Theoretical framework

The theoretical framework of Social Capital is a useful lens for understanding the lived experiences of first generation college students. A simple definition of social capital is "resources gained from relationships" (Lin, 2001, p.23). As an export from the field of sociology, social capital has a rich history of being applied to other fields, including education (Portes, 1998). In the context of education, social capital can be defined as "social relations from which an individual is potentially able to derive various types of institutional resources and support" (Stanton-Salazar & Dornbush, 1995, p.119).

Lin's network theory describes how social capital depends on (1) the resources embedded in social relations (2) an individual's position in a network or network characteristics (2000, p. 786). Generally, larger, more heterogeneous and less dense social networks allow individuals to enjoy more variety in the information, influence, and resources available through these networks (Lin, 2000). Inequality in social capital, therefore, occurs with differential access to social resources, a disadvantaged position in a network, or homogenous network characteristics, all which may limit the quantity or quality of resources available (Lin, 2000). Lin explained the implications of socioeconomic status on social capital when he said, "People in lower socioeconomic status tend to use local ties, strong ties and family ties. Since these ties are more homogeneous in resources, this networking reinforces poor social capital" (2000, p.789).

Social capital has been shown to predict a number of educational outcomes (e.g. Dika, 2003; Pascarella et al., 2004) as well as occupational attainment (e.g. Portes, 1998). In Pascarella's study of students who were among the first generation in their family to attend college, he described the social capital deficit of first generation college students as a handicap in obtaining and understanding necessary information about college (Pascarella et al., 2004).

Methodology

The phenomenological research tradition provided a basis for this study. Phenomenology is commonly used in a variety of fields, including education, psychology, sociology and nursing (Creswell, 2007; Lichtman, 2006). Lichtman summarizes this tradition by stating, "The purpose of phenomenology is to *describe and understand the essence of lived experiences* of individuals who have experienced a particular phenomenon" (2006, p.27). The current study examines two phenomena relevant to first generation college students pursuing engineering degrees: choice of engineering as a college major; and university admissions and transition to undergraduate studies in engineering. In order to identify the *essence* of these experiences for first generation college students, data from continuing generation college students was also collected and is being analyzed.

The study utilized a voluntary sample of engineering undergraduates attending an ethnically diverse research university where approximately one-third of engineering students are among the first generation in their family to attend college. Participants (N = 291) completed a brief web-based demographic questionnaire. The purpose of the questionnaire was to gather demographic information from a relatively large number of participants in order to identify potential participants for one-on-one semi structured interviews. The questionnaire was also used to collect closed-ended information regarding the sources of information participants' used in their selection of engineering as a college major. These sources were also used as points of discussion in the interviews. Incentives were offered for both survey (a raffle of ten $50 cash cards) and interview participation ($20 cash card per interview).

Strata-based purposeful sampling was employed to select prospective participants for the interviews, with the goal of achieving diversity in the sample based on: (a) parental level of education (b) gender and (c) ethnicity. Gender and ethnicity analyses will be forthcoming in future work. Forty-six students (24 FGC, 22 CGC) were interviewed. The highest level of educational attainment of either parent was used to determine generational status in college. Twenty participants had parents with only a high school (or less) education and 22 participants had at least one parent who completed a four year college degree. Four participants had parents who had some college experience, but had not completed a four year degree—because the experiences of these students were similar to those of the FGC group, these four students were counted as grouped with the FGC participants in the analysis. The sample consisted of 27 males and 19 females. Seven participants were African American/Black, 13 were Hispanic, 13 were White, and 13 were Asian.

Interviews lasted approximately 45 minute to one hour, and questions elicited participants' perceptions of their academic and career choice processes, perceived barriers and supports, and educational experiences. Specific interview questions are listed here, but actual interviews generally followed a conversational style, which allowed the researcher to remain flexible, often adapting the order in which the questions were asked, or the specific wording of the questions. Follow up questions were frequently asked in order to gather detailed descriptions of the phenomena.

Table 1. Sample interview questions related to research questions

Research Question	Sample interview questions
1. What or who are the primary influences and sources of information used by first generation college students in choosing engineering as a college major, and how do these differ from continuing generation students?	• When did you first decide to major in engineering? • Did you participate in any engineering-related activities before you made your choice? • Tell me about how you got the information about engineering that you needed in order to make your choice to go into engineering. • Where there any people who influenced your choice to major in engineering? Tell me about how they influenced you. • How has your family influenced your career plans?
2. What experiences related to university admissions and transitions to undergraduate engineering studies distinguish FGC students from CGC students?	• Where there are some things about the college application process that you learned the hard way? How about during your first year at the university? • Did you face any major transition issues when you came to the university from high school/community college/etc.? • What is the greatest challenge you presently face in pursuing a degree in your major?

Data Analysis and Preliminary Findings

Interview transcription yielded approximately 600 pages of text—a rich body of information from which to examine the research questions. Consistent with common phenomenological data analysis steps outlined by Creswell (2007, p. 60-62), steps in the analysis process included: (1) *bracketing* the researcher's own experiences in order to take a "fresh" approach to the data, (2) becoming generally familiar with the data by reading the transcripts, (3) identifying *significant statements* which illustrate the participants' experience of the phenomenon, (4) developing *clusters of meaning*, or themes, from the statements, (5) writing a *textural description* of what the participants' experienced and a *structural description* describing how they experienced it, (6) then writing about the *essence*–a composite description of the phenomenon based on the common experiences of the participants. Given the author's personal experience as a continuing generation college student, and her professional experiences directing recruitment and retention programs, conducting research and teaching at the university where the data were collected, it was necessary to acknowledge to these experiences and assumptions. A conscious effort was then made to suspend these assumptions during analysis.

In presenting an abbreviated version of results, the author sought to balance page limitations with providing enough information to elucidate her chain of reasoning from data analysis to the findings presented. Therefore, only data and results related to the first research question "What or who are the primary influences and sources of information used by first generation college students in choosing engineering as a college major, and how do these differ from continuing generation students?" are

currently presented. These begin to provide insight into the lived experiences of FGC students pursuing undergraduate degrees in engineering. Table 2 gives examples of how the author worked with raw data to arrive at clusters of meaning and ultimately, the essence of these first generation college student's decision to major in engineering.

Table 2. Steps 2 and 3 in phenomenological analysis: Identification of significant statements and formation of clusters of meaning

Significant Statements	Clusters of Meaning
"…they just always told me you know, to go to college so I wouldn't end up like them having to work at jobs that they don't like." "Now she [mother] regrets it [not getting a college degree], she's laid off, she has no degree to fall back on, no one wants to take her. " "My parents. . . since they didn't get an education, and [seeing] the jobs that they have had to have just to get by, definitely just them telling me about it and me myself seeing first-hand what not having an education can do to someone…"	Getting an education and making a decent living is important so that they don't repeat their parents' mistakes.
"Initially I talked to high school counselors and high school teachers and they realized I really liked math and science, so they kind of guided me towards this [engineering], and thought that it was something I would like to do." "My science teacher at that time [high school], she thought … I should get into engineering. So I thought 'Why not? It sounds pretty interesting,' and I just set a goal towards engineering...." Back in my high school, they had what they called a senior center and in your senior year that is the place you would go to get information about different colleges and how to apply to colleges and how to apply for financial aid and scholarships, so that's a place I would frequent. I had a teacher in high school, wait, middle school … and she introduced me to [University's] summer camp… and so I came here…and they started telling me about all the different engineering fields and stuff like that, so the first one I picked out was chemical engineering. [Interviewer: Did your high school teachers or counselors talk to you about it all?] Not really, no. [Interviewer: Did anybody in your high school help you?] No, not really. I asked …I went to a guidance counselor for career advice where I should go for and she really didn't help at all. We [my parents and I] were kind of on our own on it, I guess you could say. We got tips. We did get tips from my cousin who was at [Another University] and some advice from him, and then like I said, from my friends… I decided I was going to do engineering, I guess [in] fifth grade. I saw some people from NASA that came to my school and they talked and I said, 'I want to do that.' So I was like, 'That's what I want to do,' and we took a NASA field trip [every year] and I was getting more excited, [asking,] 'So how exactly do I start working at NASA?' and they told me that they were engineers so I was like, "OK I'll be an engineer." .. and when I went to graduate I was like, "OK so how am I gonna get this engineering degree to work at NASA?' So I looked around and I was like, 'I don't know what to do.' There were so many different choices, so many different universities I didn't know what I was doing. My mom tried to help me out …and we were like, OK [it's my] biggest decision [yet]—picking a university—and we don't know how to do it.	School personnel are significant influences or sources of support, although some students do not receive enough guidance from them.
"[I got my information about engineering] Most likely online… I searched on some of the engines like Google and places like that to find out the specific definition of engineers or what the individual fields, what kinds of things they will be doing." "It was mainly books in the library that told you an overview of what each major does and how much they get paid and stuff like that."	The internet, and to a lesser extent, books, were the primary source of specific information about engineering.
[Interviewer: At that point (when you enrolled in a technical college) did you understand the difference between engineering technology and engineering?] "It was probably my fifth semester [as an engineering technology major] before I realized the real difference. I knew there was a difference but I didn't really understand the true difference until after I had worked [with engineers] at [an internship]."	A number of FGC students described their decision to study engineering as coincidental based on a specific piece of

"It was kind of a fluke. I came here to do chemistry and during the process, seeing counselors the first time, he looked at my scores and said, 'Well since you seem comfortable with math, have you thought about chemical engineering?' and at that point I really had never thought about chemical engineering.… I looked into it and I was like 'Yeah, okay, why not, I'll give that a try.' And [I] switched…"	information learned late in the admissions process or after entering undergraduate studies.
"I know that they're really supportive of that but it's just sometimes that they want to pull me away towards home… so my mom's usually like, 'Oh I need this or can you come with me to this or you know, there's this thing going on with the kids and can you be here with me'. … Sometimes it's like, 'I'm sorry but I can't.'" "At first they [my family] didn't really [understand], 'cause like most of us really, I hadn't heard of engineering before college so most of them didn't understand it and didn't know why I wanted to do it. I myself was kind of not sure my freshman year, but then I started going into more of the material and find it more interesting, I'll be able to explain it to them a little bit better, see what potential jobs I could have. So they thought that was very interesting."	Parents and family were generally supportive of getting an education, but sometimes lacked understanding of the demands of the engineering curriculum, or what engineers actually do.

Borrego (2009, p. 60) provides a very useful description of components that together comprise *trustworthiness* of qualitative research, and compares them to counterpart terms typically used in quantitative work, including the qualitative concepts of credibility, transferability, dependability, and reflexivity. Page limitations do not permit the author to argue the trustworthiness of the research in terms of each of these elements, however, the topics deserves further discussion in a subsequent full paper.

Phenomenological essence and theoretical elements

Many first generation college students experienced high levels of emotional support from their family, but in nearly all cases, their family was unable to connect them to needed institutional resources and support to assist them with their college major choice. In many cases, FGC students "fell into" engineering, and seemed to be searching for direction—any direction—from the college-educated people in their lives (namely, teachers and guidance counselors). Many described their choice of engineering as a coincidence, rather than something that was planned in advance. Their connection to information about engineering was tenuous—in most cases, a teacher who recognized their ability in science or math. Furthermore, once someone in their social network suggested engineering possible college major, FGC students often just "went with the flow," perhaps having no other reasonable alternatives in mind. The fact that an engineering degree would help them make a decent living and perhaps raise their socioeconomic status was appealing, because the students were keenly aware of their parents struggles due to lack of higher education. Specific information and potential college and career opportunities (including salary ranges) were gained from independent research on the internet, and not from people in their social networks. Turning to the internet as a primary source of information revealed a lack of social capital related to pursuing an education in the field of engineering. First generation college students generally did not have engineering-related social capital through their peers prior to entering college, although many formed peer groups at the university, which contributed decisions to persist in the field.

Preliminary implications for practice

Analysis of continuing generation college students' interview transcripts is ongoing. Once complete, this analysis will allow for comparison of the experiences based on generational status in college. Inter-rater reliability with another researcher is also underway. In addition, an analogous study is currently being conducted at another university in order to better account for the full range of lived experiences of first generation college students in engineering.

Although preliminary, these data provide insight into the influential people and sources of information used by first generation college students in their decisions to major in engineering at the undergraduate level. While the author's recent research (Trenor, Yu, Waight, Zerda & Sha, 2008; Fernandez, Trenor, Zerda & Cortes, 2008; Trenor, Yu, Waight & Zerda, 2008) agrees with studies in the general higher education literature regarding the disadvantages faced by FGC students, the author purports that the

field of engineering places additional and compounding barriers to their recruitment and persistence. A better understanding of the potentially unique experiences of FGC students' academic and career choice processes is the first step toward designing effective messaging strategies as well as engineering outreach, recruitment and retention interventions which meet their distinct needs. While preliminary, these results indicate that providing opportunities for FGC students to develop sustained engineering social capital deserves further investigation.

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