DISSERTATION

WOMEN IN ENGINEERING: STORIES OF ATTRITION AND RETENTION

Submitted by

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In partial fulfillment of the requirements

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ABSTRACT OF DISSERTATION

WOMEN IN ENGINEERING: STORIES OF ATTRITION AND RETENTION

The number of women choosing to enroll in engineering programs has steadily increased since 1970, but the retention rates for women have drastically decreased despite initiatives to encourage women to enter engineering and graduate. Why do so many women drop out of engineering programs? Why do so few women persist and graduate? What are the experiences that women have that lead them to make their decisions about persisting or attriting from engineering programs? What meaning do they ascribe to their persistence or attrition?

Using narrative inquiry and a feminist perspective, this study looked at the stories that women share about their experiences in engineering programs to understand how those experiences impact their decisions to persist or attrit from engineering and to understand how women explain their persistence or attrition to themselves. Although this study focused on engineering majors, the findings may apply to women in mathematics and other science fields as well.

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CHAPTER 1

INTRODUCTION

This study looks at the experiences of women in engineering programs in order to understand their decisions to persist or attrit from engineering majors. The significance of this line of research is apparent when one looks at statistics for women undergraduates in science, mathematics, and engineering (SME). For although women account for approximately 55% of current undergraduates in the United States (Matthews, 1997), they account for only 26% of college SME graduates (Hyde & Gess-Newsome, 1999).

The latest figures compiled by the National Science Foundation (NSF) indicate that women's representation in some SME fields is relatively high. For example, they account for 50.8% of the bachelors degrees awarded in social science and 45.8% of the bachelor's degrees in mathematics and statistics. However, in SME fields such as engineering, the number of women receiving degrees is extremely low, with women receiving only 17.9% of the engineering degrees awarded (National Science Foundation [NSF], 2000). It is apparent from these numbers that the representation of women in SME fields varies considerably depending upon major.

The majority of existing research on attrition and retention of women in science, mathematics, and engineering has focused on science, mathematics, and engineering majors as a homogeneous group. However, SME majors comprise an array of majors, and the number of female students entering and graduating from some of these majors is quite

good. For example, women account for 73% of the bachelor's degrees awarded in psychology (NSF, 2000).

In addition to viewing SME majors as a homogeneous group, both in terms of major and in terms of individual characteristics, researchers have also used varying definitions of *science*; these definitions have produced research results that often appear contradictory. For example, including psychology in majors characterized as science would positively skew the results of a study looking at women's representation in the field given that women receive almost three quarters of the degrees in psychology. Because previous researchers have looked at science, mathematics, and engineering as a conglomerate and have not reached a consensus on a definition of science as a field of study, it is probable that issues that impact women in these fields have not been clearly identified or understood. This in turn may account for the high attrition rates of women within some of the majors found under the umbrella of SME.

Just as most previous studies have viewed SME majors as a group, the majority of the research has also used quantitative methodology to investigate SME persistence and attrition (Hyde & Gess-Newsome, 1999). Although sex has often been a category in these studies, gender as an historically changing reality that is socially constructed (Broido & Manning, 2002) has rarely been a focus. This study used qualitative methodology, in particular narrative inquiry, to elicit women's stories of their experiences in engineering, the SME field with the poorest retention rate for women. Interpretation of these experiences was done from a perspective that combines humanistic psychology, feminist theory, and critical theory. This combination of perspectives leads to a philosophical stance that advocates respect for the integrity of the individual, her thoughts, experiences,

and beliefs. In addition, these stances assume the coconstruction of meaning through dialogue, recognize the importance and value of reflexivity in the dialogic process, and have growth of the individual through self-awareness and/or empowerment as their goal. Finally, although humanistic psychology recognizes the importance of the individual's perceptions in the interpretation of experience, critical theory and feminist theory focus in particular on the importance that the consideration of gender, race, class, ethnicity, and sexual orientation bring to the experience and its interpretation.

Research Problem

Women do not graduate from science, mathematics, and engineering majors at the same rate as their male peers, even though up to the point of their attrition they have grade point averages that are comparable to or better than men (Rosser, 1997; Santovec, 1999). Since the 1980s, researchers have investigated possible reasons for the attrition of women in SME. Factors such as teaching style, need for a gendered peer group, and need for extrinsic reinforcement have been identified as issues that contribute to female attrition (Belenky, Clinchy, Goldberg, & Tarule, 1986; Hyde & Gess-Newsome, 1999; Seymour, 1995; Tinto, 1997). Despite the identification of factors that influence female persistence in SME and the implementation of college and university programs to address these issues, female attrition in SME remains high relative to males in these same fields, even though the National Science Foundation has funded initiatives at the K-12 level to develop teaching methods to encourage young women to enter these fields and at the post-secondary level to retain them once they have declared SME majors (Farrell, 2002; Frehill, Benton-Speyers, & Cannavale, 2004; Hyde & Gess-Newsome, 1999; Seymour, 2002).

Much of the research on female attrition in SME fields has viewed science, mathematics, and engineering as a homogeneous group of majors. The NSF grouping for SME, however, covers a diverse range of majors, including engineering (8 types), physical science, earth, atmospheric, and ocean sciences, mathematics and statistics, computer science, agricultural sciences, biological sciences, psychology, and social sciences (8 categories) (see Appendix A). Within some of these majors the number of female graduates is quite good. For example, in 1996 women accounted for 52.9% of the bachelor's degrees in biological science, 63.5% of the bachelor's degrees in anthropology and 45.8% of the bachelor's degrees in mathematics and statistics (NSF, 2000). Research has led to the identification of factors that may have an effect upon the retention of female students in SME majors, but we have looked at both the majors and the women within SME as a homogeneous group and have likely failed to grasp the full range of issues that impact women's attrition and persistence in these fields.

For women in science, mathematics, and engineering fields, engineering represents the worst-case scenario for the number of degrees granted. The latest figures compiled by the National Science Foundation indicate that women account for only 17.9% of the engineering degrees awarded in 1996 (NSF, 2000). This worst-case scenario holds true for retention rate as well. Babco (cited in Brainard & Carlin, 1997) indicates the national retention rates of women in engineering have fallen from a high of 90% in 1976 to less than 60% in 1994, in spite of the fact that enrollment of females in engineering has steadily increased since the 1970s.

Thus, women are increasingly choosing to major in engineering and, according to Rosser (1997) and Santovec (1999), up until the time that they attrit from their programs

they have grade point averages that are comparable to or better than men. Why, then, are women leaving engineering majors when they seem to be succeeding academically? Previous research on women's retention in SME has often been extremely localized (Dietz, Anderson, & Katzenmeyer, 2002), and the research methodology has traditionally been quantitative (Hyde & Gess-Newsome, 1999). Most important, however, is that research on women's retention has focused upon a conglomerate SME population and has rarely considered gender from a feminist perspective where gender is conceptualized as socially constructed and historically defined.

The purpose of this study was to investigate women's experiences in engineering programs in order to understand how these experiences impact issues of persistence and attrition. Narrative inquiry provided the method of investigation. Using stories of women's experiences, using the worst-case scenario of the female engineering major, and using a diverse group of women from a number of colleges and universities led to a picture of the issues and dilemmas faced by a number of women who chose engineering majors.

Theoretical Framework

Since the 1980s, researchers have sought to identify the issues that led to low retention rates for women in SME fields (Seymour, 2002). However, according to Hyde and Gess-Newsome (1999) only a few gender studies have focused on retention at the college level, and the majority of those researchers used quantitative methodology to identify factors leading to women's retention and attrition in SME fields. Dietz et al. (2002) asserted that different methods of research and evaluation questions must be posed and different theories and frameworks must be implemented in order to reframe the

problem from women *in* science to women *and* science. Finally, because research has typically considered SME as an aggregate, it is likely that results have been unclear, and, as Wyer (2003) suggested, that future research in this area would benefit by addressing gender influences alone within a single major.

According to Lincoln and Guba (2000), "Methodology is inevitably interwoven with and emerges from the nature of particular disciplines (such as sociology and psychology) and particular perspectives (such as Marxism, feminist theory, and queer theory)" (p. 164). The perspectives used in this study were humanistic psychology, critical theory, and feminist theory. These perspectives created a framework for formulating and interpreting research questions focused on the experiences of women who have enrolled in undergraduate engineering programs. Because narrative is "the study of the ways humans experience the world" (Connelly & Clandinin, 1990) and because it recognizes the uniqueness of the individual, narrative inquiry was the methodology that seemed to best fit the research project.

Humanistic psychology combines experiential psychology with philosophical humanism. Humanistic psychologists believe that psychology must deal with human subjective experience as opposed to the mere observation of human behavior; they "accept verbal reports of self-observation as reflecting the inner experiences of a person" (Kendler, 1987, p. 413). For humanistic psychologists, conscious experience is the essence of humanity. They believe that humans strive to seek meaning in their lives and have the ability to make choices (Kendler, 1987). Humanistic psychology is aligned with the postmodern rejection of a notion of one truth. Instead, the humanistic psychologist believes that one must look at truth as the individual defines it.

An additional theoretical perspective of this research was critical theory. Critical theory conceptualizes reality as being socially constructed. That is, at any point in time reality is constructed by social, political, cultural, economic, ethnic, and gender values (Lincoln & Guba, 2000). Thus, the truth that is defined by the individual is a truth that is dependent upon time and place. In addition, critical theorists claim that society is oppressive in its current form and that the oppressions—race, class, sexual orientation, gender—must be considered and dismantled in order for social transformation to occur (Broido & Manning, 2002). Although critical theory does not dictate a particular research methodology, it does require a methodology that supports equal power distribution and allows for the joint construction of knowledge with the purpose of empowering and emancipating the individual (Lincoln & Guba, 2000).

Feminist theory also informed this research. The development of knowledge and theory that is inclusive of human diversity is indicative of feminist theory (Broido & Manning, 2002). Though there are many different orientations within feminism, qualitative feminist research "centers and makes problematic women's diverse situations as well as the institutions that frame those situations" (Olesen, 2000, p. 216). Sandra Harding (1991) spoke in particular about feminist standpoint theory and its perception that the social position of the knower influences what is known. In Harding's view, women's exclusion from dominant conceptual schemes, in this case science, provides women with an advantage in terms of generating explanations of the social order from the perspective of an outsider. Finally, many feminists see social change and institutional transformation as goals to be accomplished by implementing the results of research or through its consciousness-raising effects (Safarik, 2002).

These theoretical frameworks—humanistic psychology, critical theory, and feminist theory—work well with the concepts of exploration and emergence that are hallmarks of the qualitative research study. My desire to understand the experiences of women in engineering programs in their own terms pointed to narrative inquiry and narrative analysis as the method and tool for gathering and interpreting these shared experiences. It was the stories that participants created about their experiences, not the experiences themselves, that were of interest to me, and, as Riessman (1993) observed, because narrative inquiry gives prominence to human agency and imagination, it was an approach well suited to studies of identity and subjectivity. The concept of interpretation of narrative in terms of time and place allows for the structural and historical insights that are standards of critical and feminist theories. Finally, attention to word choice and language structure are basic tenets for both narrative interpretation and followers of Rogerian psychology.

Initial Theory

In the fall of 2003, I enrolled in ED792V, Seminar in Narrative Inquiry, at Colorado State University in Fort Collins, Colorado. During this course I was required to conduct three 1-hour interviews with one or more participants. Because of my interest in the experiences of women in engineering programs, I interviewed a young woman in her final year of electrical engineering at a private Midwestern university. The assignment served as a learning experience with narrative inquiry as well as a pilot study for this research project (see Appendix B). And, by introducing me to the realities of narrative inquiry, it also helped me further shape my research design for this study.

A key finding from the pilot study interviews was the lack of attachment J (the study participant) had with both female and male peers in the electrical engineering program. This lack of attachment was also apparent when she spoke of her relationships with her father, her employer, and her friends. Her lack of attachment seemed to lead to a lack of both social ability and personal awareness and was reflected in J's level of identity formation.

In terms of what the pilot study taught me about the research process itself, I found that using scripted questions created an atmosphere where I was perceived as being in control and responsible for the interview. I was unable to completely remove myself from this pattern once it was established, and I believe that it dampened spontaneity and the flow of stories. It certainly created a power differential in the interview that I had not intended.

During the pilot project it became clear that multiple interviews were necessary in order to develop a relationship with J and to cover her experiences in the engineering program. I learned that transcription of an interview takes a tremendous amount of time and that it is extremely helpful to complete the transcription of one interview before scheduling another interview. Rereading the transcript helped immensely in terms of knowing where to begin the next interview and having in mind issues that I hoped to cover. Finally, I found the narrative process extremely interesting and personally rewarding.

Clandinin and Connelly (2000) observed that

> the contribution of a narrative inquiry is more often intended to be the creation of a new sense of meaning and significance with respect to the research topic than it is to yield a set of knowledge claims that might incrementally add to knowledge in the field. Furthermore, many narrative studies are judged to be important when

> they become literary texts to be read by others not so much for the knowledge they contain but for the vicarious testing of life possibilities by readers of the research that they permit. This use of narrative extends the educative linking of life, literature, and teaching. (p. 42)

Although Clandinin and Connelly indicated that the goal of narrative inquiry is not to "yield a set of knowledge claims" (in the modernist sense), I found that discourse with a number of women who had majored in or were currently majoring in engineering enabled me to make statements about the experiences and feelings that these women as a group had had and to begin to conceptualize a larger framework within which to understand these experiences.

Research Questions

1. What are the political, social, and cultural dimensions of women's experiences as engineering majors?
2. How do the experiences in an engineering program impact a woman's decision to either persevere or change majors?
3. What meaning do women ascribe to their persistence or attrition in engineering programs?

Significance of the Study

Although this research concerned itself with the attrition and persistence of women in SME in the United States, the issue of the underrepresentation of women in science, engineering, and technical fields is, in fact, an issue in much of the Western world. According to Cronin and Roger (1999), women accounted for only 32% of the graduates in science, engineering, and technological fields in Scotland. "These figures are roughly similar to those for the United Kingdom as a whole, and the under-representation

of women . . . persists in many other European countries, the United States, Canada and Australia" (Cronin & Roger, 1999, p. 637). The American Association of University Women noted that technology has become the new "gender gap" (Brickhouse, 2001). Some even equate the increased enrollment and success of women in the physical sciences as necessary for the United States to maintain its position as a world leader (Kennedy & Parks, 2000).

Since the 1980s researchers have looked at the issue of women in science, mathematics, and engineering in an effort to increase the number of girls in the K-12 pipeline and to increase the number of young women majoring in and completing post-secondary programs in SME (Alper, 1993; Farrell, 2002; Frehill et al., 2004; Hyde & Gess-Newsome, 1999; Seymour, 2002). Research has predominantly used quantitative methodologies (Hyde & Gess-Newsome, 1999), but more recently qualitative and mixed design methodologies have been used as well. Research participants have been women, men, and a combination of both genders. Theoretical stances have covered a wide range. As a result, numerous programs and initiatives have been put into place. Still, the percentage of women completing their studies in these fields has remained constant (Rosser, 1997). This investigation focused only on the experiences of women in engineering majors in an effort to see how their experiences affected their decisions to complete their engineering programs.

The significance of this study lies both in its design and in its interpretive stance. Science, mathematics, and engineering majors represent a large and varied group of majors, and the number of female students both entering and graduating from some of these majors is quite good. For example, women outnumber men in the declaration of

majors in anthropology by two to one and they account for 63.5% of the bachelor's degrees in this field (NSF, 2000). Because previous researchers have often looked at science, mathematics, and engineering as a homogenous group of majors, it seems likely that they failed to identify some of the issues that impact women in these fields. In addition, some previous research into women's attrition and persistence in SME fields has made gender a focus or even a primary variable, but few studies used a feminist perspective to look at the political, social, and cultural impact of the choice to study in a science, mathematics, and engineering field. Finally, as Blaisdell, Middleton, and Anderson-Rowland (1996) pointed out, it is important that issues of female retention be addressed to assure that engineering problems are approached from the unique angles and perspectives that women bring to engineering.

At the time of this writing, research in the area of increasing female retention in SME appears not to have paid off in terms of retention rates. Despite increased enrollment of women in SME, the proportion of women enrolled in undergraduate engineering programs remains around 20%, approximately the same as 20 years ago (Farrell, 2002). According to Longino and Hammonds (1990), "The strategies proposed by feminists and non-feminists [women scientists] to help women achieve their career goals and to bring more women into the scientific professions are virtually identical to those of women scientists before World War II" (p. 180). That is, women scientists advise their peers to use the scientific method, work harder, become more confident in the lab, don't drop out of science after having children, and put aside a desire for emotional connectedness. "The feminist critique of science begins, in part, with the acknowledgment that these strategies have failed" (Longino & Hammonds, 1990, p. 180).

The use of narrative inquiry as a mode of investigation is unusual in this area of research, and I believe that it offers a richer, more complete and complex view of the experience of women in engineering and helps to breathe life into a laundry list of factors that have previously been identified as affecting women's persistence in SME majors. Miles and Huberman (1994) stated that qualitative data

> are a source of well-grounded, rich descriptions and explanations of processes in identifiable local contexts. With qualitative data one can preserve chronological flow, see precisely which events led to which consequences, derive fruitful explanations. Then, too, good qualitative data are more likely to lead to serendipitous finds and to new integration; they help researchers to get beyond initial conceptions and to generate or revise conceptual frameworks. (p. 1)

In line with the purpose of narrative inquiry, this research does not seek to generalize its results. For, as Nancy Tuana (Olesen, 2000) contends,

> We are less likely to find a common core of shared experiences that are immune to economic conditions, cultural imperatives, etc., than a family of resemblances with a continuum of similarities, which allows for significant differences between the experience of, for example, an upper-class white American woman and an Indian woman from the lowest caste. (p. 228)

I believe that this study leads us to an increased understanding of the experiences of women in engineering programs and to an understanding of how women make meaning from those experiences. It has also led to the germination of a theory of the experiential path that women in engineering traverse as they pass through their engineering programs. Hopefully, other researchers will find this theory useful to investigate with other research designs. And, because women in engineering represent the worst-case scenario in terms of persistence, it is possible that some of the experiences and insights that these women shared may apply to women in other science and mathematics fields as well.

CHAPTER 2

REVIEW OF LITERATURE

Women account for over 55% of the bachelor's degrees awarded each year in U.S. colleges and universities, but they account for only about 18% of the degrees awarded in the field of engineering (Chiu, Chiu, Chiu, & Chiu, 2002). Research into the factors contributing to the lack of persistence of women in engineering grew out of recognition that the professions of science and engineering were predominantly White and male and privileged (Rose, 1983; Seymour, 2002). A look at the history of the development of science underscores the battle that women have faced since the Middle Ages in their quest to be included in scientific fields.

Women in Science

Western science was an outgrowth of the Christian clerical tradition. Many of the early devotees of science were from the ecclesiastical academies, and early practitioners often belonged to ascetic mendicant orders: The culture was strictly male, celibate, and devoted to the service of God (Noble, 1992). Except for a period in the 15th and 16th centuries when women were recognized for their knowledge in herbs and folkloric medicine, science remained part of the clerical order and was therefore a masculine undertaking. In the 1900s the development of professional societies, such as the American Chemical Society, the American Physical Society, the American Society of Civil Engineers, and the American Institute of Electrical Engineers, assured not only that

males would dominate the scientific community but also that universities would be fashioned in a predominantly male image as well (Noble, 1992).

Because of the historical roots of science, there was "a virtual male monopoly of the production of scientific knowledge and discourses about science, its history and meaning" (Fee, 1986, p. 43). Feminists believe that science is neither objective nor gender neutral and that its dualistic nature (e.g., masculine-feminine, reason-emotion, mind-body, objective-subjective) is related to male-female dualism. "As such, not only was masculine culturally defined in opposition to feminine, but scientific was also defined in opposition to feminine" (Brickhouse, 2001, p. 283). Women have traditionally held no place in science except as the object of knowledge, nature. The history of women in science has been a battle for the right to participate and to contribute to a field created by men and defined by the male image.

Women and Higher Education

The historic absence of women from significant roles in the development of science runs parallel to their exclusion from higher education. As late as the mid-19th century, women were excluded from higher education based on the belief that development of the female brain resulted in the shriveling of their reproductive organs. "When deciding whether to admit women, the president of the University of Michigan charged, 'we shall have a community of defeminated women and demasculated men. When we attempt to disturb God's order, we produce monstrosities'" (Sadker & Sadker, 1990, p. 176). Women in the United States gained admittance to universities in the 1870s, but it was not until 1920 that women gained admittance to Ph.D. programs, the prerequisite for serious work in the field of science (Schiebinger, 1987).

In the early 1960s there was a social movement supporting gender equity in education. The passage of the Civil Rights Act in 1964 made it illegal to discriminate on the basis of sex in education and employment (Schiebinger, 1987). However, the true legal impetus for gender equity in education did not exist until the passage of Title IX in June of 1972. Title IX of the Education Amendments of 1972 offered legal recourse to individuals who experienced discrimination based on sex in educational programs or activities receiving Federal financial assistance. Because most colleges and universities received some federal assistance, the impact of Title IX was far reaching, opening doors that had been closed to women. Just prior to the passage of Title IX, only 18% of women completed college compared to 26% of men. By 1994, that number was 27% for both women and men (Resources to Infuse Equity, n.d.).

Women in Science, Mathematics, and Engineering

In the mid-1980s, the Higher Education Research Institute at UCLA looked at enrollment patterns using longitudinal data drawn from national samples of freshmen at 2- and 4-year postsecondary institutions. They found there was a decline in the number of freshmen, both female and male, choosing to enter and persist in mathematics and science-based majors (Seymour, 2002). The loss rates ranged from 20% in the physical sciences to 40% in engineering and 50% in the biological sciences. This caused considerable concern based on the fear that the United States would not produce enough scientists, mathematicians, and engineers to handle our scientific and technological needs in the future.

As investigators began to look deeper into the problem of persistence in the fields of science, mathematics, and engineering, they became aware of an even greater problem:

The professions of science and engineering were disproportionately White and male. Researchers found that there was a 20-year decline in women's SME enrollment and that the persistence rates of those women who did choose to major in SME fields was considerably lower than the persistence rates for men (Seymour, 2002). These declines occurred despite the fact that many colleges and universities had created programs to target female enrollment. Therefore, not only was general persistence in SME deemed to be a problem, but the persistence rates of women in SME were specifically targeted as issues.

Student Persistence

In the early 1970s, researchers began proposing formal models to explain student attrition at the postsecondary level. Spady (1971) and Tinto (1975) were among the first to develop such models. Both were influenced by the work of Emile Durkheim, a French sociologist and author of *Le Suicide* (1951/1930). Durkheim studied social causation; his basic theme was that suicide was not simply an act of the individual but rather was a result of the lack of interaction of the individual with the social structure. Using Durkheim's work as a base, Spady developed an interactional model of student attrition that posited the personal attributes of the student interact with environmental demands of the institution to affect student retention.

Tinto (1988), like Spady, believed that student attrition was impacted by the individual's ability to integrate into the social structure. He was further influenced, however, by the work of Van Gennep, another French sociologist, who had anthropological leanings. Van Gennep studied the ceremonies that typified rites of passage. He identified three phases that occurred in all rites of passage: separation,

transition, and incorporation (Van Gennep, 1960/1908). Tinto developed a theory of student attrition that focused on the person-institution fit. He believed that fit occurred in two areas, social and academic. The "rite of passage" into these two areas was accomplished through separation, transition, and integration. Failure to integrate into either of these areas left the individual open to attrition, the educational equivalent of suicide (Tinto, 1988).

Kamens (1971) developed a theory of student attrition that looked at an institution's size and standing. He posited that larger, more prestigious schools had a greater hold over their students, which translated into a higher rate of persistence. Rootman (1972) proposed a different type of interactional model. His model held that withdrawal was a function of the goodness of fit between an institution and the individual.

Further research in the field of student attrition led to additional models. Beal and Noel (1980) attributed attrition to poor academic advising and lack of caring faculty and staff relationships. Bean (1980) developed a causal model based on employee turnover in the work environment. His research found that institutional commitment was the most important variable in explaining student attrition. Astin (2001) identified student satisfaction with the institution as the primary determinant of student persistence. Other researchers, such as Pascarella, Cabrera, and Nora, developed sociological models that took into account motivational, environmental, institutional, commitment, and academic and social integration factors (Nora, Cabrera, Hagedorn, & Pascarella, 1996).

Many models were developed to explain student attrition, and considerable research was conducted using these frameworks with the goal of pinpointing factors that impacted student persistence. Many of the models were used to study the factors that influence the attrition of women in SME fields. Although a number of these factors were found to be applicable to both women and men, their relative impact was found to vary when sex was the primary focus.

Berryman (1985) stated that there were two approaches to increasing the number of women with quantitative degrees. One approach was to increase the initial pool size and the other was to reduce the rate of attrition from the pool itself. Research in the field of women in SME majors has approached the problem from both of these perspectives. The former approach requires a focus on the feeder system into colleges and universities so that there are more women declaring majors in SME fields. The latter approach requires postsecondary institutions to isolate the factors that positively and negatively impact women in these majors. Research has identified a number of factors that appear to be especially relevant to women. In particular, the nature of the educational system, teaching methodology, student-faculty relationships, confidence levels, and a gendered peer group have been found to be important.

Nature of the Educational System

When looking at academic integration into the institution, gendered research in SME fields has often focused on the nature of the educational system itself. Feminists see the current postsecondary educational system as one that exclusively supports the socialization of middle-class White males (Ramirez, Laurel, & Rodriguez-Aguilar, 1999;

Seymour, 1995). Entry into SME fields leaves women at a disadvantage because they lack understanding of the socialization process (Seymour, 1995). This process is manifested in the basic approach of SME curricula as well as in the teaching methods that are used in these fields.

According to Zuga (1999), women function in different ways than men and have different ways of knowing than men. These gender differences should lead us to attempt to create alternative, more inclusive ways to approach the teaching of traditional science and technology. Fee (1986) proposed several preconditions to a feminist approach to science,

> one in which no rigid boundary separates the subject of knowledge (the knower) and the natural object of that knowledge; where the subject/object split is not used to legitimize the domination of nature; where nature itself is conceptualized as active rather than passive, a dynamic and complex totality requiring human cooperation and understanding rather than a dead mechanism, requiring only manipulation and control. (p. 47)

Zuga (1999) stated that "if women are to be attracted to a study of technology, both the value and purpose of technology and the way in which it is taught must be changed" (p. 64). Alper (1993) pointed out the need to make the curriculum relevant to women's lives. Researchers theorize that these approaches to science and technology could lead to increased persistence of women in these fields.

Teaching Methodology

Just as a more inclusive approach to science is predicted to increase the number of women both majoring in and graduating from SME fields, it is also theorized that a change in the teaching methodology in these fields will have a positive impact as well. According to Belenky et al. (1986), even if the course content is restructured to include

issues of interest to women, the teaching methods instructors use are often incompatible with women's preferred styles of learning. Women need to understand the context of an idea, they need to have a thorough explanation of the concepts that are presented. Furthermore, women seem to find group work and collaborative learning more effective than the more lecture-oriented and competitive style of the typical SME classroom (Belenky et al., 1986; Gilligan, 1982; Hyde & Gess-Newsome, 1999; Seymour, 1995). As Seymour observed, the educational system in the SME fields was not intended for women. Neither does it relate to the way in which they have traditionally been taught nor to the ways in which they have traditionally related.

Student-Faculty Relationship

In addition to teaching style, the student-faculty relationship has been found to be extremely important for the retention of college students, both female and male. Tinto (cited in Hyde & Gess-Newsome, 1999) found that interactions with faculty and staff strengthened the integration of the student into the academic environment which, when coupled with integration into the social environment, resulted in the students' ability and desire to persist. In a study designed to examine the factors that most contributed to persistence decisions, Nora et al. (1996) found that informal interaction with faculty was a significant determinant of female retention in their early college careers.

In one of the foundational pieces of research into retention of women in science, mathematics, and engineering, Seymour (1995), in a 3-year ethnographic study at seven institutions involving 460 students, found women considered a teacher's personal behavior toward them important. "They like professors who 'wanted to get to know you as a person,' 'treated you nicely . . . ,' and who really care about you, and want you to

learn" (p.465). Seymour concluded that failure of faculty to develop more personal pedagogical relationships with women is a major contributor to women's decisions to leave SME fields.

Research conducted by Hyde and Gess-Newsome (1999) indicates that a key to the success of women in science majors is the attention professors give them beyond the classroom setting.

> This research suggests that professional associations are one of the most beneficial proximal relationships a student can enjoy. The consequences of these relationships included emotional support, knowledge enhancement, added confidence, letters of recommendation, encouragement, and other support. (p. 348)

Similar results on the importance of faculty relationships to women were found by McShannon and Derlin (2000). Their study used 515 undergraduate engineering students from three colleges in New Mexico to look at the retention of minority and women students in engineering for three subgroups: male-female, White-minority, and freshman-senior. They found that freshman and female students considered informal interaction with faculty members more important to their learning than senior or male students.

Confidence

Women's lack of confidence in their abilities in SME fields, which has been documented, has been another area of interest to researchers. Klawe and Levenson (1995) looked at a sample of male and female high school graduates. Approximately 20% of males and females in the sample rated their intelligence in the highest category relative to their peers. By their sophomore year in college, 20% of the men still placed themselves in this category, but only 3% of the women did. By their senior year, 25% of men placed

themselves in this category, but none of the women did. Klawe and Levenson theorized that the isolation, powerlessness, and exclusion that women experience in SME majors leads them to blame themselves as opposed to recognizing the inherent problems in the educational system and results in continuous erosion of confidence.

A similar lack of confidence was documented in research conducted earlier by Wilder, Mackie, and Cooper (1985) on women majoring in computer science. They found that women with computer experience reported themselves to be less comfortable and no more skilled with computers than males inexperienced with computers. Alper (1993) said "In fact, a loss of self-confidence—rather than any differences in ability—may be what produces the first leak in the female science pipeline" (p. 410).

This lack of confidence may be partially overcome by effective extrinsic rewards. Hyde and Gess-Newsome (1999) found that an extrinsic reward system motivated successful women in SME majors. "The participants in this study often credited extrinsic factors for their success and often referenced the need for external validation and support, which in turn built their confidence, thus enabling them to persist" (p. 349).

Seymour (1995) found that what motivated young women was neither a desire to win nor a fear of failure, but rather the desire to receive praise. She attributed this desire to society's socialization of women and the feelings of confidence and self-worth women experience when others are pleased with what they do. Because of the teaching methodology used in SME, however, it is much more likely that students in these majors will find a system based on intrinsic rewards, a system that may cause women to lose confidence and eventually drop out of these majors (McIlwee & Robinson, 1992; Rayman & Brett, 1995).

Finally, Hughes (2002) used gender schema theory to look at the relationship among gender attributions of science and academic attributes for undergraduate science, mathematics, and technology majors. He found that in terms of academic attributes "levels of course confidence, major confidence, and career confidence were significantly lower" (p. 63) for women than for men. This disparity creates an academic environment where a group of students in gender-incongruent majors experience and express less confidence than the students in the gender-congruent majors.

Gendered Peer Group

The development of a gendered peer group is a final factor that attrition studies on women SME majors have identified as important for continued persistence. Hyde and Gess-Newsome (1999) conducted research using upperclass mathematics, science, and engineering students at a western research institution. Their goal was to isolate the factors that led to the successful education (operationally defined as graduation) of women in these fields. They discovered that one of the most important factors for the women was the development of a gendered peer group that could act as a support network. This support network provided both academic and emotional support to the women. Participants in the school's orientation program for women in SME majors "overwhelmingly agreed that the most beneficial aspect of the program was the important relationships they developed while in the program" (p. 341).

Similar findings resulted from research conducted by Cohoon (2001) to identify variables that affected female retention in computer science departments in the Virginia system of postsecondary education. She found that "the single strongest factor and most consistent finding of this gendered attrition study was that the departments with higher

female proportions of enrollment were more likely to retain women at comparable rates to men" (p. 112). In addition, she found that in computer science departments where female enrollment was so low that same-sex support was unavailable, the gendered attrition rate rose as high as -19%, indicating the positive effect that a gendered peer group provided. According to Alper (1993), a key factor to women's success in science fields is the presence of other women. It was hypothesized that their presence creates a different environment than the typical competitive male domain of most science.

Conclusion

Over the past 20 years, researchers have moved from looking at general student retention issues to looking at the specific issue of retention of students in science, mathematics, and engineering fields (Rosser, 1997). In the 1980s researchers began to focus specifically on the retention of women in SME. With the emergence of feminist epistemologies during this same time, feminism became integrated into the work of feminist educators (Brickhouse, 2001). Feminist researchers began to look into the issue of gender in SME in terms of equity. Some feminist researchers then began to look at the educational climate within SME as the primary reason for attrition of women in these fields (Brainard & Carlin, 1997; Brickhouse, 2000).

Women currently receive 55% of the undergraduate degrees awarded each year (Matthews, 1997), making women the new undergraduate majority in higher education (Sadker & Sadker, 1990). To date, however, relatively few studies have been conducted on SME majors with gender as the primary focus. Very few of the undergraduate pedagogy and curriculum reforms that have been instituted have focused specifically on

women, and the percentage of women completing their studies in these fields has remained constant (Rosser, 1997).

As early as 1930, researchers studied student retention and identified the need for interaction between the student and the social structure of the school as necessary for retention (Durkheim, 1951/1930). Over the years, many researchers approached the topics of student persistence and attrition looking for key variables that could accurately predict student success. Carol Gilligan's research in the 1980s on women's development and voice, gave rise to specific studies focusing on the retention of women. Researchers began documenting women's need for connection in the classroom (Belenky et al., 1986), need for connection with instructors (Hyde & Gess-Newsome, 1999; Nora et al., 1996), and need for connection with a gendered peer group (Alper; 1993; Cohoon, 2001; Hyde & Gess-Newsome, 1999) in order to be successful.

Researchers, educators, government officials, and members of industry have recognized that the retention of women in science, mathematics, and engineering fields is a problem, and over the years researchers have sought answers to rectify the problem. Though the enrollment of women in SME majors continues to increase, the persistence rates for women in SME majors remains constant and the persistence rate for women in engineering has declined precipitously.

Rosser (1997) asserted that the failure of the current educational system to reach a large portion of our population "damages more than the pool of scientists and the quality of science. It undercuts the effectiveness of the entire workforce in an increasingly competitive global economy" (p. 141). If science is the key to providing renewable sources of energy and promoting productive lives free from hunger and disease for all

people, then we must be certain that science is a field that is not exclusionary and that represents all people. The attrition of women from science, mathematics, and engineering must be addressed. However, it must be addressed using new methodologies and new perspectives, for it is apparent that we have as yet to tap into some of the significant issues that face women in SME fields. In order to do this, we must go to the source herself and listen to her experiences. We must look at the feeling and meaning attached to these experiences in light of the social, cultural, and political climate that exists today. It is these feelings and meanings that I believe hold a key to understanding the issue of attrition of women in engineering. It is only by addressing the attrition of women in SME that we can assure that the unique perspectives and methodologies women can bring to science, mathematics, and engineering are indeed given an opportunity to be heard.

CHAPTER 3

METHODOLOGY

Research Design and Rationale

This research study looks at the meaning that women ascribe to the stories they share about their experiences in engineering programs in order to understand how those experiences impact decisions of persistence in and attrition from engineering. Qualitative research was the research method that was most appropriate for this study. According to Locke, Spirduso, and Silverman (2000), a qualitative approach is called for when the meaning that people make of their experience is important and when the researcher believes that there are aspects of reality that cannot be quantified.

In addition to fitting the goals of this research study, qualitative methodology fit well with the theoretical perspectives and values that I brought to the research. As Lincoln and Guba (2000) pointed out, research methodology is by necessity a function of both one's disciplinary orientation and one's theoretical perspective. I approached this research study as a counselor with strong ties to Carl Rogers's theories of humanistic psychology as well as an acceptance of the assumptions of feminist standpoint theory and critical theory.

Humanistic psychology is considered the third force in psychology. It rejects the behaviorist idea that the environment controls us and it rejects the psychodynamic belief that personality is ruled by unconscious forces (Coon, 1986). It is an "optimistic, self-

determined, positive philosophy about human existence" (Evans, 1975, p. xxvi). Humanistic psychologists believe that psychology must deal with human experience, and we stress the importance of subjective factors of self-image, self-evaluation, and frame of reference (Coon, 1986). For humanistic psychologists, conscious experience is the essence of humanity and we accept the individual's verbal reports as the way to access this experience. We believe that humans strive to seek meaning in their lives and have the ability to make conscious choices (Kendler, 1987). Because humanistic psychology conceptualizes truth as being defined by the individual, it fits well with the postmodern rejection of a notion of one truth, and because it is interested in the subjective experiences of the individual, it fits well with narrative methodologies.

In addition to my beliefs in humanistic psychology, I am also supportive of critical theory. Critical theory is dialogic and conceptualizes reality as socially constructed. That is, at any point in time reality is constructed by social, political, cultural, economic, ethnic, and gender values (Lincoln & Guba, 2000). Thus, the truth that is defined by the individual is a truth dependent upon time and place. Other hallmarks of critical theory are equality, emancipation, and justice, and empowerment of the individual.

A final perspective that I brought to this research project was that of feminism. Like critical theory, feminist theory uses discourse as the basis for interaction. It recognizes that the researcher and the participant are positioned by history and context. It, too, seeks social justice and emancipation for women and recognizes that there are multiple knowledges based upon race, class, and gender issues (Olesen, 2000).

Thus, qualitative methodology supported both the goals of the research project and the theoretical frameworks of humanistic psychology, critical theory, and feminist theory that I brought to the research. It was also supportive of the skill set I have developed as a counselor. The reflexivity that qualitative research requires offered me an opportunity for continued personal awareness and growth.

Grounded theory, a type of qualitative research, differs from other types of qualitative research in that its emphasis is upon the development of theory (Merriam, 1998). Early conceptions of grounded theory were based upon positivist underpinnings by assuming an objective external reality and neutral unbiased data collection. In an effort to move more to a mid-ground between positivism and postmodernism, I propose to work within the framework of what Charmaz (2000) termed constructivist grounded theory.

Constructivist grounded theory is more interpretive, looks for what is real for the individual as opposed to what is true, and recognizes that there are multiple realities and multiple viewpoints of those realities (Charmaz, 2000). Because constructivist grounded theory "does not represent a quest to capture a single reality" (Charmaz, 2000, p. 523), the product of constructivist grounded theory is not intended to be reproducible and the results not generalizable. However, the interpretations may "constitute a set of hypotheses and concepts that other researchers can transport to similar research problems and to other substantive fields" (p. 524).

According to Charmaz (2000), "a constructivist approach necessitates a relationship with respondents in which they can cast their stories in their terms. It means

listening to their stories with openness to feeling and experience" (p. 525). A constructivist approach therefore fit well with humanistic psychology.

Given the parameters of constructivist grounded theory, the purpose of the research project, and my own philosophical base and capabilities, narrative inquiry was the most appropriate method for data collection. Narrative inquiry is a research method frequently used in education and the social sciences and is well suited to feminist studies (Riessman, 1993). According to Riessman (1993), narrative inquiry is inherently interdisciplinary. It looks at the meaning that people make of consequential events in their lives and is especially useful when "there has been a breach between ideal and real, self and society" (p. 3). It is a method that works well in feminist studies because in a male-dominated society women often cannot name their experiences. Sharing their experience in dialogue with another woman enables women to make meaning of the experience for themselves and allows participants to come to voice and to have that voice heard and interpreted. According to Deborah Britzman,

> Voice is meaning that resides in the individual and enables that individual to participate in a community. . . . The struggle for voice begins when a person attempts to communicate meaning to someone else. Finding the words, speaking for oneself, and feeling heard by others are all a part of this process. . . . Voice suggests relationships: the individual's relationship to the meaning of her/his experience and hence, to language, and the individual's relationship to the other, since understanding is a social process. (quoted in Connelly & Clandinin, 1990, p. 4; ellipses in Connelly & Clandinin)

Thus narrative inquiry is a methodology supportive of equal power distribution between participant and researcher, the sharing of experience and meaning, and the recognition of the importance of voice in making meaning and in coming to consciousness. And, because culture speaks through an individual's stories (Riessman, 1993), narrative inquiry makes it possible for the researcher to examine gender inequality

and other practices of power. It therefore works well with the theoretical stances of feminism, humanistic psychology, and critical theory.

Human Subjects Approval

The usage of human subjects in this study required the researcher to seek approval. A copy of the letter is included in Appendix C.

Participants

This study investigated the attrition and retention of women from postsecondary engineering programs. The population studied was women who were currently studying engineering at a postsecondary institution, women who had graduated and chosen to work as engineers, and women who graduated from an engineering program but chose to leave the field of engineering. Thus the study embraced the experiences of women who enrolled in engineering as a college major regardless of the outcome of that enrollment. This was a way to maximize the diversity of the participants in order to see the variations in their experiences.

Likewise, in an additional effort to strive for the inclusivity and diversity that are indicative of qualitative research in general and feminist research in particular, this study sought to understand the experiences of women from various colleges and universities as well as women of various ages, races, ethnicities, sexual orientations, and social classes. Participants for the study were recruited by gatekeepers. These gatekeepers were faculty members and advisors of local chapters of Women in Science and Engineering (WISE) and the Society of Women Engineers (SWE).

After introducing myself to the gatekeepers (Appendix D) and securing their commitment to help me locate participants, I provided them with a number of Research

Information Sheets (Appendix E). This sheet was designed to provide potential participants with general information about the research study. My contact information (telephone number and e-mail address) was included on the sheet so that the potential participant could contact me directly if she was interested in volunteering for the study or in receiving more information about the study.

Gatekeepers were located at three postsecondary universities located in the Midwest. Another of the gatekeepers was a writer for the SWE-CRS Midwest edition of the newsletter. My hope was that the gatekeepers would help me find six to eight participants for this study. Through their help, 15 women responded to my request for participants.

When potential participants contacted me by telephone, I responded to their questions with information from the contact script (Appendix F). If they contacted me by e-mail, I e-mailed them a copy of the contact script. Of the 15 women who originally expressed interest in participating in the study, only 7 actually committed to scheduling an interview (the 8th participant was referred to the study by another participant). Each of the women who scheduled an initial appointment continued her participation in the study.

With a group of participants this small, it was important to seek diversity because, as Patton (1990) pointed out, "a small sample of great diversity yields important shared patterns that cut across cases and derive their significance from having emerged out of heterogeneity" (p. 63). The participants in this study met this requirement. They were a diverse group in terms of age, ethnic group, degree attained in engineering, major in engineering, and school of attendance.

Finding women who were currently studying engineering was a relatively straightforward task, but finding women who chose to drop out of engineering programs or who finished engineering programs but chose not to use their engineering degrees proved to be more difficult. A student advisor from the University of Illinois at Chicago sent two e-mailings to women at that campus who had begun school as engineering majors and then switched majors to study in another field. None of these women were interested in participating in this study. However, all of the women who participated in this study knew of women who had dropped out of school, changed major, or changed career. They spoke with their friends to see if any of them would be interested in participating. Only one woman contacted me asking for information. Although she had graduated 4 years earlier, she chose to participate in the study.

Data Collection

Data were collected through one-on-one unstructured interviews with the participants. Because the participants came from several locations, their interviews occurred in varying locations as well. The only parameter for an interview site was that it provide a relatively private area free from distractions.

With the participants' permission, interviews were audiotape recorded. Each participant had three interviews of approximately one hour each. The majority of the data was usually gathered in the first two interview sessions. The third interview session was generally set aside to discuss questions that came up during transcription and interpretation. I also set aside time during the third interview so that I could share my interpretations and insights with the participants. Likewise, each participant was given a

chance to provide me with feedback as well. Finally, the third interview offered an opportunity for closure for both the participants and me.

Interview topics covered the nature of the educational system, teaching methodology, student-faculty relationships, confidence, and peer group relationships, all issues that previous researchers had found to be important factors for retaining women in science, mathematics, and engineering majors. In addition, questions focusing on identity and self-concept, issues that I found to be important to the young woman in my pilot study, were covered as well. In fact, like J in my pilot study, the women frequently spoke on these topics spontaneously. When the topics arose, I encouraged each woman to elaborate on them. If the topics were not spontaneously mentioned, then I asked a probing question in an effort to tap into these areas.

Participants were interviewed not only in a location of their choice but at a time of their choice as well. Although each participant had three interviews, they were free to decide the amount of time between subsequent interviews. Most of the participants chose to meet once a week. At times, there was overlap between participants with one participant completing her interview sequence and one participant just beginning her sequence.

Prior to the start of the first interview, I asked each woman for permission to audiotape the interview sessions. If permission was given, I started the tape recorder and introduced myself. I then reiterated the purpose of the research, read and explained the Letter of Consent (see Appendix G), discussed any questions the participant might have, and requested a signature on the consent form. After receiving written permission, I began the interview itself.

Though I had an interview protocol prepared that corresponded to the conceptual framework that I began with, I opened the initial session with a statement that I was interested in the participant's experiences in engineering and indicated that whatever she felt was important to share of those experiences was of interest to me (see Appendix H). The purpose of beginning the interview in this manner was to establish that the research process was a mutual relationship. During my pilot study, I found that beginning with a formal interview protocol created not only a situation where I was seen as the "leader" of the interview, but also, I believe, removed some of the responsibility for the dialogic relationship from the participant. In addition, opening the interview in this manner allowed me to hear how the participant chose to present her story.

While this was my plan for conducting interviews, there were also times when it was difficult for the woman to know exactly how or where she wanted to begin her story. When that happened, I suggested that a possible place to start would be with what led her to choose engineering as a field of study. Questions I covered and prompts that I used to elicit further comments when the participant was having difficulty with an unstructured interview format are located in Appendix I. Therefore, while my plan was to cover all questions in the interview protocol, I preferred that the questions flow from the dialogue and not from the format.

At the conclusion of each interview I asked the participant how she felt about the session and if she had any questions. We then selected another interview time and location. Because the interview process sometimes stirred up forgotten thoughts and memories, I suggested that the participant jot down these thoughts and memories to share in the following interview session. Although I did not anticipate that the women I

interviewed would be at risk for trauma because of their participation in this study, I continuously watched for signs of discomfort and stress during the interviews.

At the conclusion of each interview, I wrote field notes in order to capture my own thoughts, feelings, and impressions of the interview and the participant. My goal was to transcribe and tentatively analyze each participant's interview between interviews, but this was not always possible due to time constraints. If transcription was not possible before the succeeding interview, I listened to the tape and took notes, paying special attention to themes and word usage. This allowed me to become familiar with the content of the session and to formulate additional questions or identify additional areas of interest for exploration so I was prepared for the following interview session.

For the second interview, it was not necessary to deal with the consent form or to request permission to record the interviews, but otherwise the second interview was much like the first interview, with the participant choosing the topics she wanted to talk about and deciding what she wanted to share. The third session was somewhat different. During the last interview session I summed up for each participant my impressions of her experiences and the meaning it appeared that she had given to those experiences. In addition, I pointed out the issues that I thought each woman was currently dealing with in her life. I sought participant reaction to my interpretation and worked to identify any gaps that occurred with her acceptance of these interpretations. In this way I tried to offer a sense of closure to the participants and generally assess their psychological state at the conclusion of the interview process.

Merriam (1998) noted that "one of the assumptions underlying qualitative research is that reality is holistic, multidimensional, and ever-changing; it is not a single,

fixed, objective phenomenon waiting to be discovered, observed, and measured as in quantitative research" (p. 202). Discussions of issues of validity and reliability are therefore inappropriate. In fact, "it is important not to squeeze the language of narrative criteria into a language created for other forms of research. The language and criteria for the conduct of narrative inquiry are under development in the research community" (Clandinin & Connelly, 1990, p. 7). So instead of reliability, validity, and generalizability, I strove for plausibility, authenticity (Clandinin & Connelly, 2000), and transferability (Lincoln & Guba, 1985) as ways to evaluate this research.

Reflexivity, multiple interviews, and member checks were methods I used to establish plausibility in this research project. Clearly delineating my theoretical base and assumptions was a method to establish the study's authenticity; maximizing the diversity of the participants and creating an audit trail were additional ways to bolster authenticity. Finally, by using the words of the participants themselves, I hoped to invite the reader into the process of meaning making so that she or he can comprehend the basis for resultant interpretations. This, too, will add veracity to the study. If the research has been firmly grounded in plausibility and authenticity, then it should ring true with the reader and there should be consensus that the interpretations I made fit comfortably with the data and thus provide a basis for transferability.

Data Analysis

"Grounded theory is an iterative process by which the analyst becomes more and more 'grounded' in the data and develops increasingly richer concepts and models of how the phenomenon being studied really works" (Ryan & Bernard, 2000, p. 783). Although this research study was not "pure" grounded theory, I nonetheless

conceptualized it, too, as an iterative process. Or, as Huberman and Miles (1998) viewed the process, it is interactive with the components of data reduction, data collection, and data display continuously occurring and affecting the interpretations made from the data.

According to Ryan and Bernard (2000), the themes in grounded theory are often fuzzy and abstract and emerge before, during, and after data are collected. Prior to beginning the research, themes are induced from the literature review and from work with a pilot study; during the research process itself themes are induced from analysis of the data. As the researcher listens to the stories that are shared during the interview and begins to note her own reactions and feelings about what she is hearing, she begins to analyze her data. This analysis continues with writing field notes shortly after the completion of each interview session.

Formal data analysis begins after transcription of the data. At this time, a line-by-line reading is done of the interview to familiarize oneself with what is in the data. It is during this reading that the researcher begins to note attitudes, tone, themes, actions, assumptions, and consequences (Ryan & Bernard, 2000) as well as character, place, scene, plot, tension, end point, narrator, context, and tone (Clandinin & Connelly, 2000). Notes are written in the margins to underline ideas and thoughts that the researcher may have as well as to mark particular areas where a facial expression or a gesture, something unaccounted for by the transcription itself, may have occurred.

Data are then coded. According to Miles and Huberman (1994) "codes are tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study" (p. 56). Chunks of data, that is, words, phrases, sentences, or

paragraphs, are assigned codes or given meaning. It is this coding that allows for the categorization and retrieval of data.

Initial themes for this research followed the themes that surfaced during the literature review. In my review of the literature, there were five factors that researchers consistently identified as important in the persistence and attrition of women in engineering majors. These five factors were the nature of the educational system, teaching methodology, student-faculty relationships, confidence levels, and a gendered peer group. In addition, during my pilot study the themes of search for identity and search for connection also emerged. Thus, I used these seven categories as a beginning rubric for coding and reducing the data.

The interviews I had with the participants of this study produced approximately 1,000 pages of transcribed notes. As I read through the transcriptions, I made note of the stories that were shared and the themes that were discussed. Word usage, tone, and attitude were aspects of the interviews that I focused on as well.

I spent many hours working with the transcriptions, reading them over, and writing thoughts and notes in the margins. Immersion in the data was an important aspect of the data analysis. Continuous exposure to the transcriptions made it possible for me to recognize the themes and issues that the women discussed in their interviews.

I began analyzing the data by chunking it into categories or themes. This led to the creation of approximately 40 categories. Closer inspection of the data allowed me to begin to reduce the number of categories by discarding some of them completely because of their lack of relevance to this study. Others were subsumed into new categories. Finally, I reduced the data to five themes that I feel represented what the women in this

study shared with me in terms of their experiences in engineering programs. These five themes were lack of acceptance, gender estrangement, inappropriate acceptance of responsibility, gender affiliation, and identity synthesis.

According to Miles and Huberman (1994), data analysis leads to the drawing of conclusions and the verification of those conclusions. In narrative inquiry that analysis may be based either upon themes found in the lives of each participant or on overarching categories found in the lives of all participants (Clandinin & Connelly, 2000). Analysis is dependent upon the data and their presentation. Verification lies partly with the participants and partly with the words of the participants. Thus it was my job to gather, listen, and, as Denzin and Lincoln (2000) said, become a "bricoleur," a jack of all trades, one whose solution or bricolage is emergent and takes new forms as different tools, methods, and techniques of representation are used. The interpretive practices that I used in this study were not set in advance, for in narrative research the "choice of research practices depends upon the questions that are asked, and the questions depend on their contexts" (Nelson, Treichler, & Grossberg, 1992, p. 2). Ultimately it was the data that determined the final methods of data analysis that were used in this study.

Researcher Perspective

My father was a mechanical engineer who loved taking things apart and seeing how they worked. I inherited my dad's interest in how things work, and my parents made certain that as a child I had access to mechanical and scientific toys to support my curiosity in these areas. As I grew older, my parents also encouraged me in advanced math and science, making certain that I had a strong academic foundation that would allow me to maximize my future educational choices. When it came time for college,

however, I did not consider majoring in engineering. I saw it as a "non-choice" because I saw it as a "non-field" for women. My father was especially sad to see me select another field of study, but he didn't push me towards engineering. I think he understood how difficult the selection of that major would have been for a woman.

Instead of studying engineering, I chose to study psychology and then continued to graduate school to study counseling and guidance. I have spent my career working at institutions of higher education in the United States and abroad. Within these institutions I have watched women struggle for acceptance and a place within a system of higher education that is often gender biased.

My decision not to major in engineering was based largely on my perception of the inhospitable nature of engineering relative to women. Over the past 30 years this perception has not changed. I still believe that engineering classrooms are unwelcoming to women, that the curriculum is male-oriented, and that faculty expect women to adapt to the status quo. In addition, I believe that it is likely that the failure of female students to graduate in engineering is viewed by the women more in terms of personal failure than in terms of flaws in an established educational system designed by White males to educate White males.

It is obvious that I brought personal bias to this research project. Narrative inquiry does not strive for objectivity. Indeed, much of its appeal to me was that it is subjective. My purpose in sharing my own perspective is, as Josselson and Lieblich (2003) advocated, to share what motivated the research and to decrease the possibility that these biases were projected onto the participants. Because narrative research is also about the researcher using herself as a tool in the research, sharing my personal perspective was a

way to begin to reflect upon my role in the research process. It was a beginning step down a path that led to personal growth and self-awareness both for myself and for at least some of the women who participated in this study with me.

CHAPTER 4

FINDINGS

In the mid-1980s, research indicated that there was a 20-year decline in women's enrollment in science, mathematics, and engineering curricula, and that the persistence rates for those women who did major in SME fields was considerably lower than the persistence rates for men (Seymour, 2002). This began a spate of research relative to women in SME in an effort to try to understand the dynamics behind both the decline in women's enrollment and in their low rate of persistence. With the emergence of feminist epistemologies during this same period, feminism became integrated into the work of feminist educators (Brickhouse, 2001). The goal of feminist research was to liberate women by unraveling the web of oppressions that bound them and then reweaving the web of society to make it less oppressive, more inclusive (Alcoff & Potter, 1993).

The Present Study

Feminist researchers began to address the theories and practices of both science and technology using approaches that they had been developing in the humanities, social sciences, and, particularly, in the feminist movement (Harding, 1991). These researchers looked at women as an oppressed group and rejected the idea that the process of knowing was universal. Instead, they proposed that knowing must take into account the social and historical context of the knower herself (Alcoff & Potter). With these theoretical assumptions in place, feminist researchers began to look at the issue of women's success

in SME as a function of both gender and equity. The research that resulted pointed to a number of factors that appeared to impact a woman's success in SME.

Factors that were frequently identified as having an impact on women's success in science, mathematics, and engineering were nature of the educational system, teaching methodology, student-faculty relationships, confidence level, and a gendered peer group. However, although these factors have been identified as influencing female persistence in SME and although colleges and universities have developed programs to address these issues, the attrition of women from SME fields continued to remain high relative to those for men. Despite the amount of research that has been done on women's retention in SME, and despite the fact that the National Science Foundation has funded initiatives to retain women who declare SME majors, it is apparent that we have yet to fully understand the dynamics of women in SME fields.

The purpose of this study was to investigate women's experiences in postsecondary engineering programs in order to understand how those experiences impacted women's persistence in and attrition from these programs. Previous research on women's retention in SME has often been extremely localized (Dietz et al., 2002) and the research methodology has traditionally been quantitative (Hyde & Gess-Newsome, 1999). Most important, however, is that research on women's retention in SME has focused on a conglomerate SME population and has rarely considered gender from a feminist perspective, where gender is conceptualized as socially constructed and historically defined.

This study used qualitative research methodology, in particular narrative inquiry, to look at the stories that women shared about their experiences. In addition, instead of

focusing on the experiences of an aggregate SME group, this study used only the experiences of women in engineering programs, the worst-case scenario in SME in terms of attrition and retention. This study also sought stories from a diverse group of women from several colleges and universities as opposed to the more localized studies that have previously been carried out. Finally, the theoretical frameworks of humanistic psychology, critical theory, and feminist standpoint theory offered a unique perspective for framing women's experiences in engineering.

The results of this research study were, for the most part, supportive of findings from previous research. The goal of narrative inquiry is not to generate theory but to look at the experience of the individual; nevertheless, the results from this study may provide researchers with a new way to begin to conceptualize the issues women face as a marginalized group in engineering in particular, and in science and mathematics as well. Perhaps then it will be possible to develop interventions that halt the decline of women in SME fields.

Dawn, Sarah, Carol, Blanche, Phoenix, Maggie, Jenna, and Mandy (pseudonyms for the eight women who participated in this study) comprise a diverse group ranging in age from 19 to 27 years old. Two of the women were Asian exchange students and one was African-American. Four of the women were currently in school; three had recently graduated—one with a bachelor's degree, one with a master's, and one with a Ph.D. Two of the women studied mechanical engineering; two, electrical engineering; one, chemical engineering; one, aerospace engineering; and one, architectural engineering. Three women were affiliated with a state school in a major Midwestern city and four with a private school in the same city. The last was a student a state school in a nearby state.

Because the women selected the sites for our meetings, we had interviews in some unusual locations: student centers, coffee shops, train stations, restaurants, and the front seat of my car. We shared sushi and Cokes and coffee and frappuccinos and talked about what it was like to be a woman studying engineering. All of the women were thoughtful and open as they tried to articulate their experiences and identify the feelings that resulted from those experiences. It was not an easy journey for any of us. There was often dissonance between a woman's perceived feelings and the words she used to describe those feelings. Together we tried to address the discrepancies so that each woman could come to a clearer understanding of what she was expressing. This opened the door to begin to reframe those experiences in a way that was more meaningful for the participants. We delved into all sorts of experiences and memories, and each of the women was as open as she was able to be with me. Volunteering was an act of courage for each of them. I came to care about and respect each of them and was sorry when our interviews were completed.

Factors Influencing Retention

I began this study with an idea of the areas I hoped to tap into during the interviews. The areas were identified after a review of the literature and after a pilot study I conducted in the fall of 2003 as described in Chapter 3 (see Appendix B). Questions in the interview protocol were designed to elicit information relative to the seven areas or factors. The factors that were identified by previous research were nature of the educational system, teaching methodology, student-faculty relationships, confidence level, and a gendered peer group. In the following sections each quotation is identified by participant, interview session (I, II, or III), and transcription line number.

Nature of the Educational System

Feminists see the current post-secondary educational system as one that exclusively supports the socialization of middle-class White males (Ramirez et al., 1999; Seymour, 1995). Feminists theorize that because women are excluded from and lack understanding of this socialization process, they are at a distinct disadvantage in terms of this postsecondary educational system (Seymour, 1995). Further, feminists view science as a male-created field, one that has traditionally been closed to women both as participants (scientists) and as subjects of study (Wyer, Barbercheck, Giesman, Ozturk, & Wayne, 2001).

Zuga (1999) stated that we must create alternative and more inclusive ways to approach the teaching of science and engineering to benefit both women and men. She also advocated changing the value, the purpose, and the way science is taught. Alper (1993) stated that curriculum must be made relevant to women's lives in terms of both content and teaching methodology.

The women who participated in this study were almost unanimous in their call for relevancy in the curriculum. As Carol (I, 23) said,

> I think there should have been more of an emphasis in class on societal implications of what we were doing, of the benefit and why it was important.... Maybe a small shift in focus would really be beneficial for people who want to go into a profession where they can help people and don't immediately see beyond the obvious things like medicine. (Carol, I, 23)

Teaching Methodology

Feminist researchers have also pointed to incompatible teaching styles as a factor that works against women in SME. According to Belenky et al. (1986), even if course content were restructured to be more relevant to women, there would still be a disconnect

for women because of teaching styles that do not thoroughly explain the concepts being introduced or that allow women the opportunity to learn collaboratively.

Teaching methodology was a topic that every woman in this study addressed. Whether in her second year of study or her ninth year of study, the women unanimously found teaching methodology lacking in their courses. Phoenix, in particular, was very clear about what she needed from a professor. "There's no story. He just starts teaching. . . .He shows us equations without saying why this situation exists. That's what I want to know when I come to class" (Phoenix, I, 17). Mandy and Maggie both addressed the organization of their classes: "He jumped a lot and I don't think he fully answered most of the questions and the fact that he was reading from his notes didn't help that much" (Mandy II, 8). Similarly, Maggie said, "I can't stand the way he lectures because he'll literally write on three different sides of the board about one problem and he goes directly from the book. I could go through the book and be more organized than he is" (Maggie, III, 18).

However, whereas the women commented on teaching methodology on many fronts, collaborative learning was not a topic that they specifically addressed. For example, while both Phoenix and Blanche expressed how they liked to learn in the lab, it appeared that this learning was more a function of the hands-on aspect than of collaborative learning per se. In fact, I quite often heard that learning in the engineering program was a lonely task because understanding concepts, working problems, and grasping what approach to take to solve a problem were, in fact, tasks that needed to be done alone. "The material, you pretty much have to learn it on your own. Nobody can put it in your brain for you" (Dawn, I, 14).

Student-Faculty Relationships

Research since the-mid 1980s has consistently indicated the importance of the student-faculty relationship for the success of both women and men. In terms of female persistence in particular, Seymour (1995), Nora et al. (1996), and Hyde & Gesse-Newsome (1999) all found that interaction with faculty was important to women. The women in this study, too, consistently mentioned the importance of faculty relationships.

> I think one of the problems in retention, maybe even with male students, but maybe particularly with female students, is that you need one of those experiences with a really good professor that gets you interested in something. I had a professor that got me really interested in heat transfer and he's probably one of the reasons why I stayed. (Sarah, II, 9)

The women reported that the student-faculty relationships could have the opposite effect as well. "I was very shy and definitely the way I saw the teacher and student relationship did not help, the way I saw that if you're not a good student, you're wasting their time" (Mandy, I, 12).

Confidence

Many researchers (Hughes, 2002; Hyde & Gess-Newsome, 1999; Seymour, 1995; Wilder et al., 1985) have addressed the issue of confidence in ability as a factor that appears to impact women in terms of their persistence. Klawe and Levenson (1995) theorized that women experience isolation, powerlessness, and exclusion in SME majors. This leads them to blame themselves, which in turn leads to a loss of confidence.

Like other research, this study, too, supported the idea that loss of confidence is an issue for women in engineering programs. And, as Klawe and Levenson (1995) theorized, the loss of confidence seemed to be a result of exclusion and powerlessness. In addition, estrangement from themselves and their own unique perspective further

exacerbate the situation. As Phoenix said, "I'm kind of not as good as them [the male students] and it makes me feel uncomfortable because I try very hard to do good things in what I choose. But they seem like they naturally have the mind for engineering and it's hard for me to gain confidence in myself" (Phoenix, I, 12).

Gendered Peer Group

For previous researchers the presence of a gendered peer group was deemed important as a factor in the retention of women in SME majors. In particular, Hyde and Gess-Newsome (1999) found that development of a gendered peer group served as a support network for academic and emotional issues. In this study four of the women specifically identified a gendered peer group as an important factor for them. As Dawn said, "That would have been beneficial, too, to have any friend, any really good friend that was in the major that knows what you're going through and understands how hard you have to study for this major" (Dawn, I, 19).

Emergent Interpretive Themes

Though the women in this study did, indeed, address all of the areas that previous research identified as important, as I listened to their experiences it seemed that those issues were subsumed into larger themes that were more relevant to the stories that they were sharing. These larger themes—acceptance, estrangement, acceptance of responsibility, affiliation, and identity—became the basis for interpreting the experiences that the women shared with me and for understanding the impact of these experiences upon them as well.

Acceptance

A recurring theme addressed by all of the women was that of acceptance. Acceptance is a theme that addresses the reception that women receive from other students, in particular male students, in the engineering program. It also addresses the reception receive by women from the engineering faculty. Succinctly, acceptance is the feeling that one belongs, that one is entitled to be in the class, the program. It indicates inclusivity as opposed to exclusivity.

Most of the women in this study conceptualized acceptance as being welcomed in the classrooms, labs, and study groups, and being respected for their capability with the subject matter. What was interesting, however, was how each woman interpreted the manifestation of that acceptance. For example, for Jenna acceptance was defined simply as people saying hello to her. For Dawn, it was men in the program listening to what she had to say.

Although it was not verbalized as such, it appeared that the true issue with acceptance was, in fact, the lack of acceptance that was encountered. But it seemed important to the women to approach the issue from the perspective of how much they were accepted as opposed to how little they were accepted. It was an extremely important theme for all of the women.

Gender Estrangement

Estrangement is an interpretive theme that I gradually became aware of during the process of the interviews. As I listened to their stories, I recognized that each of the women had grappled with how to fit into a major where she was not only in the minority

but where she sometimes experienced outright discrimination as well. The women appeared either to deny or to lack awareness of their degree of exclusion.

Their response to exclusion was to attempt to fit into the educational system. This led not only to estrangement from other women, gender estrangement, but also to estrangement from themselves as women as well. Thus it was common for women to have only male friends and to think of themselves as "one of the guys." Further, it did not appear that the women recognized their issues of gender estrangement.

Acceptance of Responsibility

By choosing to major in engineering, the women I spoke with located themselves in a social system that in many instances did not welcome or support them. Rather than blaming the system, however, the women inappropriately accepted responsibility for the problems they encountered in engineering. That is, they accepted as "their fault" problems with their learning style and with the perspectives that they brought to the classroom. Other areas where they inappropriately accepted responsibility were with their inability to connect with the subject matter, with their questioning of the meaning of engineering, and with their inability to achieve acceptance from people connected to the engineering program (i.e., faculty and other students). Inappropriate acceptance of personal responsibility occurred for each of these women and it seemed to have been a coping mechanism that was a necessary element for survival in the engineering curriculum.

Release of Responsibility

Many of the women in this study seemed to arrive at a point where they could begin to reevaluate the "fault" that they had accepted for the difficulties that they had

experienced in their engineering programs. This reevaluation led them to question their assumption of responsibility and seemed to give them an opportunity to look at issues with a different perspective, one that dared to conceive of fault as lying outside of the woman herself. Release of responsibility seemed to be liberating and indicative of personal growth.

Gender Affiliation

Affiliation was a theme that I was very pleased to see emerging from the data for some of the women. Affiliation is the ability to begin developing identification and connection or relationship with other women. It can also be conceptualized as the "flip side" of gender estrangement, as a moving away from gender estrangement. For many of the women, identification manifested itself as an ability to begin to form close relationships with women both inside and outside of the field of engineering. It also seemed to lead to the potential for a woman to recognize herself as a woman and to begin to explore the meaning of that for herself. Many of the women were coping with issues in this area; however, it seemed as if this struggle was "okay" to them because they saw themselves as part of a larger group—women.

Identity Synthesis

The last interpretive theme that emerged from the data was that of identity synthesis. Identity synthesis is pulling together aspects of the self into a cohesive whole. Part of this synthesis was likely attributable to the age of the participants and to the life stage they are in. But there appeared to be an aspect of identity synthesis that occurred as a result of navigating the engineering social system to a point where a woman felt that success was within her grasp and that it was achievable. This feeling seemed to allow a

woman to move forward and to begin to consider who she is and what she wants and needs apart from the social system that exists in engineering.

Lack of acceptance, gender estrangement, inappropriate acceptance of responsibility, gender affiliation, and identity synthesis are the interpretive themes that emerged during the interview process. While talking with these eight women, I found that although their stories were different, their feelings about their experiences in engineering programs were often very similar. What follows are their stories. I begin with Jenna, the youngest woman I interviewed.

Jenna

Jenna was a 19-year-old woman just beginning her second year in architectural engineering, a branch of civil engineering. She was approximately 5' 8" tall with a slim build and beautiful skin. She wore her dark brown hair at shoulder length, with short bangs that barely reached her forehead. During our first meeting she wore mid-calf length white socks, strapped sandals, loose blue jean shorts, and a blue tee shirt. On the front of the tee shirt was a stick figure pushing a canoe with the saying "I'd rather be canoeing" on the front. She wore no makeup, and other than a black, leather banded watch, she wore no jewelry. Overall, she seemed fiercely androgynous.

Jenna was extremely nervous when we first met. She spoke loudly and very, very rapidly, as if in a rush to share her story. In fact, she began so quickly that we didn't have the chance to sit down, sign the consent form, or turn on the tape recorders. She simply burst forth with words. Her candor, her courage, and her lack of guile were amazing.

Born and raised in a mid-sized community in the central part of Wisconsin, Jenna was the middle of three children. Her father was a chemical engineer; her mother was a

homemaker with a degree in chemistry; her older sister was a biostatistician working for a major medical facility; and her younger brother was in high school. Jenna described her family as blunt.

> I mean if we say we want something, we want something. Generally, we're not trying to hide what we want in layers of misdirection and asking for things indirectly. Some people think we're kind of mean to each other. We're blunt. We always have been. (Jenna, II, 13)

School was not a good experience for Jenna. Although she was in an enrichment program in elementary school, it did not meet either her academic or social needs. Not only was she set apart from the majority of other students but also she had no friends, either male or female, in the enrichment program. Jenna's parents eventually moved her to a parochial school in the hopes that she would be more socially accepted there, but she was not.

> I've been a target for a long time. I know I was. Then I switched schools in sixth grade because it was getting so bad, Mom said, "We're getting you out of this school." But the only thing I really learned switching schools was that in the parochial school system the kids were absolutely no different, except now they had a superiority complex. They thought they were better because their parents could afford a private school. That's a great learning experience. I also know at that time I was having problems just trusting anybody. I didn't want to talk to anybody. I had too much of this and my mom told me that she'd been called in by the school administration going "Your kid's not fitting in here." It's like . . . no, duh! (Jenna, III, 14)

Things did not improve for Jenna in high school. She was still ostracized and did not feel that she belonged. "Most of the guys who talked to me then were guys who noticed that I was superintelligent. They thought this was funny or they liked harassing me or stuff like that. So I really didn't have friends in high school. It didn't happen" (Jenna, I, 21). Not only did Jenna have difficulties socially but she also found that her high school classes were slow and boring even though she took AP classes. "I was never

very challenged in high school. I was BORED through most of high school" (Jenna, I, 10).

It wasn't until she went to math, science, and engineering (MSE) camp that Jenna found that there were people who were interested in the things she was interested in and who accepted her for who she was.

> I had always been sitting there hoping there's going to be a group somewhere. I just have got to find it, and it doesn't seem to be at my high school. So, if I could find this group of techy, nerdy people. . . . I'm hoping there's this group out there somewhere that I will get along with and I was never totally sure. And I got to MSE summer camp and I, for the first time, did find people like that. And it was amazing because now it's no longer I'm hoping college will be better, it's going to be better. I know it's got to be. Just look at this one little camp. And that was great. I really liked that. (Jenna, I, 21)

Jenna was currently in her second year of college. She selected a small, technical school located in a major Midwestern city. She chose it because of its size, because it offered the architectural engineering she was interested in studying, because she liked the school, and because "they offered me a lot of money" (Jenna, I, 5). She was very happy with her choice.

Like the majority of the other women I interviewed, Jenna felt that engineering was accepting of women if they demonstrated that they were competent.

> I have not noticed any problems. I mean if any of them have any problems all you've got to do is say, "Hey, can I be a part of this?" If you show that you're also competent, show that you know what you're doing, that you're interested and you're awake, everything usually fixes itself. (Jenna, II, 23)

> I don't think if you're capable and you're a female, you're gonna be discriminated against, horribly. I mean there might always be a couple of people who say I don't like you because of this, but. . . . (Jenna, III, 7)

In contrast with her elementary and high school days, college had been an exciting, positive experience for Jenna and she was extremely happy.

> When I stop and think, it's so much better. These things that I've wanted are here. When the weeks are passing and I can't remember them . . . . It's horrible that I'm losing this great time, but on the other hand it means I'm finally, I'm really, really enjoying myself. I'm throwing myself into what I really want to do. This is all I have. This is where I want to be. And it's really hard that I'm supposed to pick a major and I'm supposed to think about jobs. I just wanted to get here. And then I'm here and I've got people that I trust. I have people I sit there and talk to at lunch every day and I care what happens to them. I'm being challenged, and I'm learning things. I'm going at my own pace and everything is so many, many times better. . . . I'm realizing after the first couple weeks that I've got people who I'm seeing constantly and people are waving hello and I mean it was almost euphoric in some way. This is great! (Jenna, III, 18)

In terms of estrangement, Jenna's course of development was somewhat different than the other women I spoke with. For her, gender estrangement began in elementary school. She never had close girlfriends nor had she ever thought of herself as a girl or woman. When I asked if she saw herself as a woman, she replied,

> I see myself as me. I don't think of girl, woman, whatever. I'm me doing my own thing. I have problems labeling myself as far as . . . . What's it matter? I'm just me. I'm doing my stuff. I'm at school; I'm taking classes. I'm enjoying myself. What's it matter? It's not important. (Jenna, II, 16)

The fact that Jenna has been able to meet people and develop friendships for perhaps the first time in her life has been a very positive experience for her. She currently had three very good friends at school, all of whom were male. She arranged her living situation this year so that she would be housed in the same dormitory one flight away on a "female floor" (Jenna, I, 18). The friends visited each other between floors and typically ate dinner together in the evening. Jenna did homework immediately after dinner, but when she was finished studying, she typically phoned her friends to see if they, too, were done with studying. If they were, she would often play video games with them or watch a short movie.

Jenna's roommate was a student from Korea. As Jenna said, "I basically got randomly paired with the one other leftover kind of kid" (Jenna, I, 18). They seemed to have a mutual respect for each other, but there appeared to be little in the way of friendship between them at the time of the interview, only a few weeks into the semester. In fact, Jenna seemed to have wariness about developing relationships with other women.

> I get along with the male personality a lot better. In general I find that the guys tend to be a little more logical. I've had problems where gals misinterpret things and then snap at you and hold grudges, but don't actually tell you anything's wrong! I really hate that because I don't pick it up. All I know is suddenly someone's snapping at me. I'm very male brained. I also think a lot more towards the guy spectrum and it's got some limitations, but it's what I have and I like it. They're a little more blunt; maybe they don't try and hide things so much. They aren't gossipy. I don't just sit and listen to them talking about makeup and stuff like that. It always seems like guys are analyzing you less and measuring you up less. A lot of the gals it seems are trying to sit there and vie for something and most of the guys they'll just accept you as who you are. The guys I'm friends with are fairly easy-going, semi-blind, techy people. They don't notice the little dumb things that other people might be afraid of. They just don't care and don't notice a lot of things. They're gonna like you for your personality and for who you are and what you know. I just found that I get along with them easier. (Jenna, I, 20)

An area that Jenna has begun to look at in the last year or so has been her identity in general, and, in particular, her identity as a woman. Like most 19-year-olds, Jenna seemed to relish being away from home and being able to make some of her own decisions, and many of her identity issues were typical for her age group. She was also learning about love and her place in a relationship as a woman with a man.

> We were talking and then he hit me with a shot out of the dark and said, "I'm attracted to you." It's still confusing to me in many ways because I didn't expect that. I mean, it was bad enough trying to get friends. I never expected anything more than that and really, I never really wanted to end up as someone who lives alone for their entire life. On the other hand, I really couldn't see any other options but that. (Jenna, II, 17)

Not only was Jenna trying to come to terms with being seen as a desirable woman, but she was also working to conceive of herself in this way as well. She seemed

to have thought of herself as "math-science," as more male than female. In fact, she referred to herself and all women as "gals," sort of an androgynous term. And, she referred to her boyfriend as a "kid," again a nonsexual, androgynous term.

For Jenna, the youngest of the women I interviewed, social life had just begun. During one of our interviews I referred to her as Sleeping Beauty. It's as if she had awakened to find herself in a new world, one where she was accepted and one where a man had expressed his interest in her.

At this point in her college career, Jenna was very happy. She felt accepted by the other students and by the faculty in the engineering department. She enjoyed the material that she was learning and the speed with which it was presented. She was reveling in her small group of friends and acquaintances.

Jenna's perception of her social and academic acceptance in college had allowed her to begin addressing themes of estrangement, particularly estrangement from herself as a woman. During our interviews, we talked about this gender estrangement and it appeared to be a theme that interested her very much. The awareness of her estrangement from herself as a woman and permission to think of herself as a woman seemed very important to her. In fact, she asked for the transcription of our last interview in order to remember the themes we discussed.

Maggie

Maggie was 21 years old and had just begun her third year of study in aerospace engineering. She selected her private school because of its small size, because it offered the aerospace engineering curriculum she was looking for, and because it had a diving team. Maggie was a native of Colorado, disliked the big city, and planned to return to her

home state "the second I graduate" (Maggie, I, 11). Maggie received word of this study from her local Women in Science and Engineering (WISE) chapter and volunteered to participate mainly because of my affiliation with Colorado State University.

Maggie was perhaps 5' 2" tall, with blonde hair that she wore clipped at the back of her head with a barrette. She wore no makeup but dressed stylishly in short cutoffs, a black tee shirt with a belt, and sandals. She was of medium build and muscular, tanned, and toned. She definitely gave off the air of an athlete.

Maggie came from a family of four. Her mother was a second grade teacher who received her degree while Maggie was in middle school. Her father had completed high school; her older brother was an engineer. Maggie appeared to be very close to her mother and her brother at this point in her life, and, while she was close to her father when she was younger, she has drifted apart from him in recent years because of some of his belief systems.

Of the women I interviewed, Maggie was the only one who gave the impression of having selected engineering as a default career. "I don't think I can do anything else. I really am not good at writing. I think I'm a pretty good people person, but I don't think that that would work out so well for me" (Maggie, I, 5). Although she spent time with her mother and brother selecting colleges that she felt would be appropriate, she really did not have much of an idea of what aerospace engineering was all about. "I knew it had to do with planes and spacecraft stuff, so I figured it'd be interesting" (Maggie, I, 2). She seemed rather vague in terms of her future goals. "I don't really know. I just want to get a job, and I'd basically be happy with anything, I think. I like crunching numbers and I like

designing stuff" (Maggie, I, 2). Maggie said that the school had been a good fit for her; she was doing well in her classes and was enjoying them.

Maggie was obviously well known and well liked on campus, the social butterfly of the women I spoke with. As we walked through the Student Center, women would greet her with a wave or a hug. Maggie was also the woman who was most aware of the school culture and vocabulary. She did not seem to be aware of how much she had her finger on the pulse of the campus.

Maggie described herself as "mid-pack" (Maggie, II, 17) in terms of her ability and grasp of the material and she had found that acceptance by male students in her program had more to do with "an intellectual level rather than any male-female thing" (Maggie, II, 17). She felt that "a lot of the guys are pretty understanding, but if you get to the point where you're just not learning anything or not trying, they give up on you and don't study with you" (Maggie, I, 21). When asked if physical appearance mattered in terms of the amount of support and acceptance she thinks women receive, she said that she did not think it would be a "huge deal" but that it "would be maybe a little harder to get a study person. But, if they realize that you're smart and willing to study with people, that would be fine" (Maggie, I, 21).

In terms of how she felt the faculty accept women, Maggie said that there were certain faculty who seemed to have the attitude that "women don't belong in engineering, period" (Maggie, I, 23). When pressed, she said that those faculty that she was aware of tended to be older, in their 60s, and foreign born. According to Maggie, not all faculty in this category had issues with women in engineering, but those that did have issues tended

to fall into this category. Her method of coping with this situation was to avoid taking courses from those faculty members.

Although she had experienced gender estrangement issues while in college, Maggie seemed to have made progress resolving those issues both in terms of her estrangement from other women and in terms of her estrangement from her own identity as a woman. Maggie described herself as having been tomboyish most of her life.

> It's so easy to hang out with the guys. I've always been one of the guys, not just a girl hanging out with the guys. I think that helps a lot. They don't see you as so much a girl or like a dating prospect. They see you as one of the guys, which makes it a lot easier to hang out with them and not have to worry about stuff like that. (Maggie, II, 5)

During her first year on campus, Maggie lived in the dorms, an experience she disliked. As a result, during her sophomore year she made arrangements to share a double apartment with five men. Several of the men were friends of her boyfriend, who lived in a fraternity house on campus. Like her living arrangement the previous year, however, this one, too, was less than ideal.

> It worked really well first semester and then the guy that I originally [arranged to move in with] dropped out of school. And then another one of the guys said that I couldn't borrow his car anymore and so I had only one other guy that I could borrow his car. I just felt really that they felt I was "mega bitch" 'cause I asked them to clean. So it was really awkward for awhile. I mean I felt I politely asked them to clean and they would put that on me so it got really disgusting. The cleanliness, it was really, really bad. (Maggie, I, 11)

In addition to the issues of transportation and cleanliness, when her grandfather passed away during the school year, Maggie found that she needed emotional support that she did not think her male roommates could or would provide her.

> I think when I was going through the stuff with my grandfather I realized that I really needed girlfriends to be able to go talk to. It was a big part of it. I mean it's hard to cry on someone's shoulder when they don't have that much sympathy and you're worried about if they really want to be there for you to cry on their

> shoulder. I was friends with them, but they weren't people that I would talk to about personal stuff. (Maggie, II, 23)

During this same period Maggie and her boyfriend were fighting quite a lot and, even though he offered her emotional support, she found that she still needed something more. About three fourths of the way through her sophomore year, she pledged a sorority. "Then, I definitely felt like I had a place to be and that I'd be fine. . . . I feel like I'm more comfortable there. I guess part of that is I feel like I've found a place where I belong" (Maggie, I, 24).

The death of her beloved grandfather and the difficulties that she was having with her roommates and her boyfriend created a situation where Maggie came to reevaluate her relationships and her needs within her relationships. She left her apartment with its 5 male roommates and joined a sorority composed of 25 women. Shortly thereafter she ended her 2-year relationship with her boyfriend.

Maggie now seemed focused on working toward gender affiliation and identification. She still had a tendency to "hang out with the guys" (Maggie I, 8) because at social events "the girls and the guys tend to separate, and I tend to feel kind of torn because I am really good friends with the girls, but I also like to hang out with the guys. So I tend to go back and forth" (Maggie, I, 8-9).

Although she seemed to have moved more toward gender affiliation in the social realm, she still seemed to prefer males in terms of the educational realm. "I think I relate myself more to the guys in my classes than I do to the girls in any of my classes. I don't know very many of the girls in my classes and those I do know I don't hang out with very much" (Maggie, II, 15). However, she did seem to have made a significant amount of progress in terms of having women as friends and in terms of recognizing her need for

women as friends. In fact, when I asked if there were anything that would have put her in a better position for being successful at college, Maggie answered that being able to talk with girls would have been helpful. "I would have made a lot more girlfriends when I started out and I think that's a really nice aspect that I didn't have my first two years" (Maggie, II, 22).

In terms of issues of responsibility, Maggie accepted responsibility for creating situations that led to relationship miscues with males. She found that her appearance initially helped her become acquainted with males in the program, but it also "tends to get me in trouble. Like as far as them thinking more of me than just a friend. I mean that kind of gets in the way of getting stuff done" (Maggie, I, 22). For although men initially thought of her as a friend and classmate, she then became a sexual possibility. She attributed the dynamic to the fact that "I'm a little more flirtatious than I should be. I don't try to be, but that is kind of my personality. That tends to get me into trouble" (Maggie, I, 22).

Finally, in terms of issues of identity and selfhood, Maggie showed indications that she was beginning to get an idea of who she was and who she wanted to become. One of the ways that she had described herself during high school was as independent, as knowing many people but as not hanging out with any particular group. During her first 2 years at college, however, she was disappointed in her dependence upon her boyfriend. "I wouldn't go anywhere by myself, especially being in [this city] and not knowing the area and knowing that I shouldn't be by myself. . . . I think now I have found a balance and I've definitely changed" (Maggie, II, 13). It seemed that she was coming to the

realization that she was able to have relationships, both male and female, where she could be a part of a relationship yet still be a distinct individual.

Another identity issue that Maggie seemed to be working through for herself had to do with reconciling her perception of herself as an engineer with that of being a mother as well. She appeared to have moved to a point where she felt that it would be her future husband who would need to take on the female role while she would take on the typical male role in child rearing. She seemed to have accepted that this was right for her and that she could do this and yet still "be there for my kids. I don't think it will be that big of a deal" (Maggie, II, 24).

Maggie was only just halfway through her college years, and, according to her, most of her very difficult engineering courses had been completed. She still had some estrangement issues she was dealing with, but she had only one issue that she felt she had to accept responsibility for, being too flirtatious. She seemed to be dealing with experiential themes of affiliation with other women and identity synthesis.

Phoenix

Phoenix was a 22-year-old student in her fourth year of chemical engineering. She was about 5' 3" tall and very fine-boned. She was slim, with straight, black, shoulder-length hair. She wore gold-rimmed glasses and had a gold chain around her neck. She wore no other jewelry and she wore no makeup. Her lips were full; her teeth, beautiful; and she had a ready smile and an excellent sense of humor. She was dressed in blue jeans, jogging shoes, and a bright green tee shirt with a white figure on the front that she later told me was from a video game. She carried a blue backpack.

Phoenix was a foreign student from Saigon, Vietnam. Both of her parents were engineers, her father a mechanical engineer and her mother both a chemical and mechanical engineer. She had a younger brother. Phoenix came to the United States because foreign study was a family tradition. She chose chemical engineering as a major because she liked chemistry in high school and engineering because her parents insisted upon it.

Phoenix selected her college because she wanted to be situated in a large city and because she was offered scholarship money. Although she was somewhat "forced" into chemical engineering by her parents, she found that she liked the field and was, in fact, becoming quite passionate about it. Even though engineering was working out well for her, she did regret that she was not able study writing or psychology because of the communication issues involved with a foreign language and a foreign culture. She volunteered to be part of the study so that she could practice her communication skills.

Phoenix would like to finish her degree this year and then continue immediately to Yale for graduate work. Her boyfriend was already attending Yale and studying engineering. Her ultimate goal was to return to Vietnam and open a research center to advance agricultural technology.

Phoenix's humor, her joy, her depth of thought, and her global perspective made her interviews very interesting. However, it was difficult for me to tease out whether her comments were the result of her experiences or were a product of her cultural perspective. We all interpret our experiences through the lenses our culture gives us, but Phoenix's culture is so different from what I have experienced, I found it difficult at times to read her themes clearly.

Phoenix thought her college was academically sound and had a good reputation. She believed that the foreign student population, which made up approximately 17%, tended to segregate itself based on ethnic background. She felt that there was little ethnic interaction, and, because there were only three Vietnamese women at her college, she felt at a distinct disadvantage in terms of meeting new people and in terms of deep acceptance from other foreign students at the school.

When asked specifically about the acceptance of women in the program, Phoenix, like most of the other women I spoke with, said that competence determined whether one was accepted or not. "Actually I think men respect women a lot. When they have a problem with their homework they come to me and say, 'Hey, how do you do this problem?' I don't think that there's any problem with men and women" (Phoenix, II, 9).

Phoenix had found that there were faculty who had difficulty accepting her value system and the competence of her work. For example, when she came to campus she was assigned a faculty advisor who advised her to take a class she did not feel prepared to take due to the lack of prerequisite knowledge. And, although she enrolled in the course and was on her way to an A for the semester, she eventually withdrew because she felt that she was missing the underlying understanding of the material. At the end of the semester her advisor asked her why she had given up so easily.

> I told him that I need to take another class first to understand what is happening with the computer program. He listened to me, but now he is not very interested in me anymore. So basically I just go to him, get the list of classes to take and I review it again and then I decide myself [which class to take]. (Phoenix, II, 12-13)

Because she was very interested in lab research, Phoenix had volunteered to work for one of her faculty members. Our first meeting was during summer break when we met at a prestigious research university on the other side of the city. Phoenix was there

working in the lab on a project for this faculty member, using sophisticated equipment not available on her campus. She spent 2 hours on a train to get to the lab and would spend another 2 hours to get back to her campus in the evening. She said she had volunteered for the work in order to build up her confidence in the lab. When I asked if it had helped her, she replied,

> I can't say so because my professor thinks that I am an undergraduate and that I don't really have enough knowledge for his research. I always ask him for things to do, but he says that maybe I don't really have the ability to do this" (Phoenix, I, 12).

Rather than seeing either of these incidents as an indication of a lack of acceptance on the part of some of the faculty that could be attributed to gender or ethnic discrimination, Phoenix chose to accept personal responsibility for them. She continued to select her own classes each semester and continued to work for a faculty member who denigrated her capability in the laboratory.

Phoenix seemed to do quite well in her relationships with the other female foreign students in her engineering program. "We have study groups and . . . even go out together after class. So it's like very, very close" (Phoenix, I, 7). She believed that her relationships with these women were crucial to her success in school.

> Friends are very important to me because both of my parents are engineers and they just work all day. They support me in some way, but I don't really feel that they support me spiritually. So these friends are like my parents, always beside me, talking to me and saying I should do whatever I want to do. My engineering women friends they take responsibility for what they like to do. I learn that from them. And it makes me feel that I should be responsible for what I do, too. (Phoenix, II 17-18)

Though friends were important to her, especially women friends, Phoenix had difficulty making friends with American women and seemed to do much better developing relationships with American men.

> Maybe it's because I feel more free when I talk to them. I feel so different when I talk to American girls. Of course there are many kinds of girls, but it's like they care about fashions and material things much more than my level so I feel like I don't have a common point to talk to them. They talk about celebrities and I don't know what to talk about. TV shows and like the Bachelor Show are not interesting enough. To them it's interesting and I feel left out of the group of American girls. So I start to just deal with guys. They like sports and I like sports so we talk about soccer and basketball. It is more fun. (Phoenix, II, 18)

In addition to American girls, Phoenix also had estrangement issues with women faculty. During her 3 years at college, Phoenix had had only one female faculty member, a woman who taught physical chemistry.

> She's awesome, but I still feel that she doesn't really have the mind of an engineer, of a real scientist. There is something very woman-like in her way of teaching. She is hard working and she has made professor at a very young age, but I still feel there's no passion in her lectures. . . . I don't really see that she can go any further in research, that she can really find a new thing for science. (Phoenix, I, 13)

Phoenix is able to develop good female relationships with some women in engineering, but she was unable to develop relationships with American women. She was also unable to accept the quality of scholarship of the one female faculty member she had encountered. The former was likely a cultural issue, but the latter seemed to be more an issue of either not recognizing or not accepting that there was a female perspective in science that was different, but not inferior. However, the result was that Phoenix estranged herself from a person who could have possibly offered her insight into some of her issues of gender and engineering.

Phoenix accepted a tremendous amount of responsibility for her inability to come up with the same questions and the same perspective on problems as the male students in her program. This inappropriate acceptance of responsibility for her perceived inadequacy has caused a loss of confidence in her own capabilities and made her

incapable of accepting the expertise of the one female faculty member she had encountered.

Phoenix identified two areas that she believed made her less successful than the men in her engineering program. One area she saw as difficult for her was the ability to communicate effectively. Communication as she defined it was not the ability to use the English language, but rather it was the ability to come forward and express ideas.

Phoenix described herself as shy four different times during our first interview. She also informed me that women in Vietnam were not very outgoing and said that even if a Vietnamese woman were educated, she would have difficulty expressing herself on topics in her area of expertise. I pointed out the dissonance between that statement and the fact that she was studying in a foreign country in a foreign language, that she had convinced a faculty member to hire her as a research assistant, and that she volunteered to do three 1-hour interviews about her experiences in her engineering program with an unknown American woman. She seemed to be surprised with the disparity between her statement and her behavior.

The other area that Phoenix saw as an issue for herself was her ability to get to the core of a problem, as she believed the men in her classes were able to do.

> They ask good questions and they have the right answers for their problems. And I saw they work carefully for their homework, they really spend a lot of time on it. I've spent the same time or maybe more. But there's something that . . . when they look at it and they just question. And it's like the core of the problem and when I hear things, it sounds right. It sounds logical to me. Actually when they bring up their questions I start to realize that they found the very, very problem that I could not see and I just look at them. (Phoenix, I, 13)

Phoenix inappropriately accepts responsibility for not interpreting things the way men do. However, she also seemed to have an idea as to why she did not interpret in the

same way as the men do. According to her, women are good at "naturally" occurring things like "talking and encouraging other people."

> We are good at analyzing why people are doing this, this, and that because we observe and we learn from the behavior. But in engineering and in science it's like the whole framework is imagined by people so it's basically design and it need logic and a man's brain to develop . . . . It seems like they naturally have the mind for engineering and it's hard for me to gain confidence in myself. (Phoenix, I, 15)

What eluded her, and what we discussed at length, was that science and engineering were, indeed, conceived of by people, in particular by males. Because men conceived of these subjects—using their perspective and using their logic—it made sense that other men would find it easier to follow the path that was developed for them and that women would find these male centered systems alien to the feminine way of thinking.

Another area that caused Phoenix difficulty was that of the teaching methodology used in engineering. Surprisingly, she did not accept personal responsibility for not "getting" the methodology used in engineering. She found her classes quite boring, saying that faculty routinely came into the classroom and began talking and started doing equations,

> you know, without saying why there is this situation. . . . There are, like, some calculations to get to this equation, but there is, like, no story. . . . It's a woman thing, you know. We like to listen to a story and enjoy it. Men, they don't really care about stories. (Phoenix I, 17-18)

So, once again, she came close to understanding the situation from a feminist perspective but could not quite grab it in its entirety. She was therefore caught in a world where she felt she did not understand things the way she should. Her desire to understand the male perspective was so strong that the pain she felt at not being capable of doing so

almost bordered on angst. When I asked how she managed to continue in engineering given her lack of confidence and the degree of pain she seemed to feel, she answered that it was because of her passion for the subject matter.

In terms of affiliation with other women, Phoenix seemed to do quite well with other female foreign students, but dealing with American women seemed to be difficult for her. And it was interesting to note that she, like the other women I spoke with, had found it easier to relate to the men in the engineering program than to the women.

Phoenix seemed to see herself as a woman in relation to the personality characteristics and talents that she perceived she had. Indeed, it appeared that she had synthesized some of those characteristics into her identity, like the need for stories and connection in her learning. By the end of the third interview, she seemed to have experienced a degree of consciousness raising that led to a feeling of more self-confidence. She said,

> I feel that when my classmates can't do many of the problems I still can do them. I have the ability to understand more than them, and I have a willingness to learn more from engineering than them. Some of the professors have said that I am good in what I'm doing and that makes me feel good. I'm getting more self-confidence. (Phoenix, III, 7)

When I asked her if she felt uncomfortable being a woman in engineering she said, "Oh, no. I feel proud actually, because I am a girl and I am unique" (Phoenix, II, 5).

In her last year before graduation, Phoenix seemed to have progressed further than the previous two women in her development towards selfhood. She was able to hear and accept suggestions that possibly her perspective and her approach were different than that of a man, but still just as valid. In her interpretation of Bakhtin, Josselson (1995) said, "We must cease to regard people as finished entities and, somewhat paradoxically,

we must find those places within narrative where the self is most clearly in dialogue with itself" (p. 37). During our interviews together Phoenix seemed to have dialogued with herself in relation to her capabilities and her future in engineering and to have changed her perception of them considerably.

Dawn

Dawn was the first woman I interviewed. She responded to a call for study volunteers sent out by a chapter of Women in Science and Engineering (WISE) at her school. She volunteered to participate because when she read about the study she feared "it would be hard for you to find people that would do it" (Dawn, III, 3).

Dawn was a 23-year-old African-American woman who was currently in her fourth (and last) year in the electrical engineering program. She was an attractive young woman about 5' 5" tall who wore her hair cornrowed and then gathered in a bun at the nape of her neck. She had a beautiful complexion and wore no makeup. She dressed in jeans and a black jacket identifying her school. Underneath the jacket she sported a blue Wizards' jersey that was too big for her. She wore jogging shoes and a bracelet watch.

Unlike any of the other volunteers in the study, Dawn was a mother. She was single and was the sole support for herself and her two sons, aged 1 and 3 years old. She was also the only African-American woman I interviewed and the only woman who had had a course in gender studies. Motherhood, race, and exposure to gender studies made Dawn's perspective unique among the women I spoke with.

Between her junior and senior year in high school, Dawn attended a math and science summer camp at Purdue University. She enjoyed her time there and was enthusiastic about the school and about engineering. However, because of her fear that

she would not be able to afford an education at Purdue, Dawn selected a state school where she could pay in-state tuition. Dawn and five of her friends began the engineering curriculum at the school at the same time. None of those five friends remained in engineering, choosing either to switch majors or leave the university altogether. Because Dawn stopped out of school the semesters when she gave birth to her children, those friends who did remain in school had already graduated by the time we talked.

Dawn excelled at math and science in high school and called herself a bookworm. On her college placement test, however, she scored at a level indicating a need for remedial math and chemistry. Because of her two pregnancies, it took her four semesters to complete the three remedial math and one remedial chemistry courses she needed to begin the actual engineering curriculum.

During her time at the university, Dawn had found a lack of acceptance on the part of both male students and faculty. Her experience had been that the male students preferred to work with other male students and that they excluded the female students.

> When I'm in a group with guys, whatever color, they always approach my input as if I don't know what I'm talking about. . . . Eventually my work stands for itself . . . but initially when I get into a group setting, people kind of blow me off or try not to listen to me. They just ignore what I said. They do that to the women a lot. . . . It's like you're an outsider coming into their circle. (Dawn, I, 9)

Dawn has also found some of the faculty unsupportive of women in the classroom as well.

> There was one time that I asked the teacher something and he was like, "Well, I think this is my third time saying this, let me just write it on the board for you guys." So he just wrote it down on the board and that made me feel so bad, I didn't [want to] ask him any more questions. . . . Ever. But I didn't ask him any questions in front of people. I would go to him after the lecture and ask him. Sometimes he was still like, mad. (Dawn, I, 12)

This was in contrast to her perception of how men were treated in the classroom.

> But there was this one guy, I think he was in all three of my classes and he always asks dumb questions but the professor always answers his questions real nicely and thoroughly and tries to take time to think about it and answer the questions. When I ask a question it's like, "Well, you know what . . . we're not going to get into that right now . . . so let's just go back to the lecture. Maybe you can come and discuss it with me after the lecture." (Dawn, I, 13)

During another interview, when asked if being a White middle-class male would have made a difference in terms of inclusivity in the classroom, Dawn answered, "I think that if I were a White male in the engineering field, those who appreciate the engineering field would find my input to be more valuable" (Dawn, II, 19). These perceptions of lack of acceptance in the classroom on the part of both male students and faculty left her feeling, as she puts it, "annoyed." "I get tired of people, mainly instructors, just treating me like I'm dumb, because I'm not dumb. I'm not. I'm not stupid. I'm very capable. So it's just annoying" (Dawn, II, 20).

In addition to a lack of acceptance by male students and faculty, Dawn experienced gender estrangement and found it difficult to connect with other women in engineering as well. In her case, however, the theme of gender estrangement was compounded by ethnicity as well.

> I don't feel alone because I'm a woman. Sometimes I kind of feel alone being a Black woman because it's been hard for me to really make friends with the other women in my class. In most of my classes I'm usually the only Black person in my classes, male or female. Most of the women are Arab and they usually are friends with each other, so it's hard for me to get into that circle. I don't know why. . . . Maybe it's me. (Dawn, I, 8)

As a result, Dawn felt isolated and alone. "So, it kind of makes you want to just alienate yourself or isolate yourself so that you won't be rejected" (Dawn, I, 9).

More than any other woman I spoke with, Dawn had experienced lack of acceptance. Gender issues combined with racial issues and her status as a single mother

to place her in a position where she was unable to connect with many of her faculty members or with either male or female students. What was interesting, however, was that even as Dawn experienced lack of acceptance, she, like the other women in the study, coped by estranging herself from other women as well.

For Dawn, themes of estrangement from women seemed to center around her lack of acceptance of the way women conduct themselves as students in group and classroom situations.

> What bothers me, too, if I'm in a group with another woman most of the time they won't speak up. They won't say anything. I'm the type of person I'm going to speak up because I'm not going to let somebody take complete control of something. . . . Most of the women they won't say anything. (Dawn I, 9)

> The behavior of other women appeared to frustrate and disappoint Dawn.

> Another time we were in class and [this girl] wanted to ask a question, but she felt like it was a dumb question so she didn't want to ask and so she kept asking me to do it and I said, "Just ask the teacher," and she said, "No, I don't want to ask." (Dawn, I, 10)

So, even though she had expressed her sorrow at feelings of isolation, she added to those feelings of isolation by estranging herself, distancing herself, from other women.

Themes of acceptance of responsibility were important for Dawn because in accepting responsibility for having "caused" some of the lack of acceptance and gender estrangement that she felt, the situation became more bearable, more manageable for her. Dawn accepted fault for both her lack of involvement in the engineering program and her isolation from people in the program. "I think that the engineering program would have had more impact on me if I didn't have my children. I would have been able to become more submerged in the studies and in the programs that are available" (Dawn, II, 5). She went on to say "I kind of put walls up around myself. That's kind of how I am" (Dawn,

II, 6). She also accepted responsibility for having poor relationships with the Arab women in her classes, saying, "It's hard for me to get into that circle. I don't know why . . . maybe it's me" (Dawn, I, 8). And finally, she also accepted fault for the lack of acceptance by faculty in her program by thinking "Maybe I did just ask dumb questions, but it doesn't seem like it" (Dawn, I, 12).

Affiliation was a difficult theme to discuss in relation to Dawn. She had experienced exclusion by other women in the engineering program. Likewise, she, too, had judged the women in her program as being unwilling to ask questions and stand up for themselves. As a result, she herself had pushed women away. Because she was a single mother who worked part-time while attending school, she was not so much a part of the campus environment as the other women in this study. Thus her distance from and involvement with the other women in her program worked against her in terms of dealing with themes of affiliation with other women.

Dawn was dealing with many issues that relate to the theme of identity. She was the only young woman I spoke with who brought up the topic of her own sexuality. When discussing her classes she said, "You're always around guys so there is always some guy you are interested in. That makes it hard to study and to focus because there are so many guys. You are always around guys all the time" (Dawn, I, 7). With these comments Dawn acknowledged her awareness of her sexual identity and her struggle to deal with the feelings associated with that aspect of herself.

Another identity issue that she was dealing with was that of working mother. While she was currently working on campus part-time and going to school, she was concerned about the impact working full-time would have on her children. Dawn would

prefer being a stay-at-home mother to her children; however, she recognized that there was no one but she to provide for the three of them. So, like many women, she was grappling with how to balance the necessity of working with the guilt that she felt.

> I need to get a job because I want them to have the best. I want them to be able to go to good schools, be able to participate in activities and stuff. I need a good job so that I can take care of them. That's been kind of hard, being a mom and then having to be away from them all day. I'm hoping when I graduate I'll be able to spend more time with them. I won't have to be at home studying all night. I can just be with them. (Dawn, I, 16)

As she neared her last semesters in school, Dawn began to identify herself as an engineer in terms of how she looked at the world around her and in terms of applying what she had learned to her everyday life. For example, she said, "Sometimes I will be walking somewhere and I think that I shouldn't walk in a straight line. I should walk diagonally because that will get me there the fastest" (Dawn, II, 3-4). Due to the training she had had, she worried about focusing more on objects than on people, but she found it interesting and enlightening to relate what she had learned to the things she saw. During one of our interviews she gave quite a good example of how people getting on an elevator and spreading out is much the way that electrons behave when they come into contact with each other.

The past 4 years have been very eventful and very difficult for Dawn. She had managed to persevere, however, and was due to graduate in the spring. "I'm doing this. I am almost done. I'm sure I'll finish. That makes me feel very good about myself and it makes me feel that I can be decisive about what I want" (Dawn, II, 5).

Mandy

Mandy was the final woman I interviewed for the study. Mandy graduated from a private school in the spring of 2005 with a degree in electrical engineering. She was not yet employed and was not certain if she would like to work as an engineer. This uncertainty caused her to feel as if she were a failure.

Mandy was 22 years of age, a Chinese national whose family emigrated to Hawaii when she was 6 years old. Her stories and her views were an interesting mix of the pros and cons of engineering, a blend of traditional and modern ideas, and a combination of Chinese and American values. About 5' tall and slim, she was the most fashion conscious woman I spoke with. Her dark, straight hair was pinned back with silver clips and she wore a white Michigan baseball cap with a large pink letter 'M' on the front. She sported stretch hip hugger blue jeans, a pink, Lycra Abercrombie and Fitch tee shirt and black and white flip-flops. Her jewelry consisted of small pearl earrings and a very dainty diamond ring that she wore on her left middle finger.

The older of two daughters, Mandy had a sister who was one year younger and attended college in Hawaii. She was very close to her sister and they spoke on the phone every day. Mandy's father graduated from high school in Hong Kong; her mother, from China, did not complete elementary school.

When the family emigrated to the United States, her parents worked very long hours, so the girls were on their own much of the time in the house. A few months after emigrating, her parents separated and then divorced. The girls lived with their father and were expected to stay in the house unless they were in school. Because of language

difficulties, Mandy went to an ESL classroom and gravitated towards math, where she found she excelled.

Mandy was full of energy and life. She was ready to talk and almost burst forth with stories. She needed very little prompting and had ideas and experiences and beliefs that she wanted to share.

One of the first things Mandy told me was that she had researched women in engineering for a paper she had done a few months before. Because of this research, she had a much better framework to use in discussing her feelings and thoughts than the other women I spoke with. I believe that Mandy found her research useful in terms of helping her realize that many of the problem areas she had identified in engineering were problem areas for other women in engineering as well. She also discovered that there were other women who had graduated but chose not to use their engineering education. Participation in this narrative study gave her the opportunity to talk her way through her thoughts and her feelings and to receive feedback on what she was sharing.

Mandy graduated approximately 4 months before we began our interviews. Since that time, she had already begun to "move on" from her student days so that although she did experience issues of acceptance from male students and faculty in the engineering program, they had become mostly irrelevant to her. Likewise, themes of estrangement from other women and from herself had begun to dissipate as well, as she worked on themes of affiliation with other women and identity synthesis. She was still, however, doing a considerable amount of work coming to terms with themes of inappropriate acceptance of responsibility, gender affiliation, and identity synthesis.

One of the most interesting things I found with Mandy was that even though she still accepted responsibility for many of the issues she encountered in the engineering program, she was now capable of questioning some of the responsibility she previously assumed. In some cases she was able to let go of at least part of that responsibility.

Many of Mandy's responsibility issues went back to her feelings of failure for not embracing engineering. Her primary explanation for that was that she did not have a strong enough reason for choosing engineering as a field. She was likely correct about this, having chosen engineering because she saw it as a stable field and one of the four choices of study (medicine, law, accounting, engineering) that her father gave her. She had been able to ameliorate these feelings somewhat by recognizing that many of her peers may actually have had the same lack of interest in engineering but simply had not considered the issue as she had. "They might not question it. Sometimes I wonder if they question themselves and what it is that they're doing" (Mandy, II, 3).

In addition, she accepted responsibility for not using the resources that were available to her. By resources I believe she meant both physical resources and people. Part of the reason for not using the resources was that "I didn't know the resources that I had" (Mandy, II, 7). Another aspect of the issue, however, was that she felt she simply chose not to use what she knew was available; from the beginning, Mandy said, she was unable to make a connection with engineering, due to the way concepts were presented to her.

> I was very stubborn my freshman year about the way that professors taught something, especially in electrical engineering. Because I was questioning. I felt like they didn't give me enough answers. They didn't really answer the questions. So I was very stubborn in not accepting just the answer. I kept on questioning. It made it very hard for me to study. I got very stressed out and there were parts

> where I felt like, "Oh, I need to close this book. I can't see it anymore." (Mandy II, 9)

Mandy also accepted responsibility for not developing relationships with faculty who might have helped her: "That was a big problem when I was here. I was not a very active person in going after professors and talking to them" (Mandy, III, 11). She also tried to convince herself that possibly she just did not get things "right" the first time. "Maybe it's just the people I met. I didn't meet the right people or I didn't pick the right classes. Maybe if I did, I might like it" (Mandy, II, 16).

As we talked over a period of three weeks, Mandy began to see that there were two ways to begin to look at her perceived failure in engineering.

> I have two sides I think. There's part of me that makes me feel that I haven't done enough, that I'm not good enough, especially when I compare it with my friends. I definitely felt like I failed. And that, that is something that I have to live with every day, and I'm trying hard to try to get over it and not let it be a burden. And then there's the other part of me that makes me feel like I did get over it in a way. I was able to finish it and I did do something, and I was able to find at least an idea of what I want to do, better than graduating and not knowing what I wanted to do still. So there was two sides. (Mandy, II, 12)

I asked Mandy what her final grade point average had been. It was 3.1 (on a 4.0 scale), and, as she said, "that was really bad" (Mandy, II, 23).

Although Mandy still had some residual themes of responsibility she was dealing with, it seemed to me that she was moving towards a more realistic view of her part in those issues. Mandy was also doing considerable work in the area of affiliation with other women. Despite having some women friends during her first 3½ years in college, she had two very close relationships with young men that she believed kept her from developing deep friendships with women. During her last semester at school she broke up with her

boyfriend, another electrical engineering student. She then began actively cultivating her women friends by starting what she called "girl's night."

> I would organize "girl's night" now and then. Most of the girls, they were definitely younger than me. There was one that was my same age. We would have maybe a really "girlie" movie like "Prince and I" or something like that, very sweet, and some dessert I made, some juice, some drinks. And then, after we're done watching the movie, we might be talking about what's going on in our life, relationship problems. So in that group I think I was sharing a lot of what I learned. Maybe I needed that, too. I needed that group for me to tell them what I learned, and I didn't want them to have to learn it alone. (Mandy, II, 22-23)

Not only was Mandy working on affiliating with women but she was actively becoming a mentor to the women she knew, something that she did not herself have and something that she felt would have been of benefit to her.

> I needed someone in my life that could tell me where I was going or where I could go. And I think I didn't have that. I spent a lot of time doing that on my own. And I was lucky to meet some other women outside of my field, but it would definitely help if there was someone in my own field and I could see the path that she took and how I could also do it. (Mandy, II, 23)

When I suggested that she very likely played a big part in the lives of the younger women, Mandy replied, "I'm not sure. I think it's just friends being together. I don't think it is only one-sided learning. I definitely learn a lot from them, too" (Mandy, II, 24).

Even though I wrote of Mandy's issues of affiliation with women and her mentoring as separate from her issues with identity, I think that they overlapped each considerably. Mandy's awareness that she needed a sense of connection with someone, preferably a woman, in the engineering program as well as permission from someone "important" to explore her thoughts and feelings led her to mentor a number of younger women in engineering. This gave her a sense of meaning and it helped her define for herself what she valued and thought important.

After approximately 3 years with her boyfriend, Mandy was still getting a feel for who she was apart from the relationship. She was learning that "I don't have to depend on someone for support. That was what I had and I don't think that was very healthy. That's something I needed to know before I get back into a relationship" (Mandy, III, 4). During her last semester at school she worked very hard and was very proud of herself.

> I didn't need someone to be there. I was able to go on my own and pick myself up again. I had a very, very strong ending, a very satisfying ending. I finally got a 4.0 and I was very happy. (Mandy, II, 23)

Mandy also surprised herself the summer after graduating with her ability to find an apartment in a neighborhood several miles from the school. She rented the apartment, arranged for electricity and a telephone hookup, and then found two suitable roommates on-line, women coming to the city to do graduate work. She admitted it was hard to accomplish, but she was proud that she was able to arrange a comfortable living situation for herself. She saw both her successes during her final semester and her ability to setup a home as very important accomplishments, and they contributed to her growing understanding of who she was.

Coming to terms with her feelings about engineering and who she was in relation to a career were the most pressing identity themes that faced Mandy. Resolution of these issues would give her not only peace but also a better understanding of herself. She was making progress towards resolution, something I could almost palpably feel during our time together.

When we first began to talk, Mandy began with exploration about economic stability, the reason she chose engineering to begin with.

> I think more and more if you're doing what you like to do you'll find stability there. It doesn't mean that you will have the best paying job, but you'll do well

> because you like it. And you'll continue to do well and continue to learn, so in that sense it's stability too. (Mandy, II, 5)

Then she began to look at her own uniqueness and how that may unfold for her.

> I think I . . . that's one struggle I'm going through right now, not being so careful in the way that I take my career path. Mine might not be the same as others, but I need to be able to accept that. I think that is the most difficult part right now. (Mandy, II, 17)

During our last interview, I think Mandy summed up her search for identity quite well by saying, "I think I'm not finished finding myself yet. And I don't think I'm anywhere close to it" (Mandy, III, 4).

Blanche

Blanche was a 26-year-old mechanical engineering graduate who was told about the study by Sarah, another participant. Blanche graduated from a state school in the city in 2001, worked as an engineer for one month, and then quit her job. Since that time she had not worked as an engineer. She was currently employed as a bank teller, did substitute teaching on the side, and was investigating enrolling in a program to obtain her teacher's certification. Her goal was to teach high school physics.

Blanche was about 5' 6" tall and of average build, with straight, reddish brown hair between chin and shoulder length, worn in two braids banded together in the back. She dressed in cropped blue jeans with rolled up cuffs and a scarlet, sleeveless tee shirt; she carried a smallish, red backpack. The only jewelry she wore was a short, silver necklace and very small, silver, stud earrings. She wore no makeup, but had beautiful skin and very nice, rosy cheeks.

A first generation American, Blanche's parents emigrated to the United States from Poland. Both of her parents had had some community college. Her mother worked

in a factory and her father owned his own construction business. Blanche described her dad as "not too smart," but she seemed to have an appreciation for her mother's capabilities.

Although she worked part-time during her college days, Blanche's parents paid for her college education. She chose the state school because her parents would not allow her to leave home. During high school Blanche was a very good student, especially in science and math, and her high school counselor encouraged her to major in engineering. A student she met at the university suggested she change from engineering management, her first choice, to mechanical engineering, because mechanical engineers were cool. Blanche took his advice.

Although she liked physics, Blanche began to get clues fairly early in the curriculum that engineering was not a good fit for her. She persevered, thinking that she could use her engineering degree in a job that would be fulfilling to her. However, the farther she got into her curriculum, the more concerned she became about her lack of connection with the field. She chose to continue in the engineering program, primarily because her parents were paying her tuition.

When we talked it was 4 years since Blanche had graduated, and I wondered whether she would be of any help to my research study. In fact, I was amazed at what she remembered about her experiences in the engineering program, and many of the things she discussed validated what I had heard from other women. For example, Blanche had much to say about the teaching methodology used in the engineering program.

> I had a lot of questions on why things were. I didn't just accept it. . . . I was frustrated in a lot of my classes. I was just copying down notes throughout the whole class and by the end of the class I wasn't paying attention at all. I was just doodling or something because I was completely lost as to what was really going

> on. I was just copying formulas. . . .There were examples, but I didn't really feel drawn into them. I didn't have the time to really think about what I was learning, I guess. . . . It was just kind of like a cut and paste kind of thing. (Blanche, II, 5)

Blanche found that there were faculty who were able to teach in a way that was meaningful to her. Those faculty were the ones who used examples that were relevant to her.

> They would have maybe a picture of what's going on or they would approach the problem maybe more personally like, "Let's say that this is happening, how would you solve that?" An approach that made you think about it instead of an approach that just said this is how to do it. (Blanche, II, 6)

Blanche was the only woman I interviewed who did not describe the engineering curriculum as grueling. She said that she always attended class and took notes, always did the homework, but rarely did the reading. She said that she "didn't spend too much time studying. I would kind of cram, I guess. I studied, but not that much" (Blanche, I, 20). Her final grade point average was 4.2 (on a 5.0 scale).

Like the others, Blanche experienced lack of acceptance from both male students and faculty. She felt that the teaching methodology that was used in the engineering program did not match her learning style. Like some of the other women, she found it difficult (in her case, impossible) to connect with engineering.

In terms of interpretive themes of gender estrangement, affiliation and synthesis of identity, and how Blanche perceived and experienced these themes during her time as an undergraduate in engineering, too much time has passed to be able to address them with any clarity. What was apparent, however, was that Blanche was still currently dealing with issues of responsibility and identity that seemed to relate back to her time in college.

Fairly early in her program Blanche found herself in a major that was not meaningful to her, but according to her she was "afraid" (Blanche, I, 9) to tell her parents she did not like engineering. In addition, she wanted to complete school as soon as possible in order to get a job and move out of her parents' house. As a result, she chose to remain in the engineering program and graduate.

After graduation Blanche decided to try a career in engineering, and she took a very high paying job as an engineer for the electric company. She stayed in this job for one month. At the end of that time, she was certain that she did not want to be an engineer.

> My first job definitely wasn't well suited for me. It was very military like. Most of the people that worked at the power plant had been in the Navy. They were older men, they were in their 40s and 50s. I was one of the only younger people and one of the only girls. I felt this enormous pressure all these afternoons . . . that wasn't an enjoyable experience walking through the power plant and hearing all the machines and looking at them and it was kind of interesting, but I didn't want to be there for 8 hours of the day and I didn't want to learn about it. . . . On the way there, driving to the parking lot, there was an armed guard and that just made me feel so awful in the morning just being there. I knew I wouldn't be happy there because I wasn't. I was miserable while I was there. So I quit. (Blanche, I, 3-4)

After this experience Blanche seemed to have lost confidence in herself and in her ability to determine what she should do with her life. She drifted from job to job for a while and eventually began working at a bank as a teller. She was able to support herself, move out of her parent's house, and begin to figure out what she wanted to do with her life.

During the past 4 years Blanche had discovered that "I really needed to be helping people" (Blanche, I, 3) and that what she really cared about was "being happy and finding a job that I enjoy doing at least 40 hours of my week" (Blanche, I, 8). For much

of her time since graduation she had considered becoming a schoolteacher, and during the last year and a half she had worked in the public school system as a substitute teacher. Because of her experiences as a substitute teacher, she decided that she would like to teach high school physics.

Through our talks together, Blanche began to see that she had not rejected science, engineering, or physics so much as she had been unable apply it in a way that was meaningful to her. She appeared to be in the process of doing just what she had hoped to do with engineering, and that was to find a way to make it fit her.

Sarah

Sarah was a 25-year-old woman with both bachelor's and master's degrees in mechanical engineering and a year of additional engineering study in Belgium; she had recently graduated and was employed in her first job as an engineer. Sarah was an extremely striking woman, standing over 6' tall. She was slim, with very long legs and the body of a runner or a basketball player. She had straight, chin-length, dark blonde hair highlighted around her face and parted down the middle. She wore camouflage cargo pants with a knit camisole top and a cream colored jacket. Around her neck she wore a platinum necklace, a vertical bar encrusted with small diamonds, and a cream color leather-banded watch. She wore no makeup but had a beautiful complexion and rosy cheeks. Physically imposing, very attractive and confident, she was someone who turned heads whenever she walked into a room.

Sarah grew up in Michigan, where her father was a machinist for General Motors. She described herself as her father's favorite child. Sarah said that she would spend time

in the garage with him while he tinkered with cars, and she credited him with introducing her to the basic concepts of mechanical engineering.

Sarah said that she was drawn to engineering because she liked putting things together and "I loved being able to do things that guys typically do and I love to prove them wrong" (Sarah, I, 2). She described herself as "kind of a tomboy" (Sarah, I, 2). She was the youngest of three children; her brother, with whom she is very close, was the middle child and her sister, the oldest.

During her junior year in high school, Sarah's parents divorced. Her father moved from the house and Sarah was left to live with her mother, whom she described as "kind of out to lunch and already dating somebody new" (Sarah, I, 2). For a short time she tried living with her father, but "my dad was weird, too, so there were a few months when I lived with him but I didn't like that, either" (Sarah, I, 3).

Because she was unhappy with her home life and because she was an exceptional student in high school, she received permission to take courses at the local junior college that would allow her to graduate a year early. After completing her coursework at the community college, she graduated, and, at the age of 17, she received a full basketball scholarship to a small, private, technical school. Sarah accepted the scholarship and began to study mechanical engineering. Because of her lack of physical and mental maturity, however, she found that she had a lot of difficulty in college. She described herself as unhappy and "all over the place socially and athletically" (Sarah, I, 3).

At the end of her first year of college Sarah came to the city to live with her brother. Her plan was to work during the summer to make enough money so that she could change colleges. During the summer, however, she and the CEO of her brother's

company, Joe, began dating. Eventually she, Joe, her brother, and her brother's girlfriend wound up sharing an apartment together. To her credit, Sarah enrolled for classes first at a local community college and then at a university in order to continue studying engineering. She, herself, was surprised when she looked back. "I stayed on track with something and I don't even really know why that is. I could've strayed a hundred different ways, but I didn't" (Sarah, I, 5).

Sarah received notice of my research from an announcement on the SWE list serve. She volunteered for the study because she felt that now that she had finished her studies she had a good understanding of the issues of women in engineering. She hoped there would be "more female involvement in engineering. It makes it easier on everybody if you're not a complete minority" (Sarah, I, 1). Later in the first interview, she said, "I wish I knew if women are really just being discriminated against and discouraged or if they just don't really want to do engineering as a whole. . . . I want them to have the same opportunities as men" (Sarah, I, 13).

Although she volunteered for the study, Sarah was the woman who had the most difficulty with the concept of qualitative research. Just moments before the end of our final interview, as her commuter train was pulling into the train station, she said, "You are not going to hear from women who are total loners. They are just doing what they are going to do. Nobody is going to respond [to your e-mail for volunteers]. Your subset is inherently skewed" (Sarah, III, 19). Further, in her opinion, quantifying my data was going to be impossible.

Like the other women I interviewed, Sarah felt that there were issues of acceptance for women in the engineering program. For her, however, the experience was not one of exclusion, but rather one of patronization.

> I never felt discriminated against in the classroom, not in asking questions or anything like that, but, there would be like a kind of patting on the head and you could tell that you were being treated differently than the guys, but it was more like they [faculty] wanted to be your friend. (Sarah, I, 9-10)

Again, like the other women, Sarah had gender estrangement issues. For her, estrangement seemed to be especially from men but also from other women. In terms of her relationships with men, Sarah had had two lasting relationships that carried her through a good part of her undergraduate and graduate school days, so she was capable of developing close relationships with men. In general, however, she said that her attitude towards men was "cynical" (Sarah, II, 4) and she approached them with caution, seemingly waiting for a cue as to their intentions. In school Sarah said that faculty members would sometimes want to be her friend and that "I couldn't fight it. . . . All I could do is just hope that they don't cross a line" (Sarah, I, 10). And, in relation to her faculty advisor, "I am on my toes with everybody, I don't trust any man who has authority over me. I feel like that is what I have to do" (Sarah, I, 10).

Her feelings toward men did not appear to have changed as a result of her experiences in the workplace. "I definitely feel apprehensive. . . . It fits in with the guilty until proven innocent thing. I just assume that that's the way it is until I'm proven [convinced] that they can be trusted" (Sarah, II, 11). This constant focus on the intentions of the men she came into contact with required a tremendous amount of her energy.

In terms of her estrangement from other women, Sarah echoed comments I had previously heard.

> Women tend not to look out for each other. I am disappointed in the level of competition there is between women. Instead of helping each other out they'd rather see the other women crash and burn. There is that whole competing for men, or competing for some kind of attention or reputation or whatever it may be. So, they don't help each other out a lot of times. I don't think that there's an instant camaraderie within women like in an engineering situation where they're in the minority. (Sarah, II, 5)

Aside from issues of estrangement, Sarah was also dealing with responsibility issues. In particular, I noted her acceptance of responsibility for assuring that the boundaries between herself and men she came into contact with were not only drawn but are also drawn in such a way that she did not offend the offender.

> So that is something that I need work on, being able to think of something in the moment to show them that that's not acceptable. But you have to do it on their level. You have to do it in a very witty and quick way that they can, you know, verbally sparring rather than "Oh, well, that's not appropriate." You can't handle it that way or you are going to get massacred. (Sarah, I, 12)

Sarah said that she believed that it was a "man's world" (Sarah, I, 12) and that it would probably not be changed in her lifetime. Her goal, then, was to be able to "stand up for myself and not ruin my career and become the tattle tale" (Sarah, I, 13).

Though estrangement and responsibility issues wove through Sarah's interviews, the primary themes that she appeared to be dealing with at this point in her life were themes of gender affiliation and identity synthesis. For Sarah, these issues were tightly intertwined. In terms of gender affiliation, Sarah was now in a position where she had begun to evaluate if she were ready to become like the wives and mothers she knew. This had not been an affiliation that Sarah had ever perceived positively.

> I looked up to my brother rather than my sister and I wanted to be like him rather than her. I saw her as this bratty, weak girl and I didn't want to be like her. I was always striving to understand the male point of view and prove to them that I can do what you can do and I'm like you. (Sarah, II, 18)

Later Sarah said, "I am in no hurry to get married and have kids and all that. . . . I don't have an agenda like that" (Sarah, I, 7).

The issues of gender affiliation as a wife and mother also affected Sarah in terms of her identity. At 25 years of age, she had just completed her education and had begun to work at her first engineering job. She was making a good salary and had just purchased a one-bedroom condominium downtown in the city, where she lived by herself. She had begun to think of herself as an engineer.

Sarah had been dating her current boyfriend for about a year and a half. He recently began talking about marriage and family. Sarah had mixed feelings about this. She said, "I didn't go through all of this [her schooling] for nothing" (Sarah, I, 7). She felt that she was being asked to make a decision between being an engineer or being a wife and mother. It seemed to be an all-or-nothing choice for her and it angered her that she must make this choice, a choice that she felt men did not have to make. Engineering, she said,

> is a pretty traditional career path where you work very steady hours and if you're not willing to put in the steady hours over the years, and a lot of hours at certain points, then you are not going to progress. You are not going to get promoted. (Sarah, II, 1)

During the course of our interviews, Sarah returned again and again to the issue of marriage and children. When I asked her if she liked her new job and if it fit her well, she said, "I feel as though my work is significant because I'm developing defense systems that directly save people's lives" (Sarah, III, 5). She then immediately segued into "if I do decide to do a marriage and kids thing, how am I going to fit that in on my timeline and all of that?" (Sarah, III, 5).

Sarah had recently graduated and had begun her first job as an engineer. She continued working on themes of acceptance of responsibility, gender affiliation, and identity synthesis. Because Sarah was so physically striking it was possible that she would deal with boundary issues throughout her career. Like other women in her field, or any field, for that matter, she was faced with making decisions about marriage and family that would impact her career and her identity.

According to Sarah, at the time of our interviews there were no women in middle management at her company. The reason, she had been told, was that they had all stopped out to have families. No one had stayed long enough to climb the ladder to the middle tier. Sarah's primary dilemma right then was to determine how she would choose to navigate the next portion of her life in terms of her career in engineering. The decisions she made would have an impact on her resolution of themes of gender affiliation and identity synthesis.

Carol

Carol was a 27-year-old woman with a bachelor's degree, a master's degree, and a Ph.D. in electrical engineering. She relocated from her doctoral institution in the southern United States to the Midwest in order to do postdoctoral work with a well-known engineer in her field and to build up her list of published work. Carol just accepted an assistant professorship at a prestigious university; we managed to squeeze in our interviews days before she moved.

I met Carol in a Starbucks late one spring evening. I arrived, scanned the fairly crowded room, and spotted a young woman sitting alone in a booth, ramrod straight,

typing purposefully on a laptop. She looked professional and "engineering-like," so I approached and introduced myself. It was, indeed, Carol.

Carol was about 5' 7" tall and very slim. She had shoulder length curly brown hair parted in the middle. She wore black slacks, black shoes, and a fitted blue shirt with black stripes. She wore no makeup. She was extremely poised, relaxed, confident, and alert, seemingly ready to receive words, ideas, and thoughts. Carol was like the girl next door or everybody's little sister. She was down to earth and approachable.

Carol was the oldest of three children. Her father was a professor in computers at a technical university and her mother a retired nurse. She described herself as close to her family and said that religion was a very important aspect of her life. She was currently engaged to a young man she met through mutual friends while working at UCLA for a semester. Her fiancé, coincidentally, was also an engineer.

Carol attended high school at the Illinois Math and Science Academy, a selective, state-run high school that accepted students based on their mathematical and scientific abilities. After completing high school, she received a full scholarship at a prestigious university for her undergraduate work. The scholarship also provided her with the opportunity to study abroad in England one summer, something that she thoroughly enjoyed. Her graduate work was done on a National Science Foundation scholarship. Once again, she chose a very highly regarded, but smaller, graduate school.

It was apparent that Carol was an exceptional student and that her excellence was recognized from an early age. She seemed to have partaken of the very best that the educational system had to offer. And now, after completing her postdoctoral work, she was literally on the brink of starting her professional academic career. Wooed by

universities from across the country, she and her fiancé worked as a team to find a placement where both of them could find fulfillment in their academic and research careers. They chose a very woman-friendly university where approximately 25% of the faculty in the engineering department was female. Carol would be mentoring, researching, and teaching; her fiancé would be doing much the same work, but on a non-tenured track.

Carol's story of her experiences in engineering was different from that of the other women I spoke with. I suspect that much of this difference was due to the fact that she was an extremely gifted individual. And, some of the difference, too, was likely attributable to the perspective she brought to her experiences after 9 years of schooling.

For Carol, acceptance by faculty had never been an issue. It appeared that from junior high school onward Carol's teachers recognized the tremendous potential she had to make an important scientific contribution and were dedicated to seeing that she had every opportunity to continue to grow and develop in the educational system. Likewise, Carol found the male students in her engineering classes extremely accepting as well. When I pointed out to her that it was likely that everyone wanted to work with her because of her capability, she conceded it was a good point. "I imagine that if I had been less capable, that things might have been different, but there was no way of really knowing" (Carol, I, 8).

Although Carol found the male students very welcoming, she did qualify her statement somewhat:

> I mean, there're different degrees. What I experienced was that while we were all working together, they were more than happy to have me along, and it went really well and it was good for me, too. But then, when it came to Saturday night, and they all wanted to go out and meet girls they didn't necessarily want me to come

> along, so there were some instances of that happening. But, if they were all going to the basketball game, they would include me. You know, it's very understandable that they don't want me coming along when they want to meet girls, so there were some things that I didn't feel welcome at, but it had nothing to do with work and there were reasonable reasons. (Carol, I, 7-8)

In terms of themes of gender estrangement, Carol noted that despite having had female friends, she was "closer to the guys. . . . I didn't go out of my way to look for female friends" (Carol, I, 4-5). In fact, she said that she had a male friend that "I studied with nonstop for 4 straight years" (Carol, I, 7).

During her undergraduate years, Carol admitted that she had to deal with issues of isolation. She attributed her isolation to the sheer number of hours she put into her studies as opposed to any issues of exclusion, saying that she worked "EXTREMELY HARD at it [engineering]" (Carol, I, 17). Carol accepted responsibility for her isolation, and she worked to change that situation when she went to graduate school.

> When I was an undergrad, when I was done working I would just go read a book or something. And so I spent my social time differently. When I went to graduate school, when I wasn't working I would call people up and say, "Let's go do something." So it wasn't that I was spending less time studying . . . but I changed how I had fun so that it was a little bit of a better investment. (Carol, I, 19)

At this point in her life, themes of gender affiliation did not appear to have relevancy for Carol. She was such an exceptional student and she went through the educational pipeline so quickly and so smoothly that she did not appear to be aware of the difficulty that other students, especially women students, experienced. Carol was committed to mentoring students, both male and female, and she saw little distinction between their experiences. It may be as she is exposed to other women studying engineering that she will have cause to reflect on the differing experiences that women

and men seem to encounter as they travel through the educational system, thus making themes of gender affiliation more relevant to her.

Like Sarah, most of Carol's energy at this point was more directed towards themes of synthesis of identity in relation to herself as a professional and in relation to herself as a wife and mother. Carol was beginning to think of herself as a professional, a professor, and a researcher. During our conversations, she seemed to begin to put together for herself what she found valuable in her own classroom experience. In particular, she mentioned the importance of understanding fundamental concepts and knowing how to find resources so that it would be possible to solve problems. She did not find solving the problems themselves of much use and thought of them more as "busy work" (Carol, II, 10). She also mentioned that she found the traditional English-style tutor teaching method extremely effective but said that "pretenure I would gravitate towards the lecture style because it is less demanding but posttenure when I perhaps have a little more time . . . then I might try to devote more time to something like tutor style" (Carol, II, 9). Finally, she would like for the interim material to relate to real-world problems and the "societal implications" (Carol, I, 23) of what we were doing and why it was important.

In terms of her identity as a wife and mother, Carol's outlook was much different than Sarah's. It was much more positive, more hopeful. However, it appeared that until recently Carol and Sarah might have come from the same direction. Carol said that when she was considering her life 2 years previously she remembered feeling

> really kind of pessimistic. What kind of opportunities would I have? It was like I had to choose one way or the other and there was not going to be a middle ground about being a wife and mother (Carol, III, 5). I had seriously considered not finishing my degree because I thought, Well, I could get the degree, but then

> what? Am I going to have to give it all up so that I can have these kids? Or am I going to have to forego any kind of family life because of this? (Carol, III, 8)

Now, however, she seemed confident that she would be able to continue to work as an engineer and yet raise a family as well. Part of this change in her perspective was likely because she had found a man who shared her vision of herself. Another factor was likely her reception from the academic community. When she began sending out resumes a few months ago, she found that many well-known universities courted her. Finally, the decision she and her fiancé made to relocate to a university known for both its female and family friendly practices no doubt had helped her change her perception as well.

Carol was on the brink of soaring into the academic life that she had only so far prepared for. Her happiness and joy were apparent when she spoke. She appeared to have it all.

Experiential Commonality

The eight women who participated in this study ranged in age from 18 years old to 27 years old. Developmentally speaking the women covered the spectrum of late adolescence, early young adulthood, and young adulthood, so at the time they were interviewed their developmental issues were different. For example, some of the women were wrestling with independence issues and were separating from their families. Other women were developing deep, life-long commitments to a partner. And, in terms of their progression within their engineering programs, the women were also at different points. However, as their stories began to unfold, certain parallels or commonalities in their experiences, interpretations of their experiences, and reactions to their experiences began

to emerge. It is this commonality of the participants' experiences and responses that I believe is important to further understanding the issues of women in engineering.

All of the women I spoke with were encouraged to choose or themselves chose engineering as a field of study because of their degree of proficiency in math and science in high school. Only Carol, Sarah, and Jenna actually seemed to have a solid knowledge of what engineering was and of the careers that would be available to them as a result of studying engineering. Both Phoenix and Mandy were somewhat pushed into the field by their parents' perceptions that the field was stable and would give their daughters the potential for financial security and independence. Dawn and Blanche seemingly selected engineering rather haphazardly because of their competency in the math and science area, and Maggie chose engineering as a default because she couldn't imagine herself as good at anything else.

The women's choice of schools varied as well, with the participants coming from three different universities. The first university was a public research university of approximately 24,000 students located in a major Midwestern metropolitan area. It was the largest university in the area. There were 16 engineering majors at the school, and it was noted as one of the most diverse and affordable universities in the United States.

Not far from that university was a private technological school of approximately 6,500 undergraduate, graduate, and law students. It offered a choice of nine engineering majors. Like the first school, it was an extremely diverse campus with students coming from over 60 countries. Approximately a quarter of the student population at the school was female.

The third school was the flagship of a neighboring state's university system. With approximately 28,000 undergraduate students from all 50 states and more than 100 countries, it was an immense school. It had a national ranking of 7th among public universities, and it was a major research university, recognized worldwide.

Not only were the women's motivations for studying engineering and their schools of attendance different, but their backgrounds varied considerably as well. Maggie, Jenna, and Mandy came from out of state, Colorado, Wisconsin, and Hawaii, respectively. Phoenix came from Vietnam. Sarah, Blanche, and Carol came from the suburbs of a Midwestern city and Dawn from an inner city neighborhood.

It is apparent that the demographics of the women varied considerably. However, irrespective of their demographics, these women seemed to have encountered many of the same experiential themes while enrolled in postsecondary engineering programs. The experiential themes that the women in this study shared were acceptance, estrangement, acceptance of responsibility, release of responsibility, gender affiliation, and identity synthesis.

It appears that after beginning their studies most of the women encountered incidents of marginalization and exclusion predicated by faculty and male students in their engineering programs. This exclusion, whether consciously or unconsciously recognized, seemed to lead the women to react or cope in many of the same ways. It is this commonality in experiences, interpretations, and reactions that I believe is important to further understanding the issues of women in engineering.

The Expression of Experiential Themes

Acceptance

Acceptance appears to be the first experiential theme that women are pushed to deal with when they enter engineering programs. Acceptance can be defined as a feeling of being included, of belonging. Science has historically been a field that has worked to exclude women first for reasons of power and second because of the professional and economic competition that a body of educated women would present (Trecker, 2001).

For each of the women that I interviewed, acceptance by faculty and other students was a major reference point for them. Every woman addressed her perception of her acceptance in engineering. And, whether there was recognition of the exclusion that the educational system perpetrated, every woman I spoke with was indeed impacted by the perceived level of acceptance that she experienced.

Only two of the women I spoke with felt unconditional acceptance in their programs, Jenna and Carol. In part this may be due to their relative placement on the educational continuum, Jenna at the beginning and Carol at the end. Jenna may be too new into her program to have a good perspective on whether she will be readily accepted by the faculty and the students that she will come into contact with in the years to come. Or, it may be that relative to the ostracism that she experienced during her K-12 years, Jenna does, indeed, feel accepted. Carol, at the end of 9 years of study, recognizes that she has "made it." In fact, Carol has received the ultimate sign of acceptance, an invitation to join the ranks of engineering faculty herself. Finally, it may be that the excellence that both Jenna and Carol displayed in the classroom and the lab enabled them to transcend issues of gender to a greater degree than most women.

Likewise, given the recognition that Sarah received while at school, I somewhat expected that she would have perceived acceptance and validation during her educational career as well. However, this was not the case. Sarah reported that she felt patronized, not excluded. It was as if they (faculty) "wanted to be your friend" (Sarah, I, 10). In fact, what Sarah was likely experiencing was what Evelyn Fox Keller (2001) referred to as "the chronic confusion of sexuality and intellect in relationships between male teachers and female students" (p. 11). So rather than lack of acceptance or patronization it was likely the expression of sexual interest that made Sarah feel uncomfortable and that she mislabeled as patronization. And, it served the same end as lack of acceptance, exclusion.

Of the other women, Maggie and Phoenix both felt that male students in the program accepted them based upon their competence in the classroom. They did not feel the same acceptance by the faculty members, however. Maggie handled this lack of acceptance by avoiding particular instructors while Phoenix forbore.

Dawn, Mandy, and Blanche reported that they did not experience acceptance from either the faculty or from the male students in their programs. Though not directly attributing her lack of acceptance by either the faculty or the students to either racism or genderism, Dawn said "I think that if I were a White male in the engineering field, those who appreciate the engineering field would find my input to be more valuable" (Dawn, II, 19). Dawn's lack of acceptance by faculty, male students, and even female students as well, has left her with a feeling not simply of lack of acceptance but one of rejection.

It is interesting that aside from Dawn, the other two women who felt unaccepted by both faculty and male students were Mandy and Blanche. Mandy, who had recently graduated, had yet to accept an engineering job and was considering changing fields.

Blanche had already turned away from engineering. Both of these women had the capability and the determination to complete their engineering curriculum and graduate; however, neither of them felt that their engineering programs were either inclusive or accepting. Both of them attributed their persistence in engineering to their unwillingness to quit.

Gender Estrangement

Estrangement is a phenomenon that became apparent fairly early in the interview process. Recognition of the lack of acceptance from the educational system appeared to lead to feelings of estrangement. In fact, estrangement was not a word that was articulated by any of the women, nor did it appear to be something that any of the women were consciously aware of. However, estrangement appeared to be a coping mechanism for them, one that enabled them to continue to function in an environment where they were regularly assaulted by lack of acceptance from faculty and other students. The lack of acceptance seemed to lead the women in this study to a general alienation from themselves as women and to an inability to bond with other women. For these women, the manifestation of estrangement seemed to be a sort of androgynous perspective where the woman began to see herself as "one of the guys."

Feminist epistemology holds that those within marginalized groups will distance themselves from that group. Instead they will seek to identify with those in power. Within the academic community those with power are male. Evelyn Fox Keller (2001) said that when she was in graduate school at Harvard in 1957, she too experienced the same phenomenon. "Like most women with so-called male aspirations, I had very little sense of sisterhood" (p. 14).

Sarah, Maggie, Jenna, and Carol all said that their friends were predominantly male and that they themselves were considered just one of the guys. Sarah found that if she talked about cars that she could gain the respect of men in what she described as a nonsexual, non-genderized way. "As soon as you can start talking about something to do with cars, it's like you're automatically like 'you know, maybe she's not just another girl. Maybe I will respect her or something like that'" (Sarah, II, 18). Maggie, Jenna, and Carol typified their relationships with men as being more comfortable than relationships with women. As Jenna said, "A lot of the gals, it seems, are trying to sit there and vie for something and most of the guys they'll just accept you as who you are" (Jenna, I, 20).

Though Phoenix had good women friends in the Asian community, she found that with Americans it was much easier to relate to American males. She, too, stated that, if given a choice, she preferred to talk with an American male as opposed to an American female. And, when speaking about how she felt earlier in her program, Mandy, too, said that "I made a lot more friends with guys" because with women "there's still a bit of something going on in between them that. . . it's not very comfortable talking in the beginning. Guys are easier to talk to about some things" (Mandy, I, 13). Finally, there was Dawn who felt as though she was unaccepted by everyone—female students, male students, and faculty. And yet Dawn, too, distanced herself from other women students with her perceptions that women were unwilling to ask questions and stand up for themselves in the classroom.

Because it had been 4 years since she was in school, many of Blanche's memories, thoughts, and feelings about her experiences in her engineering program were lost. She remembered feeling unaccepted by faculty and male students. She also noted,

however, that she had close women friends throughout her college years. It could be that Blanche was insulated from themes of estrangement from other women because of her general lack of commitment to and connection with the field of engineering. Perhaps, then, there was no need for her to distance herself from the marginalized group or to identify herself with the group in power.

Acceptance of Responsibility

Another experiential commonality that these women seemed to share was that of inappropriate acceptance of responsibility. Like estrangement, acceptance of responsibility seemed to be a coping mechanism; it occurred among almost all of the women. Acceptance of responsibility seemed to occur when the women were faced with a situation that they could not remedy or alleviate. The women then accepted that the issue was their "fault" or their personal responsibility. In short, in order to exist in a system in which they were cast as "outsiders" (Harding, 1991, p. 132), they accepted the blame. This acceptance of blame held out the hope that if they fixed themselves the problem would disappear. This enabled them to handle a situation that might otherwise be too much to bear, but it also prevented them from recognizing the dynamics of their oppression.

For example, Dawn's isolation from faculty and students in her program was very difficult for her. But, rather than labeling her problem racism or genderism, she instead chose to accept responsibility for the isolation she was experiencing. "I kind of put walls up around myself. I don't know, that's kind of how I am" (Dawn, II, 6). Similarly, Carol accepted responsibility for her lack of friends by saying that it was her responsibility for

choosing to read books in the meager amount of spare time she had instead of actively connecting with people.

> When I was an undergrad, when I was done working I would just go read a book or something. And so I spent my social time differently. When I went to graduate school when I wasn't working I would call people up and say, "Let's go do something." So it wasn't that I was spending less time studying . . . but I changed how I had fun so that it was a little bit of a better investment. (Carol, I, 19)

Mandy believed that if she had simply met the right people or picked the right classes, then she would have connected with engineering and found it more meaningful to her. "Maybe it's just the people I met. I didn't meet the right people or I didn't pick the right classes. Maybe if I did, I might like it" (Mandy, II, 16). And, after 4 years, she also held on to the belief that her lack of participation in Orientation Week made things extremely difficult for her in terms of knowing the resources that the school had to offer. "I didn't spend the orientation week here, I spent it with my mom. We came together and we went (around the city) on our own. . . . So it was very difficult" (Mandy, I, 15).

Rather than label her problems sexist, Sarah accepted responsibility for the boundary issues she had with men in the engineering program. She expended a lot of energy on not only drawing boundaries with men but also on making certain that she did it in a way that was not offensive to the men either.

> That's something I need to work on, being able to think of something in the moment to show them that that's not acceptable. But you have to do it on their level. You have to do it in a very witty and quick way. (Sarah, I, 12)

Like Sarah, Maggie said,

> I think I'm a little more flirtatious than I should be, too. I don't try to be, but that's kind of my personality, so that tends to get me in trouble. . . . finding out a friend has a huge crush on you and you never even thought about it. (Maggie I, 22)

The main issue of responsibility for Phoenix was that of her perceived lack of ability to conceive of engineering problems in the correct manner. "I feel that I'm not as smart as them [the male students]. . . . I think that they ask so many good questions that I never thought about" (Phoenix, I, 12). Acceptance of this responsibility caused Phoenix feelings of pain and futility as she struggled to perceive things from the male perspective.

Blanche accepted responsibility for mishandling her choice of major and selecting a field that held no interest for her. She believed that if she had just known herself better, she would have selected a major that was meaningful to her. "I'd say I was a late bloomer when it came to knowing myself. Even after I got out of college I still felt like 'Oh, I need to find myself'" (Blanche, I, 15). Further, Blanche accepted responsibility for staying in a major that she did not connect with.

> I met a good friend that was also in engineering as a freshman, and we had a lot of classes together and we both were kind of thinking like, "Oh, okay, whatever this engineering thing is we'll have a job." We weren't that interested in it really, but I think that maybe the friends I had in my major, maybe that was part of the reason I didn't leave. (Blanche, I, 6)

Only Jenna appeared not to have issues of responsibility. This may be attributable to the fact that she had just begun her second year in the engineering program at the time of her interviews. Or, interestingly, it may be due to the fact that Jenna felt so totally accepted and successful in her program that she may not have felt the need to compensate for being an "outsider."

Release of Responsiblity

Experiential themes of acceptance, estrangement, and inappropriate acceptance of responsibility were common among the women I interviewed. These themes appeared to occur as a result of the marginalization, exclusion, and otherness that they experienced as

women in engineering programs. Their responses to those experiences enabled them to survive within the system. However, there also appeared to be a group of other common experiential themes that were more positive and that seemed to point to personal growth on the part of the women. Those experiential themes were release of the inappropriate acceptance of responsibility, gender affiliation, and identity synthesis.

Release of the inappropriate acceptance of responsibility seemed to occur for this group of women with their recognition that there might be another explanation for the fault that they had assumed, an explanation that was not a result of some misstep or wrongness in their behavior. This recognition seemed to allow the woman to begin to look around herself and to begin to ask questions about some of the things she had previously accepted as being her responsibility. It seemed to mark the beginning of personal growth.

In her last year of the engineering program, and as one of the top students in her class, Phoenix had come to a point in her studies where she had recognized that she was successful. She, in particular, seemed capable of hearing and accepting the idea that there could, in fact, be both a male and a female approach to the study of science. She also began to accept that neither perspective was correct. "Sometimes I think I see the problem this way, but I can't explain the way I think. I usually try many approaches to my problems and somehow intuitively I know that my professor will think this way, but I think this way" (Phoenix, III, 5). And, after I asked if that then meant that her approach was wrong, Phoenix replied, "That's what I wondered, too. I don't know, because he couldn't answer me, so I don't know if it is right or it is wrong" (Phoenix, III, 5). For Phoenix, the ability to begin to recognize that her approach was different, but not

necessarily wrong, was a beginning step for her in letting go of the belief that her way of thought, her perspective, was inferior to that of the men in her engineering program.

After 9 years of schooling and a Ph.D. in engineering, Carol appeared to have few issues of responsibility to reconcile other than her acceptance that she must make time to develop personal relationships with both women and men. It is possible that Carol began to let go of any feelings of responsibility many years ago. Or, it is also possible that she was such an outstanding student, her acceptance so complete, and her ability to adapt to the engineering environment so adept, that there were few issues of responsibility that required her acceptance.

Sarah still accepted that it was her responsibility to set clear boundaries in her relationships with men and that she must set these boundaries in a way that left the man feeling comfortable. "There's a way to succinctly put somebody in their place, using respect in the process" (Sarah, I, 13). At this point, Sarah appeared to have little awareness of her right to exist without being sexually harassed. So, although she had succeeded in graduating and finding a job she liked, she still held on to her sense of responsibility for creating these harassing situations, and she appeared to be constantly on her guard so that she could handle them "correctly."

Dawn was in her senior year of college. She was beginning to anticipate a time when she would be financially capable of caring for her sons in the manner that she would like, and she was also anticipating having more time and energy to devote to them. "I'm going to do this and I'm doing it and I'm almost done. I'm sure I'll finish" (Dawn, II, 5). It appeared at this point that Dawn was not yet quite able to let go of her feelings of responsibility for the sense of loneliness that she felt. However, she appeared to be

reprocessing her feelings of responsibility and coming to new conclusions about what she was experiencing. Her statement that "If you don't say anything then . . . it can be sort of uninclusive . . . they just look over me" (Dawn, II, 17), was an indication that she was coming closer to admitting to herself that what she felt was a lack of acceptance and that it was the lack of acceptance that was at the root of her isolation, and not a result of something that she had done. And, her comment that "I think that if I were a White male in the engineering field, those who appreciate the engineering field would find my input to be more valuable" (Dawn II, 19) indicated that she was coming to awareness that her status as a Black woman in engineering necessarily put her in the category of outsider and had nothing to do with any action on her part.

For approximately 8 years Blanche had accepted responsibility for selecting a major that was unfulfilling and inappropriate for her. She had been thinking of returning to school to earn her teacher's certification since shortly after completing her bachelor's degree. "I saw some ads for this teacher certification program and actually applied, and then I wasn't sure, so I backed out because it was like a commitment. Otherwise you had to repay the tuition. You have to teach for 5 years. I didn't want to jump into anything right away" (Blanche, II, 7). So, although she had been substitute teaching for a year and a half, Blanche had still not committed to returning to school.

During the course of our interviews, Blanche and I began to talk about how teaching high school physics was a way for Blanche to use her engineering education in a way that was meaningful for her and that would suit her. This seemed to give her a different perspective, one that allowed her to begin to think of herself as successful in terms of her selection of her major many years before. This change of perspective may

allow Blanche to see that lack of acceptance from those in her engineering program and poor teaching methodology led to her disconnect from engineering. In turn, this may allow her to let go of her acceptance of responsibility for having mishandled or misplanned her education.

Mandy, somewhat similarly to Blanche, felt as though she was a failure in her major because she was not able to connect with the material she was presented. Even though she graduated with a good grade point average, she still felt that she was a failure. She was pushing herself to give engineering a try. "I'm not sure yet if I will continue in electrical, I still want to do something, give it another try. But I don't see myself there forever" (Mandy, I, 2).

As she talked through her thoughts during the interviews, Mandy was able to express her conceptualization of success as knowledge of self, too, and she began to move away from her feelings of abject failure. "I was able to finish it and I did do something. And I was able to find at least an idea of what I want to do. Better than graduating and not knowing what I wanted to do still" (Mandy, II, 12-13). It appeared that Mandy had begun to let go of some of her feelings of failure and had begun to recognize that she was, in fact, successful in a way that she believed important.

During her interviews Maggie indicated that she felt responsible for sending miscues to men, miscues that led them to perceive of her as more than a friend and a classmate. She said that she did not try to be flirtatious, only friendly, and viewed this as a flaw in her personality. As a result, Maggie was watchful in how she approached her classmates. Since moving into her sorority house, Maggie began to let go of that feeling of responsibility. She had begun to recognize that relationships are the result of the

interaction between two people. She had begun to accept that she had the right to be friendly.

Jenna did not mention experiences that dealt with themes of responsibility. Because she felt so accepted by everyone in her engineering program, it may be that she had no need to accept inappropriate fault. Or, perhaps her capabilities in the classroom insulated her from feelings of inadequacy or marginalization.

Gender Affiliation

Relinquishing acceptance of responsibility seemed to allow the women in this study to deal with experiential themes of affiliation and identity. Themes of gender affiliation seem to require some form of reconciliation between the woman and her relationship with other women. Gender affiliation seems to be a reaction to gender estrangement or an opposite of gender estrangement. Experiences in the area of gender affiliation lead not only to the exploration of relationships with other women but also to exploration of the meaning of the term woman itself.

Maggie, in particular, was working in the area of affiliation. "I think when I was going through the stuff with my grandfather I realized that I really needed girlfriends to be able to talk to" (Maggie, II, 23). As a result of her realization, Maggie pledged a sorority house and lived with 25 other women. It seemed that her affiliation with women had begun to have an impact upon her perception of herself. She said, "I'm very tomboyish, well not so much anymore, but I have been most of my life" (Maggie, II, 4). And, in terms of what the sorority house meant to her Maggie said, "I think it is definitely a support system for all of us, definitely knowing that there's someone to go to

at all times. I mean there's 25 girls and most of us can talk to at least 10 of them about anything" (Maggie, II, 9-10).

It was apparent from her comments that Maggie had begun to develop close, meaningful relationships with a number of other women. However, she still found that she was somewhat conflicted in social situations where the women and men separate. "I feel kind of torn because I'm really good friends with the girls, but I also like to hang out with the guys. So I tend to go back and forth" (Maggie, I, 9). Although Maggie was affiliating with women at this point in her life, it seemed that this was a learning process for her and would take her some time to work through.

Mandy, too, had pointedly begun to work on developing close relationships with women. During the past few months she had ended her 2½-year relationship with her boyfriend and had begun to focus on making good women friends. She and two other women began to share an apartment the summer I interviewed her. They took turns cooking, and they made a point of eating dinner together in the evening, talking and sharing their lives with one another. Mandy had also made it a point to involve herself in the lives of the younger women she knew, sharing her experiences and her wisdom with them.

> So in that group I think I was sharing a lot of what I learned. Maybe I needed that, too. I needed that group for me to tell them what I learned, and I didn't want them to have to learn it alone. (Mandy, II, 22-23)

According to Jenna, during her K-12 years both the girls and the boys ostracized her. She had no friends and, in general, it seemed that her life at school was very difficult. "I also know at that time I was having problems just trusting anybody. I didn't want to talk to anybody. I had too much of this." (Jenna, III, 14). Being at college where

she had three good friends to share her time with had been an especially positive experience for Jenna. Currently all of Jenna's friends were male, and she still seemed to have issues with her perception of women. "A lot of the gals, it seems, are trying to sit there and vie for something and most of the guys they'll just accept you as who you are" (Jenna, I, 20). Thus it appears that Jenna continued to work on themes of gender estrangement.

Phoenix was the only woman who spoke of how close she was to the other women in the engineering program. According to her, "We have study groups and we have all of those things working together, even going out together after class. So it's like very, very close" (Phoenix, I, 7). She also says, "My friends support me spiritually" (Phoenix, II, 18).

Although she was able to develop close relationships with the Asian women within her engineering program, Phoenix seemed to have more of an issue with the American women that she encountered, finding the American men much more comfortable.

> Maybe it's because I feel more free when I talk to them. I feel so different when I talk to American girls. Of course there are many kinds of girls, but it's like they care about fashions and material things much more than my level so I feel like I don't have a common point to talk to them. They talk about celebrities and I don't know what to talk about. TV shows and like the Bachelor Show are not interesting enough. To them it's interesting and I feel left out of the group of American girls. So I start to just deal with guys. They like sports and I like sports so we talk about soccer and basketball. It is more fun (Phoenix II, 18).

Phoenix also had difficulty accepting the expertise of female faculty as well.

> She's awesome, but I still feel that she doesn't really have the mind of an engineer, of a real scientist. There is something very woman-like in her way of teaching. She is hard working and she has made professor at a very young age, but I still feel there's no passion in her lectures. . . . I don't really see that she can

> go any further in research, that she can really find a new thing for science. (Phoenix, I, 13)

For Phoenix, the issue of gender affiliation seemed less to do with her ability to identify with other women than with her ability to affiliate with and accept a feminine perspective, one that she perceived as just as valid and powerful as the male perspective she so yearned to have. "But in engineering and in science it's like the whole framework is imagined by people so it's basically design and it needs logic and a man's brain to develop" (Phoenix, I, 15). For Phoenix, the key to affiliation appeared to be the acceptance of the existence of a feminine perspective on science, on engineering, on life.

Not surprisingly, Blanche was sketchy on many of the details of her experiences while in school. She did not address themes of estrangement from women, and even mentioned her friendship with another woman in the engineering program. However, it is important to note that it had been 4 years since Blanche had been in school. She may have been unable to remember some of her experiences and feelings in great detail. And, it is also important to recognize that she had likely processed or reframed, consciously or unconsciously, many of her experiences and feelings from her days in college.

Sarah had been successful in both her undergraduate and graduate engineering programs, and she was currently working at a job that she found fulfilling. However, she had been unable to release her acceptance of responsibility for sexist reactions that she received. She continued to try to set suitable boundaries and enforce those boundaries in a way that was acceptable to men. Like Sarah, Dawn seemed to be working more on themes of letting go of responsibility. In particular, Dawn was in the process of letting go of responsibility for the lack of support and contact she had while in school.

Finally, there was Carol. There appears to be little in our interviews that would indicate that Carol had affiliation issues with women. While there were no women in her classes, about halfway through her undergraduate work she met a woman from the mechanical engineering program. They developed a friendship, roomed together for a year, and maintained their friendship through the time of the interviews. Carol also noted that she lived in the dormitories throughout her years in school and had women friends outside of the engineering program. For Carol, who has wended her way through 9 years of study in engineering, the biggest issue in terms of gender affiliation may be recognizing that women in engineering programs do feel alienated and that that alienation is a result of being a female in a male-centric field.

Identity Synthesis

The women I interviewed put themselves in an educational situation where they were marginalized, cast as an outsider, and yet each of them found a way to exist within that educational system. As they moved through their engineering programs, they began to think of themselves as engineers and they began to define what that meant to them in terms of their thoughts, behaviors, styles of dress, and a myriad of other dimensions. And, as they came to a point in their programs where they recognized that they would be successful, they had to assess who they were. This assessment was framed against their identity as an engineer and was done in the context of where they were in their lives. It involved the acceptance or rejection of the roles that had been politically, socially, and culturally determined as appropriate for them as women. Identity synthesis is the pulling together of the roles and behaviors that one chooses to adopt for oneself.

Carol had been considering her new identity as an assistant professor. She was able to articulate the responsibilities that the job would require, but she admitted that she still had not settled into the idea completely. "It does feel a little unreal just because 2 months ago I had no idea where I would be and now I'm thinking about teaching and I'm trying to go to these conferences and there's a hundred things going on at once that keeps it from feeling completely real. I'm just not used to it in my mind yet" (Carol, III, 2-3).

Carol was also working on melding her identity as an engineer, teacher, and researcher with the roles of wife and future mother.

> I was fortunate enough to find a man to share my life with who is really great but also extremely supportive, unusually supportive . . . so I feel much more optimistic now than I did before [about being able to combine being a wife and mother with engineering]. (Carol, III, 5)

This was an extremely eventful time of life for Carol, assuming a new job in July and marrying in December. She necessarily seemed to be doing a lot of work with themes of identity synthesis.

Sarah, too, was dealing with merging her conception of herself as a workingwoman and engineer with the possibility of becoming a wife and mother. But for her, the road was not so clear and the acceptance of the roles not so comfortable.

> I don't have an agenda like that [marriage and family]. I don't like to think I went through all of this [her education] for nothing . . . so I am continuously looking for any inside information of how do women handle this? (Sarah I, 7)

Sarah said that she and her boyfriend had had conversations about marriage and family, "but if it were just me . . . well, I still kind of think about a few things like salary and promotions and job transfers and all that fun stuff" (Sarah I, 8).

Sarah seemed to have internalized the male model of engineering as the appropriate model. As a result she was unable to conceive of herself as capable of putting

together the constructs of engineer, wife, and mother. Themes of identity synthesis were quite important to Sarah and she seemed to be spending quite a bit of her energy trying to synthesize an identity for herself that was comfortable for her at this point in time.

For Jenna, the issue of identity appeared to be how to cease thinking of herself only as a math-science, male-brained, androgynous being and instead begin to think of herself as a female with math and science proclivities. "I'm very male-brained.... I think a lot more towards the guy spectrum" (Jenna, I, 20). And later, "But I also know that while I'm female I think in many, many ways like guys do. I mean in all these brain orientation tests I always end up going male" (Jenna II, 10). Finally, "I don't think of girl, woman, whatever. I'm me doing my own thing. I don't, I've had that problem, too. I have problems labeling myself as far as.... What does it matter?" (Jenna, II, 16). So, while Jenna is experiencing issues with identity, it does not appear that she is currently at the point where she is ready to begin work on identity synthesis.

Like Jenna, it seems that neither Dawn nor Maggie was dealing with issues of identity synthesis at this point in their lives. Dawn had internalized her identity as mother completely. And thought she had begun to grapple with how to balance children and full time work, her identity synthesis issues were not apparent at this particular time. Maggie, too, gave no indication that she was dealing with identity issues at this point. Her energy seemed to be focused more on affiliating with other women.

Phoenix had begun to let go of her perception of the feminine perspective as less valid than that of the male perspective that she had so earnestly been trying to grasp. She seemed to be trying to integrate her awareness of her differing perspective into her identity as an engineer, in particular that of a woman engineer. "I really, really like doing

this thing [engineering] and I still hope that I can find something like you said, a new approach, so I keep going" (Phoenix, I, 16). In her last interview, Phoenix showed a shift in her understanding of what her issue was. "Sometimes I feel that I can't do it because sometimes the problem is just so male-thinking that I really cannot grasp it" (Phoenix, III, 6). She seemed to be working hard to synthesize her understanding of herself into her conception of engineer in order to forge a professional identity for herself.

During the previous year and a half Blanche had been substitute teaching and she had begun to recognize that she had ability and interest in the area of teaching. "I prefer working with the older students. I like it. I'm always teaching. It comes to me naturally even now that I'm working at the bank" (Blanche, I, 6). "I just try to teach people everything I can, anytime I can" (Blanche, II, 8). It appeared that Blanche had made considerable movement towards identifying herself as a teacher.

Finally, there was Mandy who seemed to be doing identity work in terms of searching for self-knowledge. "I think I'm one of the students here that are struggling a lot to find myself. . . . I had a lot of soul-searching I guess. I was trying to do a lot of that and trying to find what it is that I want to do in life. What is it I want to do in this major?" (Mandy, I, 5-6). It appeared that Mandy was working towards reframing engineering in relation to her perceived identity and that she had yet to come to a conclusion about the result.

These were the stories of Jenna, Maggie, Phoenix, Dawn, Mandy, Blanche, Sarah, and Carol. While their demographics varied considerably, there were many commonalities in their stories, their perceptions, and their experiences as women in engineering programs. Although the purpose of narrative inquiry is not to develop new

theories or propose solutions, the stories of these women do offer a new way to conceptualize the issues and experiences that women must face as outsiders in engineering.

This study was but one step towards understanding how women's experiences in engineering impact their retention. There appears to be considerable commonality in terms of women's experiences in engineering, their interpretation of those experiences, and their reaction to those experiences. If we are to gain further insight into women and their retention in science, mathematics and engineering, we must continue to use a critical feminist lens and qualitative methodologies to look at their issues. For if it is women's voices and women's perspectives that we seek to hear, then it is the richness of qualitative data and the interpretive stance of the feminist viewpoint that can tap into both the voice and the perspective.

CHAPTER 5

DISCUSSION

Analysis of the data from this study revealed a number of commonalities of experience for women enrolled in engineering programs. The common experiential issues appeared to be acceptance, gender estrangement, acceptance of responsibility, release of responsibility, gender affiliation, and identity synthesis. These experiential themes occurred as a result of participation in a field that appears to be open to women but that is, in fact, exclusionary and that casts women as outsiders.

Acceptance is a theme that addresses the reception women receive from the engineering faculty and from other students, especially male students in the engineering program. Succinctly, acceptance is the feeling that one belongs, that one is entitled to be in the class or the program. It is inclusion as opposed to exclusion.

Estrangement, another of the common experiential themes, seems to be a response to exclusion and reflects an attempt by women to fit into the educational system. This leads not only to estrangement from other women, but also to estrangement from themselves as women as well. Thus it is common for women to have only male friends and to think of themselves as "one of the guys."

By choosing to major in engineering, the women I spoke with located themselves in a social system that in many instances did not welcome or support them. Rather than blaming the system, however, the women inappropriately accepted responsibility for the

problems they encountered in engineering. That is, they accepted as their fault problems with their learning style and with the perspectives that they brought to the classroom. Other areas where they inappropriately accepted responsibility were their inability to connect with the subject matter, with their questioning of the meaning of engineering, and with their inability to achieve acceptance from people connected to the engineering program (i.e., faculty and other students). A number of the women I spoke with seemed to come to a point in their educational careers when they took another look at their issues of responsibility. This look was more self-assured and the women seemed less willing to accept blame. Instead there appeared to be a tendency towards relinquishing responsibility and a growing belief that blame should be laid outside of themselves. This release of inappropriate acceptance of responsibility not only freed the women of fault but also seemed to allow them to move towards other, more positive experiential commonalities in the areas of affiliation and synthesis of identity.

Affiliation is the ability to begin developing identification and connection or relationship with other women. It is a moving away from gender estrangement. For many of the women, identification manifested itself as an ability to begin to form close relationships with women both inside and outside of the field of engineering. It also seemed to allow them to begin to think of themselves as women and to begin to define what that meant to them.

The last experiential theme that emerged from the data was identity synthesis. Identity synthesis is pulling together aspects of the self into a cohesive whole. This feeling seems to allow a woman to move forward and to begin to consider who she is and

what she wants and needs apart from the exclusionary social system that exists in engineering.

Feminism

The participants of this study were a diverse group of women in terms of age, socioeconomic background, ethnicity, cultural background, educational level, and institution of higher education. However, they appeared to share many of the same experiential themes. Nancy Tuana (quoted in Olesen, 2000) contends that

> we are less likely to find a common core of shared experiences that are immune to economic conditions, cultural imperatives, etc., than a family of resemblances with a continuum of similarities, which allows for significant differences between the experiences of, for example, an upper-class white American woman and an Indian woman from the lowest caste. (p. 228)

In light of this, it was surprising to uncover so much commonality in experiences and feelings among this group of women. If the women were diverse, why would their experiences and feelings be so similar? The answer may lie with their lack of exposure to and understanding of feminist theory.

Of the eight women I spoke with, only Blanche and Phoenix claimed to be feminists. Dawn, who had taken a gender studies course, had comprehension of the concept of intersection of identities, i.e., woman, mother, and African-American. But she declined to call herself a feminist because of her inability to accept the feminist idea "that you don't need a man. I don't agree with that. I just don't agree with anything that doesn't uphold the family structure" (Dawn III, 2). In essence, none of the women had a basic understanding of the meaning of feminism. Most of them equated feminism with leveling the playing field in order to offer equal opportunities to women and men.

Knowledge of feminist theory would have provided these women with an historical lens through which they could view women's participation in science, mathematics, and engineering. Acknowledgement of the historical roots of science as "a virtual male monopoly of the production of scientific knowledge and discourses about science, its history and meaning" (Fee, 1986, p. 43), combined with knowledge of the economic and social threat that their participation in science engenders (Trecker, 2001), would have exposed the women to the theory behind the alienation and lack of acceptance that they experienced in engineering.

In addition, feminist theory would have provided the women with a political and social framework within which to interpret their own experiences. It would have helped them recognize that their stories were not unique but were experienced by other women as well. Evelyn Fox Keller said it took her many years to come to awareness that her experiences were not her responsibility but were the product of a system, one she could not interpret without a feminist perspective.

> It is a consequence of the assumption in the minds of others that what I am describing must have been a very personal, private experience—that is, that it was produced somehow by forces within myself. It was not. Although I clearly participated in and necessarily contributed to these events, they were *essentially* external in origin. (p. 10)

It has only been in the past 30 years that feminists have begun to make inroads into some areas of science and recast them using a feminist perspective. Primatology is a field that is now often regarded as a feminist science. Engineering, however, is not one of the science fields actively working to change its perspective to accommodate women, much less to adapt itself to a feminist perspective. As a result, women are excluded or, at

the very least, marginalized. I believe that the impact of this exclusion and marginalization can be seen in the women I interviewed.

Without even a rudimentary understanding of feminism, the women who participated in this study had no framework with which to interpret their experiences as women in engineering programs. That left them without the vocabulary and the perspective they needed to describe and understand their experiences and feelings, nor could they perceive their experiences as a systemic issue. As a result, like Evelyn Fox Keller, each woman in this group thought of her experiences and feelings as unique to herself, as personal. This left them to either adapt to or reject the system as it existed because they were unaware of any other choices. But to each woman, her adaptation or rejection was seen as a product of her own personal experience and her own personal bias and interpretation. Each woman saw herself as alone.

The women in this study perceived their experiences as unique to themselves, whereas the women's stories were, in fact, quite similar in terms of their experiences and their responses to those experiences. Until women in engineering have their consciousness raised by exposure to feminist theory, it is likely that women will continue to conceive of their experiences in engineering programs as unique instead of a response to being positioned in an exclusionary social system.

Why do women lack the background in feminism that would offer them the reference point for their experiences it appears they need so badly in order to traverse the educational system intact? How did feminism become a negative word? When and where did its message become so distorted that very bright young women reject its existence without searching out its meaning?

In light of the above questions it was heartening to note that when I spoke of feminism to the participants of this study there was a considerable amount of interest and general acceptance generated for the feminist message I shared. That message was very simple: What was being taught in their engineering programs was the male perspective on science. For several of the women—Phoenix, Dawn, Mandy and Blanche—it was a very timely and important message to hear. It would be interesting to know if these women had their interest in feminism piqued sufficiently to investigate it further.

Research Questions

The research questions posited at the beginning of this project were: What are the political, social, and cultural dimensions of women's experiences as engineering majors? How do the experiences in an engineering program impact a woman's decision to either persevere or change majors? What meaning do women ascribe to their persistence or attrition in engineering programs? I believe that this research study shed light on the questions that were posed.

The goal of postmodern qualitative feminist research is not to generalize results. Likewise, the goal of constructivist grounded theory is not to produce generalizable theory either. However, as Charmaz (2000) stated, the interpretations that result may "constitute a set of hypotheses and concepts that other researchers can transport to similar research problems and to other substantive fields" (p. 524).

I believe that the themes of acceptance, gender estrangement, inappropriate acceptance of responsibility, release of responsibility, gender affiliation, and identity synthesis that were discussed as experiential commonalities for women in engineering programs serve not only to give a backdrop for framing responses to the research

questions that were posed but also serve as jumping off points for future research on women in engineering. I also believe that these same commonalities may be useful in terms of looking at women in other marginalized fields of study as well.

Implications for Future Research and Practice

If the goal of our research into the issues that impact attrition and persistence for women in engineering programs is to increase the rate of persistence for women, then it appears that exposing women to feminism may offer them some "protection" from attrition by making them aware of the issues that they will face in a male-conceived and male-dominated area of study. Colleges and universities currently offer orientation classes to women to introduce them to the campus and to the lab environment. These classes also seek to introduce women to other new women in the curriculum in order to provide them with a sense of belonging and with a gendered peer group. This study, however, indicated that women without some understanding of the etiology of their lack of acceptance in engineering will develop a sense of estrangement from themselves and from other women, thus negating any positive influence that gendered orientation groups provide.

If women are introduced to feminist theory and given a framework and a feminist vocabulary, how will they fare in engineering? Will their rate of persistence be higher? Will their degree of estrangement be less? If we introduce feminism into the curriculum, are women then able to accept their own unique perspective in engineering, or do they continue to think of their perspectives as second-rate or wrong altogether? If we give women an introduction to feminist epistemology do we, instead of giving them the tools to be successful, simply deter them from entering the field altogether? If we decide to

introduce women to feminism, when should we do this? Before they begin a program of study? During the first year of study? Should it be a course or a group experience?

Just as importantly, who should give this information to female engineering students? Only two of the eight women I spoke with had had a female engineering faculty member during her course of study. There are too few women in the ranks of engineering faculty in academia. How many of them are likely to have an understanding of feminist theory?

The majority of engineering faculty are men. As reported by the women in this study, male faculty are often unwelcoming to the women in their classrooms. Do we simply accept that some male faculty will be uninclusive to women? Do we try to educate them? If the faculty members are more inclusive, will that have an impact on the male students in the engineering classes? Will they, too, become more inclusive?

What will introducing feminism do to the atmosphere in our educational institutions, particularly in those disciplines that are currently uninclusive of women? Will the rate of persistence and enrollments remain stable? Will there be any difference in impact for female and male students?

It would be very interesting to interview men in engineering programs. Are they forced into issues of acceptance, estrangement, responsibility, affiliation, and identity just as women are? Does engineering force men into their own set of experiential themes?

According to Alper (1993), if we are to address the problem of women in engineering we must do two things: increase the number of women in the pipeline and hold onto the women already in the pipeline. Future researchers may find that looking at women who excel in high school math and science is a productive area for research as

well. Some of the women in this study indicated that issues of identification with men and being "one of the guys" may, in fact, have begun during their K-12 years. Does this have an impact on the number of women who choose to go into engineering?

Personal Growth

My first interview was with Dawn on May 12, 2005. I was extremely worried that I was not competent enough to handle interviews with eight young women engineering majors. As I made my way to the Student Center at her school, however, I found that it was built beside and around a building emblematic of women's activity and contribution to society. It seemed like an omen, that I was returning to the place where so many social issues, so many women's issues had been addressed.

During the past 6 months, I have learned a tremendous amount about the mechanics and the processes of narrative research, and I also discovered quite a lot about myself as well. The untrained observer may look at narrative research and think how simple it is, but as one who has been through the process, I have great respect for the amount of work, care, sensitivity, and responsibility involved. Narrative inquiry requires the researcher to use herself as a tool, and it requires honesty, acceptance, and awareness. I found myself "big enough" to do this type of research in terms of the personal sensitivity to the interviewees, in terms of my openness to the data, and, most important, in terms of hearing what was said.

Listening to myself interact with the women in my study hour after hour as I transcribed close to 1,000 pages of interview data, I came to a new awareness of myself as a person. One of the most important things I learned was that I am often extremely kind. What a wonderful thing to learn about oneself! I also learned to respect my

responses to the interviewees. Even a second or third time through the tape left me feeling satisfied that I had responded as clearly, as honestly as I could, sharing myself and my experiences. I found that the research process brought personal acceptance as well. Not only did I come to like my own voice on tape, but the sound of my laughter in conjunction with that of the participants was joyous and inclusive, not derisive or exclusionary. The sound often brought a smile to my face.

Lastly, I found that as I talked with the interviewees about their experiences and feelings I came to terms with some of my own feelings of inadequacy as well. In particular, one of the women I interviewed was very difficult for me to like and accept. I found myself being judgmental about her thoughts and her actions. These feelings distressed me and, as I searched for why I was reacting to her so negatively, I came face to face with some of my own issues. This young woman reminded me very much of myself when I was her age, and I discovered that my feelings about myself clouded my reception of her. This recognition allowed me not only to develop a better relationship with my interviewee, but also to begin to accept my "college self" a bit more, too.

I think the interview experience was an extremely positive one for many of the interviewees as well. As we talked, it seemed that the articulation of their thoughts, feelings, and experiences made those thoughts, feelings, and experiences somehow more tangible for them and provided them with validation at a time when it was particularly important to them. I believe that some of the women experienced our interaction as consciousness raising experiences.

During my last interview with each woman I shared with her the impressions I had of her and the issues I believed she was working on in her life. Each of the women

seemed receptive to what I said even though there was some initial trepidation about what they would hear. I received thank you notes from four of the women telling me how much our time together meant to them. Because of their feelings of alienation, estrangement, and fault, coupled with issues of gender affiliation and identity synthesis, these women needed to talk, needed to be heard, and needed to be validated. I believe that at some level each of these women responded to my call for volunteers precisely because of her need for validation.

Conclusion

Using narrative inquiry and a feminist perspective, this study looked at the stories that women shared about their experiences in engineering programs to understand how those experiences impacted their decisions to persist or attrit from engineering and to understand how women explained their persistence or attrition to themselves. For the women who participated in this study, there seemed to be a significant degree of commonality among them in terms of their experiences in their engineering programs and in terms of their interpretations of those experiences. This led them to deal with themes of acceptance, gender estrangement, acceptance of responsibility, release of responsibility, gender affiliation, and identity synthesis. At the root of their issues is an educational system that is predicated on the exclusion of women from science. Because they are unaware of both the systemic nature of their exclusion and of the theoretical framework that feminist epistemology provides, they face their experiences in isolation.

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APPENDICES

A: National Science Foundation Table of Bachelor's Degrees in Science and Engineering

B: Pilot Study Findings

C: Human Research Committee Letter

D: Initial E-Mail Contact to Recruit Gatekeepers

E: Research Information Sheet

F: Contact Script

G: Letter of Consent

H: Opening Statement of Interview

I: Questions and Prompts Used During Interview

APPENDIX A

NATIONAL SCIENCE FOUNDATION TABLE OF BACHELOR'S DEGREES IN SCIENCE AND ENGINEERING BY SEX AND DETAILED FIELD: 1996

Appendix table 2-7. Bachelor's degrees in science and engineering, by sex and detailed field: 1996

Field	Both Sexes	Men	Women	Percent Women
Science and engineering, total	384,674	203,341	181,333	47.1
Engineering, total	63,114	51,798	11,316	17.9
Aerospace engineering	1,642	1,395	247	15.0
Chemical engineering	6,708	4,537	2,171	32.4
Civil engineering	12,053	9,629	2,424	20.1
Electrical engineering	16,667	14,695	1,972	11.8
Mechanical engineering	14,509	12,773	1,736	12.0
Materials engineering	1,004	781	223	22.2
Industrial engineering	3,727	2,630	1,097	29.4
Other engineering	6,804	5,358	1,446	21.3
Physical sciences, total	15,396	9,694	5,702	37.0
Astronomy	148	93	55	37.2
Chemistry	10,713	6,091	4,622	43.1
Physics	3,703	3,019	684	18.5
Other physical sciences	832	491	341	41.0
Earth, atmospheric, and ocean sciences, total	4,457	2,972	1,485	33.3
Atmospheric sciences	434	348	86	19.8
Earth sciences	3,838	2,504	1,334	34.8
Oceanography	185	120	65	35.1
Mathematics and statistics	13,076	7,084	5,992	45.8
Computer science	24,545	17,773	6,772	27.6
Agricultural sciences	16,388	9,884	6,504	39.7
Biological sciences	62,081	29,216	32,865	52.9
Psychology	73,828	19,965	53,863	73.0
Social sciences, total	111,789	54,955	56,834	50.8
Economics	17,896	12,524	5,372	30.0
Political science and public administration	39,928	21,578	18,350	46.0
Sociology	24,169	7,794	16,375	67.8
Anthropology	6,389	2,331	4,058	63.5
Linguistics	619	181	438	70.8
History of science	21	12	9	42.9
Area and ethnic studies	5,197	1,980	3,217	61.9
Other social sciences	17,570	8,555	9,015	51.3

Source: Tabulations by National Science Foundation/Division of Science Resources Studies; data from U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System completions Survey.

Women, Minorities, and Persons with Disabilities in Science and Engineering, 2000.

APPENDIX B

PILOT STUDY FINDINGS

PILOT STUDY FINDINGS

Although there are many themes that run through my interviews with J, there are two that I find particularly interesting and important to understanding J. One of these themes can be called J's search for her identity. The other theme has to do with J's connection to people and her battle to overcome isolation and rejection. Erik Erikson sees adolescence as the time when development of an identity is the primary developmental milestone. He sees early adulthood as characterized as a time when the individual searches for intimacy and/or a partnership (Scarr & Vander Zanden, 1987). At the age of 22 years J seems to be working on both areas simultaneously, which I suspect is not so unusual.

In terms of searching for and developing her identity, J speaks of how she sees herself, how her family sees her and how others see her. J's outward appearance seems to lend credence to the notion that she is seeking an identity. She presents herself as somewhat genderless, wearing no makeup, pulling her hair into a ponytail, and wearing a stocking cap pulled low over her forehead. She does not wear jewelry other than very large dumbbell-like studs in her ears and a large stud in her tongue. She also alluded to genital piercings and tattoos as well. Although she is very slight of build, J wears very large jeans and oversized layered tee shirts or sweatshirts. Shoes tend to be either clunky, black leather shoes or tennis shoes. J stressed that this was her personal style since high school and that studying in a field dominated by males had not had an impact upon her mode of dressing. She did, however, share that she had recently purchased a suit and was working towards a more feminine, high-class wardrobe. Her reason for doing so was so that she could "look like really good and attractive" when she went on interviews. She

seemed somewhat embarrassed by this admission and I wasn't clear whether it stemmed from her desire to look attractive or her feeling that possibly it was presumptuous of her to think she could look attractive.

Of Asian descent and adopted when she was about 2 years old, J identifies herself an American even as she comments on the lack of Asian students in her engineering classes. Although she states that most people view her as smart because she is Asian, she states that she is smart because she is J. I sense that J is grappling with her identity in terms of her culture of birth and is not certain how to reconcile her American self with this other self she sees in the mirror. Sometimes she sees her gender and her features as a liability:

> I mean, I have being a female against me, I have being an Asian against me. So I have a couple of minorities against me. Being an Asian, I know everyone looks at me and goes "Oh, you're smart." Like I'm not smart because I'm Asian. And I'm like, simply, "I'm American." So go and stop it.

It may be that these feelings are common among children of adoption and that there are a number of phases that one must go through in order to come to terms with one's identity as an adult. However, there is also no doubt that J sees her distinctly Asian features as a liability at this point in her life, something that makes her stand out and seem different.

I am not certain if you asked J to tell you who she is if she would be able to comply. She is able to give some descriptors that she feels are characteristic of herself. Most of these descriptors she has gathered from home, work, and school. At home J is known as the one who can put things together. The first story J was able to share had to do with this theme:

> My dad's favorite story to tell people about me when I was 9 or 10. I got the Lego Monorail System which was like 3,000 pieces or something of Legos. I had it together and up and running in an hour on Christmas Day. So from there he's always, like, knew I had an engineering kick in me.

And later:

> I redid the light sockets in my bedroom one year. I put in a new light, electrical outlets, new plugs. I painted my room and then did new electrical plugs and I rearranged my room. My walls were white and my ceiling was purple. And one year I came home and took apart or pulled up their floor because my dad started it and so I helped him and he just stopped and let me have at it, so I tore up his kitchen floor. They were putting down new Pergo flooring, so I cleaned everything up and got ready for the Pergo guys to come and take care of that. So they, they trust me, actually, they've had me put together a lot of, like, furniture type stuff. And mechanical-like stuff. Bookcases. Desks, entertainment centers, that kind of stuff. I put together so much . . . they'd bring home a bookcase. "J, I have a bookcase for you."

This role seems to have given J a tremendous amount of confidence in her ability to do hands-on kinds of things and it seems to be the one area that she is able to identify where her father is proud of her. It may be that the strength and importance of this identity has helped J remain in the rigorous electrical engineering program.

J has also gotten a sense of identity from her years working in the fast food industry. She has received several promotions in this field and thus sees herself as a good worker, a valuable employee, and someone who is capable of supporting herself. In addition, these jobs have helped her perceive of herself as having a good personality and a good sense of humor as well as an ability to relate well to people.

> Sometimes. When I *want* to be. You know the days that they just the people that they irk you and they just kind of like, That's nice. Now go away now. But most people I *am* really good with. I don't know, a little bit of my own personality [goes] into my conversations I have with people so that they, so they, customers kinda get a kick out of it.

J speaks of these aspects of herself with obvious pride as well as modesty.

Another contributor to J's sense of self-identity has been her academic success in the EET program at a private Midwestern university.

> It has definitely made me more confident in my grade ways. I just never perceived myself as being really smart and as I sit here today I know that there's a group of people outside of my classes that just look at me with awe and say, "I can't believe you do this. You are really intelligent." So it's definitely kinda boosted my ego in that aspect. And it has pushed my intelligence level, too.

From external sources, J has a number of descriptions that others have given her to describe herself. Though those external descriptions of who she is are important to her, she sometimes seems to have a poor grasp of what she herself likes and wants. For example, at the beginning of our initial interview, as we were just beginning to learn about each other, J revealed that the school band experience had been great. She said, "I enjoy music. Music and art and stuff like that. But I can't draw, so I never took art class, so I took music instead." She emphatically denied characterizing herself as an artistic type until I rephrased the statement to a "real sensitive, creative type." She then agreed.

Two weeks later, when asked what would be the most wonderful thing she could imagine herself doing in 5 years she said,

> Something that I'd like, I'd love, to do but I don't know how far I can pursue is to go into aerospace engineering or to go and get my master's in the arts. Like theater. Theater design. Like tech crew, stage production type of thing. Or one in multimedia art, like computer graphic images—something I'd really like to do which is drawing and then it's on the computer. That'd be cool.

In her interpretation of Bakhtin, Josselson (1995) says that "We must cease to regard people as finished entities and, somewhat paradoxically, we must find those places within narrative where the self is most clearly in dialogue with itself" (p. 37). I think this is an instance of what Bakhtin and Josselson describe. Within the interviews J begins to see and explore an additional dimension to herself. She begins to feel safe enough to

share her hopes and dreams with another person, perhaps formulating those ideas for herself for the first time.

I see J as a young woman still searching for her identity. She has gathered information from outside sources that help tell her who she is, but she is still in the process of learning who she is in her own eyes. Although I see this process of self-discovery as a life-long journey, I think J has been at somewhat of a disadvantage in this process, too, because of her inability to make close connections with other people in many areas and points in her life. This lack of intimacy and connection may be due to her original abandonment as an infant, because even though it seems that she was told her birth-adoption story many times, she, herself, cannot remember which birth-adoption story is hers and which belongs to her adoptive sister. In a way, it as though J does not even make an intimate connection with herself or with her beginnings.

Another period of her life that we discussed was high school. This was an unhappy time for J and she seemed to be isolated and ridiculed by the other students.

> I went to General North. It wasn't a fun school. I didn't enjoy it. High school is about social classes and things and I didn't fit in. General is very clique orientated, very superficial about looks and cars and money and stuff that doesn't have much value to me. So I kind of didn't fit in and I didn't like the people there because they were just kind of rude and mean to me. They'd point and laugh at me. Well, not quite point, but they'd laugh at me and just start making fun of me because . . . . I can't remember now. I tried to put it off, but . . . .

Because of her experiences in high school, J decided to work after finishing high school. Her choice of career was the fast food business, where employee turnover is high and shifts change constantly, thus making it difficult to form close relationships with others on the job. In addition, J worked for three fast food franchises during the 2 years

between high school and the private university, again indicating a possible lack of connection with both people and company.

When J's father became an instructor at the university, she found herself with the opportunity to attend college tuition free. On her father's recommendation, she chose to enroll in the electrical engineering technology (EET) program, a 3-year bachelor's degree program with the most stringent entrance requirements in the university and the program with the smallest female population as well.

As mentioned above, the EET program has served J well in terms of giving her a feeling of intellectual competence; however, it also seems to have presented obstacles for her in terms of providing an environment conducive to making friendships with classmates. For example, J states that she doesn't feel welcomed by the men in her classes.

> I think I didn't feel welcomed because they weren't welcome to me. As an analogy, the door wasn't open to accept me, like you have your door open. They need their door open, too. It kinda felt like their door was shut off to me. [Long pause]. It still kinda feels that way, so I don't really interact with a lot of the guys in my classes. Just because I mean we've been together for 2 years now but nobody has made any step towards it and I guess that kind of prevented me from making a step towards interacting with them.

Nor does she seem to connect well with the two or three other women in her program.

> There doesn't seem to be much desire to [interact]. They could actually study together. I don't know too much. I know they talk with each other. I see 'em but I'm not, sometimes I'm not very interactive with people.

Because she works on campus helping instructors in lab situations and grading student papers, J meets many new students. She seems to like this group better and believes that she made a lot of her friends in this way, men in particular, but women as

well. But because the attrition rate of first-year students is relatively high, J again sets herself up for continuing lack of connection:

> Just like I said, a lot of my friends have left and so I'm just kinda secluded at the moment which is good because I can stay with school, stay with that and not worry about anything else, but at the same time it's kind of depressing because I don't have any friends up here anymore because they've gone. They've left, but I'm just waiting for a new group of friends to become closer to.

The one group with which J seems to have made a connection is with her younger, also adopted, siblings. She speaks very fondly of them and I have had the opportunity to see her interact with them on campus. She seems relaxed and happy when she is around them and she reports that she visits them fairly often.

J's mother passed away unexpectedly during the first week in October. She did not speak directly of her mother except to say that adopting her was her mother's idea, so I was unable to get a feel for this relationship. My sense was that she is unable at this point to begin to process her mother's death and therefore prefers not to talk about her in any depth. Again, other than in passing, she did not refer to her father. Informally, I saw them exchange a few seemingly cordial phrases but nothing that would suggest a warm, loving relationship.

According to Belenky et al. (1986),

> In order for reflection to occur, the oral and written forms or language must pass back and forth between persons who both speak and listen or read and write—sharing, expanding, and reflecting on each other's experiences. Such interchanges lead to ways of knowing that enable individuals to enter into the social and intellectual life of their community. Without them, individuals remain isolated from others; and without tools for representing their experiences, people also remain isolated from the self. (p. 26)

This passage seems to me to speak of J. It seems that during much of her life she has been, if not isolated, then not connected to, her peer groups, thus leading to a lack of

both social ability and personal awareness. Whether this is due to a basic lack of depth on her part or whether this is merely, to paraphrase Ruthellen Josselson (1995), the present in terms of the past that points to a future that we cannot predict, remains to be seen (p. 35). I like to think, however, that J could benefit from therapy in which she could develop a close, safe relationship with someone who would help her begin to process who she is and what she wants for herself in the coming years.

Finally, I approached J as I saw her at this particular place in time. I worked very hard to get J to share stories, but she was often unable to do that and was never able to provide stories with any richness. It was obvious that J was depressed. Whether this is a long-standing depression or whether it is due to the recent, untimely death of her mother is something I was unable to assess. But, I would suspect that if I had interviewed J 2 months earlier I would likely have gotten a different picture of her experiences in the EET program.

APPENDIX C

HUMAN RESEARCH COMMITTEE LETTER

HUMAN RESEARCH COMMITTEE LETTER

Application for Human Research Review H-100
Colorado State University

This information will assist you in applying for approval to use human participants for research under Colorado State University's auspices. All of the information is available on the Regulatory Compliance Web page, http://www.research.colostate.edu/rcoweb.

1. Instructions

Under the Federal Policy for the Protection of Human Subjects, Federal Register, V. 56, No. 117, June 18, 1991, and later amendments, Colorado State University's Human Research Committee (HRC) is required to review and approve all proposed research involving humans that is conducted under the University's auspices. Approval is required regardless of funding status or sponsorship. Our campus policies are affirmed to the federal government in a document titled "Federalwide Assurance of Compliance with DHHS Regulations for Protection of Human Research Subjects" (1996, copy available on the Web page or by request).

The main considerations and responsibilities of the HRC are to determine that

a. the potential risks to research subjects are adequately addressed and their confidentiality is assured.
b. adequate explanation of the potential risks and safeguards, as well as benefits, are given to the subjects and their consent to participate is validated.
c. the proposals are clearly planned and the risk/benefit ratio to the subjects is clearly articulated and acceptable.

Philosophically, the HRC believes that investigators who use humans in their studies have a fundamental ethical responsibility to inform the participants of the nature of the investigation and obtain informed consent for participation in the studies. The procedure for obtaining informed consent may differ from one study to another, but using a carefully considered procedure has the advantage that it will reduce problems for the investigator in the future. Participants who have a clear understanding of the extent and purpose of their role in a study are less likely to have complaints about the investigator and the study. The fundamental right of individuals to be informed of their role in research should not be violated by investigators, and should be of particular concern to all involved in conducting research involving human participation. Failure of even one researcher to abide by ethical guidelines could jeopardize the future right of everyone at the University to conduct research.

The Administrator for the HRC is a staff person (see below) with the Regulatory Compliance Office, located at 410 University Services Center. All inquiries, correspondence, and submissions should be directed there.

A current copy of the *curriculum vitae* of the Principal Investigator must be on file in the Administrator's office. If you have submitted a vitae since July 1 of this year, you do not need to include it with this application.

If this project is being conducted for a graduate degree, the student's faculty advisory committee should approve it before it is submitted to the HRC. The faculty Principal Investigator will receive the original review and approval documentation; the student will receive copies through his/her campus department address. Renewal documents will be sent to the Principal Investigator only, since the student typically has graduated. It is the responsibility of the Principal Investigator to retain records and report the status of the project for renewal or close-out.

Data from human subjects are not to be collected until approval is received from the Human Research Committee.

Training of the PI:
A protocol may be reviewed, but not approved, until the Principal Investigator has successfully completed one of CSU's human research protection training options and met any continuing education requirements. This became a requirement with CSU's 2001 Federalwide Assurance. Details about training are linked from the human research web site at www.research.colostate.edu/rcoweb.

How to proceed:

1. Become familiar with this packet. Consult other links on the Human Research web page (FAQ and tips especially).
2. Complete Parts A, B, C & D. This must be done for all types of review. Include all necessary attachments.
3. *Preliminarily* determine the type of review for which your project would qualify (the final determination rests with the HRC and any project may be referred to the HRC for full review at a regularly convened meeting). If you have questions about the type of review for which your project will qualify, call the HRC Administrator in the Regulatory Compliance Office (see below).

- **Exempt Review:** See Exemption Criteria. Submit anytime. **Submit the original application.** Keep a copy for yourself. Reviewed by one reviewer. Response in approximately 10 days.

- **Expedite Review:** See Expedite Criteria. Submit anytime. **Submit the original application and one entire copy (but only one copy of the proposal/prospectus and résumé).** Keep a copy for yourself. Reviewed by two reviewers. Response in approximately 14 days.

- **Full Review:** Every other type of activity. Submit by noon on second Thursday of every month. **Submit the original application and 13 entire copies** (but only one copy of the proposal/prospectus and résumé). Keep a copy for yourself. Reviewed by full HRC at regular monthly meeting on the third Thursday of every month. Response is within 10 business days after committee meeting.

REMEMBER: Each application set represents your project to the HRC reviewer. It must be complete.

Submit application and copies to:

HRC Administrator
Regulatory Compliance
410 University Services Center
Campus 2011

After review, you will receive an e-mail or printed determination notice (copy to the student co-PI via campus mail to the department) outlining the reviewers' concerns. Once the concerns have been satisfactorily addressed, a written approval notice will be sent to both the researcher and the student Co-PI. Federal certification forms will be provided if the project is being submitted for funding to a federal agency requiring such forms (USDA, NIH).

Recognizing every situation has unique characteristics, please do not hesitate to call the Administrator if you have questions or concerns: Janell Meldrem, HRC Administrator. Telephone: 970-491-1655 FAX: 970-491-2293 E-mail: janell.meldrem@colostate.edu.

2. **Forms to be completed: Application to Use Human Subjects H-100**
   Part A: Cover page.
   Part B: Research Project Review Summary.
   Part C: Protocol information, to be typed on your word processor in Word. Every question must be answered, even if "not applicable."
   Part D: Special requirements/attachments checklist. Don't forget a copy of the entire proposal or prospectus.

3. **Helpful information** All of these are available separately on the HRC Forms web site.
   a. Exempt criteria
   b. Expedite criteria
   c. Risks of common procedures (focus groups, blood draws, etc.)
   d. Definitions
   e. Elements of a consent form
   f. *Model consent form. If your project will require a consent form, remove the italics, bracketed text from this model and add project-specific information to produce a consent form that is typically suitable for a routine project.*

   For best results, save this as a file to your computer. If bullets or different formatting are needed, unprotect the file.

Office Use Only: HRC Tracking number: _____
Type of Review: ☐ Exempt ☐ Expedite ☐ Full Category #_____ PI Trained Y ☐ N☐

APPLICATION FOR HUMAN SUBJECTS RESEARCH REVIEW
COLORADO STATE UNIVERSITY
(Please type or electronically fill)

Complete the cover page, review summary, and sections A, B, C & D. For full review protocols, submit the ORIGINAL (with original signatures and copy of proposal/dissertation/thesis) and 13 copies (each with attachments except proposal/dissertation/thesis) to Regulatory Compliance Office (RCO), 410 University Services Center, Campus Delivery 2011. Assistance is available on the RCO web site at http://www.research.colostate.edu/rcoweb

H-100 COVER SHEET Part A
Project Title (identical to proposal or thesis/dissertation): **Women in Engineering: Stories of Attrition and Retention** *OR* Grant Title if different from Project Title:

Contact Information

Principal Investigator (PI):

Name: **Lynn Safarik, Ph.D.**	Department: **Educational Leadership: School of Education**
Campus Mailing Address & Mail Code: **206 Education Building, Fort Collins, CO 80523-1588**	Phone #:
E-Mail Address: **safarik@cahs.colostate.edu**	

Co-Investigator (attach information if more than one Co-PI):

Name: **Janet Huelsen Abri**	Department: **Educational Leadership: School of Education**
Campus Mailing Address & Mail Code: **[address provided here]**	Phone #:
E-Mail Address:	

Funding Source: N/A	**PASS #:** N/A
Proposed Start Date (may not precede approval date): OR ☒ *"Upon HRC approval"*	**If Co-PI is a student, is this project for a:** ☐ **thesis** ☒ **dissertation** ☐ **other**
I think this qualifies for the following type of review: ☐ Exempt Category number **(submit original)** ☒ Expedite Category number **(submit original & one copy)** ☐ Full Review **(submit original & 13 copies)**	**New Protocol** YES ☒ NO ☐ **Resubmission** YES ☐ NO ☒ **Follow-up to 118 request** YES ☐ NO ☒

As the PI submitting this proposed research and signing below, I agree to conduct the research involving human subjects as presented in the protocol or modifications to it and as approved by the Department and the Human Research Committee; to obtain and document informed consent and provide a copy of the consent form to each subject unless this is waived by the HRC; to present any proposed modifications in the research to the HRC for review and approval prior to implementation; to retain records for the mandated lengths of time; and to report to the HRC any problems or injuries to subjects.

PI Signature: _____ Date: _____

My signature below confirms that I have read this protocol and approve of this research.

Department Chair/Head ☐ or ☐ Acting Signature

Signature:_____ Date: _____
(If PI is Department Head, please have alternate/designee sign)

PART B. RESEARCH PROJECT REVIEW SUMMARY Your completion of the following checklist will facilitate the review process.

1. **SUBJECT POPULATION:** (Check all appropriate boxes.)

☒ Healthy adults	☐ Children or minors (<18)
☐ Institutional residents	☐ Cognitively or psychologically impaired
☐ Elderly	☐ Pregnant women or fetuses
☐ Prisoners or parolees	☐ Non-English speaking

2. **IF THE RESEARCH INVOLVES ANY OF THE FOLLOWING, CHECK THE APPROPRIATE BOXES:**

☒ Interview	☐ Survey/questionnaire
☐ Clinical studies	☐ Behavioral observation
☐ Investigational drugs	☐ Investigational devices
☐ Deception	☐ Waiver of consent
☐ Study of existing data	☐ Controlled substances
☐ Study of human biological specimens	☐ Microorganisms or recombinant DNA
☐ Venipuncture	☐ Genetic research
☐ PI or Co-PI is the treating physician	

3. **LOCATION(S) OF RESEARCH TO BE CONDUCTED AT:**

☐ CSU campus	☒ Other locations, specify: **Research area described.**

4. **INFORMED CONSENT OF SUBJECTS: Your study protocol must clearly address one of the following areas: (justification for #2 & #3 must be included in your application) Discuss details in purpose section, (question lf).**

☒ **INFORMED CONSENT**: Signed informed consent is the default. A model consent is available on the HRC website and should be used as a basis for developing your informed consent document. **If applicable, the proposed consent must be submitted with the study protocol.** http://www.research.colostate.edu/rcoweb/hr/hr_forms.htm

☐ **COVER LETTER**: You may request a waiver of documented informed consent under the following conditions: (1) *That the only recording linking the subject and the research would be the consent document and the principle risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern*; **(45CFR46.117c1)**, ***OR*** (2)*That the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent if normally required outside of the research context.* **(45CFR46117c2)**.

It is the responsibility of the investigator to: a) provide clear justification for how a project meets the criteria for waiver of documented informed consent under one of the two previous categories, and b) provide what will be used to inform the subjects about research activities. It may be a telephone or verbal script, a cover letter, or some other means.

The cover letter needs to be sent to the subjects and to the HRC on CSU departmental letterhead.

☐ **NO INFORMED CONSENT**: You may request a waiver of informed consent under the following conditions: *(1) The research involves no more than minimal risk to the subjects; (2) the waiver or alteration will not adversely affect the rights and welfare of the subjects; (3) the research could not practicably be carried out without the waiver or alteration; and (4) when appropriate, the subjects will be provided with additional pertinent information after participation* **(45CFR46.116d)**.

It is the responsibility of the investigator to: a) explain how a project meets all four of the criteria for waiver of informed consent and b) where applicable, provide an alternate form of sharing study information with prospective subjects (i.e., a public service announcement, or a modified version of a consent to be used in research that by design requires deception – this type of research requires an accompanying debriefing form that completes the informed consent process).

PART C. RESEARCH PROTOCOL:

I. PURPOSE, METHODS, AND PROCEDURES: Describe the following:

a. Purpose (will be used in assessing the risk/benefit ratio for subjects. The hypothesis to be tested may be listed.) **The purpose of this study is to look at the meaning that women ascribe to the stories they share about their experiences in engineering programs to understand how those experiences impact their decisions to persist or attrit from engineering programs and to understand how women explain their persistence or attrition to themselves.**

b. Research methods and procedures of the study. (It is OK to diagram complex designs. Please include information on the time commitment required for each activity.) **This study will use qualitative research methodology, in particular narrative inquiry, in the tradition of constructivist grounded theory. Participants will meet with the interviewer for three semi-structured interviews lasting approximately one hour each. Interviews will be transcribed and tentatively analyzed prior to each subsequent meeting. During the third meeting, I will discuss any questions that have come up during transcription and interpretation. In addition, I will share with participants my impressions of their experiences and the meaning it appears that they have given to those experiences. I will seek each participant's reaction to my interpretation of her experiences and work to identify any gaps that may occur with her acceptance of these interpretations. This will serve as a way to offer participants a sense of closure and as a way to establish plausibility for the data analysis.**

c. Variables to be studied (what is being measured or examined). **Because this is a qualitative study, there are no variables per se. Instead, I will look at the meaning that women ascribe to the stories they share about their experiences in engineering programs to understand how those experiences impact their decisions to persist or attrit from engineering programs and to understand how women explain their persistence or attrition to themselves.**

d. Describe equipment used with subjects, if any. **If participants give permission, a tape recorder and microphone will be used to record their interviews for transcription and analysis.**

e. How will subject confidentiality or anonymity be maintained? If a linked list is used, list when it will be destroyed. Provide a sample of the code that will be used. **The anonymity of subjects will be maintained by using a first name pseudonym known only to the researcher. Any institutional information will be disguised so that participants cannot be identified by their specific background information. Because the number of participants is small, and because qualitative research necessitates close contact with each participant, a more formal code will not be needed.**

f. Describe the consent process and method of consent to be used. (*signed consent, cover letter, other*) **On the day of the first interview I will again introduce myself. I will reiterate the purpose of the research, read and explain the Letter of Consent, discuss any questions the participant may have, and request the participant sign the consent form.**

g. How will research records be maintained during and upon completion of the project? (This may include audio or videotapes). Indicate when the records and/or tapes will be destroyed. ***Federal Regulations require that study data and consent documents be kept for a minimum of 3 years after the completion of the study by the PI; for longitudinal projects, a longer period may be needed.***
During the research project all taped recordings, field notes, transcribed interviews and analyzed data will be coded with a first name pseudonym selected by the participant and kept by the researcher in a locked filing cabinet in her office. Transcribed tapes will be kept by the Co-PI until the conclusion of the study at which time they will be turned over, with all other study notes and data, to the PI, Dr. Lynn Safarik. After transcripts have been verified, the audio tapes will be destroyed.

h. Address how you will monitor this study to ensure that the study is being conducted according to the protocol. **As the Co-Investigator of the study I will personally conduct the interviews and analyze the data; therefore, I will be assured that the research protocol follows that outlined in this document.**

i. Is a Data Safety Monitoring Board required to conduct such monitoring? YES ☐ NO ☒
If yes, the HRC may request copies of the reports.

II. SUBJECT SELECTION: Indicate the following (this section must also be completed for secondary data analysis):

a. How will subjects be recruited and where will the recruitment take place? (*submit recruitment material*) **Gatekeepers will be recruited and provided with information on the study. They will be asked to share their knowledge of the study with potential participants and to distribute an information sheet about the study to these potential participants (See Appendix B). This information sheet provides telephone and e-mail contact information for the researchers that allows potential participants to contact the researchers and make their own decision about participation in the study.**

b. If secondary data analysis is being conducted, please describe the original consent procedures. N/A

c. What are the characteristics of the subject population? (age, gender, student, disease conditions, behavioral abnormalities; affiliations or memberships) **Requirements for inclusion into this research study are that participants are women who have graduated as engineers, those currently studying engineering, and those who have left an engineering program before its completion.**

d. How many subjects do you plan to study? **A maximum of twelve participants will be used in this study.**

e. Address the inclusion and exclusion criteria. Federal regulations consider minors, pregnant women and prisoners vulnerable populations that require added protection. When vulnerable populations are involved, describe why they are necessary. Excluding any group, i.e., minors, elderly, gender, ethnic minorities, must be clearly justified and inconvenience can't be the reason. **For example, if minors are in a classroom where recruitment will take place, parental permission must be obtained or justification must be made to exclude the minors.** Because the focus of this study is upon the experiences of women in post-secondary engineering programs, gender is an exclusionary criteria. However, because inclusivity and diversity are indicative of qualitative research in general, and feminist research in particular, an effort will be made to select participants that maximize the diversity of the group with respect to age, race, ethnicity, sexual orientation and social class.

f. Will subjects be compensated for participation? If so, please describe the proposed compensation. N/A

g. Criteria for excluding participants involuntarily (such as "failed to keep food diary as required") **Failure to keep two scheduled interview appointments without notifying the researcher will lead to exclusion of the participant.**

h. Letters of agreement/approval from the organizations that will be recruiting subjects for the project will be needed. Such letters need to be initiated by the organization, on organization letterhead, and signed by a person authorized to do so. The letters need to include statements a) that the organization is familiar with the scope of the project, b) that it is satisfied the individuals it is involving are adequately protected as human research subjects, c) that the subjects' participation is completely voluntary, and d) identify what the organization's involvement will entail.

III. RISKS AND DISCOMFORTS:

a. Describe any potential risks to subjects and assess the likelihood and seriousness of those risks. **(If there are no known risks, state as such, but do NOT respond "NA".)** These could include: physical, psychological trauma or stress, legal, social, economic, loss of confidentiality. **Potential risks to participants in this research study are minimal. It is possible that the sharing of experiences with the researcher may be stressful especially for those women who have attrited from engineering programs, but it is more likely that the sharing of these experiences will be cathartic to the participants. And, since the Co-Principal Investigator will be conducting all interviews and participants will be using pseudonyms, legal, social, economic and confidentiality issues should not be an issue.**

b. Please describe the proposed methods to minimize the risks and discomforts associated with the research. For example, document how potential psychological distress will be addressed, by whom, and with what credentials (provide letter of agreement from counselor explaining their role – this must be someone other than the researchers on the project) Specify what factors will lead to stopping procedures causing physical or emotional stress. **Participants will be permitted to terminate their involvement with the research study at any time. And, any indication that a line of discussion is uncomfortable for a participant, either through verbal or non-verbal cues, will lead to a member check in relation to comfort level, and a possible change of topic. With a background in counseling and guidance I will be able to assess psychological distress and refer participants to their institutional counseling centers.**

c. If the methods of research create potential risks, describe other methods, if any, that were considered and why they will not be used. N/A

d. Address procedures for maintaining confidentiality if a breach of confidentiality represents a risk. N/A

IV. ADVERSE EVENTS: Explain your reporting mechanism for reporting adverse and serious adverse events to the HRC. **If adverse events occur during this research study the Principal Investigator will be notified immediately both by phone and by e-mail. She will then report the event(s) to HRC.**

V. BENEFITS: Describe the anticipated benefits of the research to the individual subjects, to the particular group or class from which the subject population is drawn. The benefits must be realistic and not overly stated of what each person is likely to gain from the research. If there is no direct benefit to the subject, state so. For example: "There is no known benefit in participating in this study, but we hope you will gain more knowledge on..." Compensation, payment for participation, gifts, etc., are NOT benefits. **There are no known benefits from participating in this study; however, participants may find that they have a greater awareness of their feelings about their experiences as engineering majors and the process they went through in deciding to persist or attrit from this major. The experiences that these women share will add to the knowledge we have about women's experiences in science, mathematics and engineering majors and may lead to changes in these majors.**

VI. *Other matters pertinent to the human participant.* **N/A**

Part D. SPECIAL REQUIREMENTS/ATTACHMENTS CHECKLIST: For the items below, check where applicable and include with your protocol submission. Items marked "required" must accompany an HRC protocol application or the project can not be approved.

Research Proposal Materials

☐ **Grant proposal** (if this is a funded project, this is required)
☒ **Thesis/dissertation methods** (if the project is a thesis or dissertation, this is required)
☐ **CV** (If this is a first time submission as PI, this is required. A current copy of the curriculum vitae of the PI *must be on file in the Administrator's office. If the PI has submitted a vitae since July 1 of the current year,* the PI does not need to include it with this application).

Research Instruments/Tools

☒ ***Informed Consent**, or*
☐ **Cover letter** (with justification for waiver), or
☐ **Justification for waiving informed consent**
☒ **Interviews** (phone or in person) - attach script if applicable and questions to be asked.
☐ **Surveys/questionnaires** - *attach surveys and questionnaires if applicable. Provide permission use for* instruments (whether copyrighted or public domain)
☐ **Focus Groups: attach introductory script to the group and sample questions. (describe in consent form what a focus group is)**
☒ **Recruitment materials**: *Advertisements, press releases, in-class announcements, posted flyers, e-mail* announcements, phone script, or other forms of recruitment.
☐ **Debriefing Materials**

Research Collaboration/Support Materials

☐ **IRB approval** from other institutions involved in research (collaborating university, hospital, etc.)
☐ **Letters of cooperation** from participating sites that do not have an IRB.
☒ **Letters of agreement** (i.e., from a site that is allowing you access, but is not directly involved in research, or a colleague allowing you to recruit from a class, a clinic or business allowing recruitment, etc.)
☐ **Letter of collaboration** from a counselor if needed.

Secondary Data Analysis (for research involving secondary data analysis, include original IRB approval and informed consent)

☐ IRB approval from collaborating organization
☐ Consent form from original data analysis

From: Meldrem,Janell [mailto:Janell.Meldrem@Research.ColoState.edU]
Sent: Monday, April 04, 2005 12:11 PM
To: Safarik,Lynn; Janet Abri
Subject: human research, Safarik, Women in Engineering...

Your project, "Women in Engineering: Stories of Attrition and Retention" has been approved as of April 1, 2005. The letter with the approval details will be sent to you in tomorrow's mail.

****

Janell Meldrem

HRC Administrator

321 General Services Building

Colorado State University

Fort Collins, CO 80523-2011

970-491-1655

FAX: 970-491-2293

http://www.research.colostate.edu/rcoweb/

APPENDIX D

INTRODUCTION TO GATEKEEPERS

INITIAL E-MAIL CONTACT TO RECRUIT GATEKEEPERS

My name is Janet Abri. I am a doctoral student in Educational Leadership at Colorado State University. I reside in the northwest suburbs of . I am currently working on my dissertation on women's persistence and attrition in engineering programs. Using the school directory I have identified you as someone who may be able to help me recruit women to participate in my study.

I am interested in studying why retention rates for women in engineering are so poor. I plan to use qualitative research, in particular narrative inquiry, to listen to the stories that women have to tell about their experiences in engineering. How do the experiences a woman have impact her decision to persist or attrit from engineering? How do women explain their persistence or attrition to themselves?

I would like to find 12 women who are currently engineering students, who were engineering majors and decided to switch majors, or who graduated from an engineering program. I plan to interview each woman three times for approximately one hour each session at a location selected by the participants.

Would you be willing to talk with me further about possibly helping me connect with women who might be suitable for my dissertation research? I would greatly appreciate your help. You may contact me at the following numbers: during the day or at in the evening. My e-mail address is in the event e-mail is easier for you. You may also contact my dissertation advisor, Dr. Lynn Safarik, through her e-mail at Colorado State University if you have any further questions or concerns.

Thank you for your consideration. I look forward to hearing from you.

APPENDIX E

RESEARCH INFORMATION SHEETS

RESEARCH INFORMATION SHEET

My name is Janet Abri. I am a graduate student working on my Ph.D. in Educational Leadership at Colorado State University. I am looking for participants to interview for my doctoral dissertation.

My dissertation focuses on the experiences of women who are currently studying engineering, who were in engineering programs and decided not to pursue that major, or who graduated from an engineering program. I hope to gain insight into how a woman's experiences in an engineering program may have an effect on her decision whether or not to continue studying in this field.

Being a participant in this study would require that you and I meet at a location and time of your choice for three separate interviews. Each interview would probably be about an hour in length. We would talk about your experiences in an engineering program.

Your thoughts, feelings and experiences are important. The experiences you share as a woman who is or was studying engineering will add to the research we have on why women continue in the field or choose to change to another major. Your experiences may also help us to more clearly identify issues of importance for women in engineering.

There are no tests. Your identity will be protected so that you maintain your confidentiality.

If you are interested in participating in my study, please contact me, Janet Abri, at your earliest convenience. My e-mail address is and my phone number is . You may also contact my dissertation advisor, Dr. Lynn Safarik through her e-mail ( ) at Colorado State University if you have any further questions or concerns.

APPENDIX F

CONTACT SCRIPT

CONTACT SCRIPT

Hello. This is Janet Abri. You left a message for me that you are interested in participating in my dissertation research on women in engineering.

Thank you so much for calling. How did you hear about my study? Did you receive a copy of the Research Information Sheet?

To reiterate for you, I am working on my doctoral dissertation. I am interested in women and their experiences in undergraduate engineering programs. The dropout rate for women in engineering is very high and I am interested in looking at why that is. I believe that talking to women who are or have been in engineering programs will give me an understanding of the issues that women in engineering face.

If you choose to participate in this study you and I would meet for three interviews lasting about one hour each. We would schedule the interviews at a time and a location that you select. During the interview we would talk about your experiences in your engineering program. Do you have any questions about my research and the involvement it would require on your part?

If you are interested in participating I would like to schedule our first interview. Can you select a date, time and location that would be convenient and comfortable for you? At that time we will review consent procedures and have our first interview.

If you need to get in touch with me you may contact me at home at or through my e-mail at You may also contact my dissertation advisor, Dr. Lynn Safarik, through her e-mail (at Colorado State University if you have any questions or concerns.

Thank you again for your willingness to share your experiences with me. I look forward to seeing you on _____ (date) at _____ (time) at _____ (location).

APPENDIX G

LETTER OF CONSENT

LETTER OF CONSENT

Consent to Participate in a Research Study
Colorado State University

TITLE OF STUDY: Women in Engineering: Stories of Attrition and Retention

PRINCIPAL INVESTIGATOR: LYNN SAFARIK, PH.D.
DEPARTMENT OF EDUCATIONAL LEADERSHIP, SCHOOL OF EDUCATION, 206 EDUCATION BUILDING, FORT COLLINS, CO 80523-1588

CO-PRINCIPAL INVESTIGATOR: JANET ABRI

WHY AM I BEING INVITED TO TAKE PART IN THIS RESEARCH? You are being invited to take part in this research as a woman who is currently enrolled in a post-secondary engineering program, who has been enrolled in a post-secondary engineering program or as a woman who has graduated from a post-secondary engineering program.

WHO IS DOING THE STUDY? Janet Abri, a doctoral student in the Educational Leadership program at Colorado State University, under the direction of Dr. Lynn Safarik, is conducting this study.

WHAT IS THE PURPOSE OF THIS STUDY? The purpose of this study is to look at the meaning that women give to their experiences in engineering programs in order to understand how those experiences impact their decisions to persist or to dropout of engineering programs and to understand how women explain their decisions to themselves.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST? The study will take place at a location determined by you. You will be asked to meet for three interviews of approximately one hour each over a span of several weeks.

WHAT WILL I BE ASKED TO DO? You will be asked to share your experiences in the engineering program that you attend(ed).

ARE THERE REASONS WHY I SHOULD NOT TAKE PART IN THIS STUDY? You should not participate in this study if you are not willing to commit to doing three interviews or if you are not willing to share your experiences while enrolled in an engineering program.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS? There are no known risks involved with this project. While it is not possible to identify all potential risks in research procedures, the researcher(s) have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

WILL I BENEFIT FROM TAKING PART IN THIS STUDY? You may find that there are some benefits to participation. Those benefits may involve a greater awareness of your own feelings about your experiences in an engineering major as well as a greater understanding of the process you went through in terms of deciding to persist or drop-out of this major.

Page __ of __ Participant's initials _____ Date _____

DO I HAVE TO TAKE PART IN THE STUDY? Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled. You may also ask to have all of the information that can be identified as yours returned to you, removed from the research records, or destroyed.

WHAT WILL IT COST ME TO PARTICIPATE? There are no costs associated with your participation other than travel to the location that you select as an interview site.

WHO WILL SEE THE INFORMATION THAT I GIVE? This study is confidential. That means that no one except myself will know that the information you give comes from you. You will be known only by a first name selected by you. We will keep private all research records that identify you, to the extent allowed by law. And, while we may publish the results of this study, we will keep your name and other identifying information private.

CAN MY TAKING PART IN THE STUDY END EARLY? You will be removed from the study if you fail to reschedule two interview appointments.

WILL I RECEIVE ANY COMPENSATION FOR TAKING PART IN THIS STUDY? There is no compensation for taking part in this study.

WHAT HAPPENS IF I AM INJURED BECAUSE OF THE RESEARCH? The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury.

ARE YOU COMFORTABLE HAVING YOUR INTERVIEWS TAPE-RECORDED? YES NO
I would like to actively listen to you during our interviews. Tape-recording the interviews would free me from taking notes and would allow me to analyze the interview after its conclusion. Tapes would be kept in my office in a locked file cabinet until the conclusion of the study when they would be destroyed after verification.

WHAT IF I HAVE QUESTIONS?
Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about the study, you can contact the Principal Investigator, Lynn Safarik, at or the Co-Principal Investigator, Janet Abri, at . If you have any questions about your rights as a volunteer in this research, contact Celia Walker, Director of Regulatory Compliance, at (970)491-1553. We will give you a copy of this consent form to take with you.

Your signature acknowledges that you have read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing ___ pages.

_____ _____
Signature of person agreeing to take part in the study Date

_____
Printed name of person agreeing to take part in the study

_____ _____
Name of person providing information to participant Date

_____
Signature of Research Staff

Page ___ of ___ Participant's initials _____ Date _____

APPENDIX H

OPENING STATEMENT OF INTERVIEW

OPENING STATEMENT OF INTERVIEW

I am interested in hearing about your experiences as a woman studying engineering. If you consider the incident or feeling important then it will be of interest to me. Please begin your story wherever you would like.

APPENDIX I

QUESTIONS AND PROMPTS USED DURING INTERVIEW

QUESTIONS AND PROMPTS USED DURING INTERVIEW

1. What led you to choose engineering as a major?
    - Long-standing interest?
    - Family member/friend/teacher?
    - School experiences — science or math?
    - Future opportunities?
2. How did you select the college or university that you attend(ed)?
    - Visit?
    - Scholarship?
    - Friend/family member/teacher?
3. Think about the first class that you took that you would characterize as an engineering course. Can you tell me what that class was like for you?
    - What was the class?
    - How did you feel in that class?
    - How do you think you were received by the other students? By the faculty member?
4. Were subsequent engineering classes about the same? How did they differ for you?
5. What do (did) you like best/least about the engineering program?
    - Curriculum (subjects taught, length of program)
    - Classmates
    - Instructors
    - Format (i.e., labs, lectures)

6. How would you describe yourself?

   - Are you more of a thinker or a feeler?
   - Are you more independent or dependent?
   - Any unique characteristics that helped you?
   - Any characteristics that caused you problems?

7. Tell me about your social life.

   - Do you have a boyfriend/girlfriend/fiancée/husband?
   - How long have you been dating/living together/engaged/married?
   - Did you meet in school?
   - If he (she) is an engineering student as well, did his (her) presence help you? How?
   - How often do you see him/her?
   - How would he/she describe you?

8. How would you describe your friends?

   - Are they mostly females, males or a mixed group?
   - Are they mostly engineering majors?
   - Are they friends from college or high school?
   - How much time do you spend with your friends?
   - How would they describe you?

9. Do you believe that your interest in engineering has had an impact on how people perceive you?

   - Women?
   - Men?

10. How do you think that this program has changed you?
    - Emotionally
    - Intellectually
11. Do you like these changes?
12. Can you share an experience with me that helped you decide that you are (were) in the right field? That you should change major?
13. What has (would have) helped you succeed in engineering?
    - More time with the instructor
    - Study groups
    - More lecture
    - Different curriculum
14. If you had the opportunity to offer advice to a woman planning on an engineering career, what would you tell her?
    - Re: personal advice
    - Re: academic advice
    - Re: professional advice
15. Have you had to make choices in your personal life because of your interest in engineering?
16. Do you believe that your gender had any impact on your success or lack of success in engineering? How?
17. If you had been a white, middleclass, male student do you think that your experiences would have been different? How, specifically?
18. Would you describe yourself as a feminist? What does that mean to you?

19. Do you worry that you should be [have had been] smarter, work [ed] harder or be [been] better prepared, to be [have been] more successful in the engineering program?

20. If you could go back and start over again, would you study engineering? Why or why not?