ENGINEERING THEIR FUTURES: THE EDUCATIONAL AND WORKPLACE EXPERIENCES OF FEMALE ENGINEERS

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BRIEF ABSTRACT FOR:

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Over the past decades while women have made inroads into many nontraditional occupations, they still represent a small portion of the engineering and science workforce. In addition, research demonstrates that women tend to leave engineering occupations at faster rates than do men. Yet, occupations in engineering and engineering related fields have grown throughout the recent decades and are expected to continue to grow throughout the upcoming decade, creating millions of new jobs to fill by 2008. Indeed the jobs that are growing the fastest are precisely the jobs in which women are not represented. The question researchers and policy makers must grapple with is how do we recruit and retain women in engineering in order to not only address equity issues, but meet labor force demands.

This paper presents qualitative data from an ongoing study of female engineers. In this paper we draw on original survey data to explore the reasons women choose to enter (and stay in) engineering occupations, and more specifically, what factors serve to encourage (and conversely, discourage) women from entering this nontraditional field. In doing so, we undertake a comprehensive investigation of women in engineering in which we focus on both their educational and workplace experiences. We provide the stories of women who have chosen engineering careers, and we provide them in their own voices. After first presenting our findings, we demonstrate how they are useful in creating strategies to address barriers at both the educational and workplace levels that prevent women from entering and staying in engineering occupations.

Sex segregation- the unequal distribution of men and women into different industries, occupations, and jobs- has been a feature of the United States labor market for decades. Much research has documented that women tend to be disproportionately over represented in traditionally feminine occupations, such as secretaries, teachers, cashiers and nurses. In contrast, men tend to be concentrated in occupations that are traditionally masculine, such as engineering, law and construction. In fact, sex segregation is so prevalent that researchers estimate 50 percent of male and female workers would have to change occupations to fully integrate the labor market (Padavic and Reskin, 2002; Jacobs, 1999). The prevalence of sex segregation has lead many researchers to explore the reasons surrounding the existence and maintenance of this phenomenon. In this paper we contribute to the literature on sex segregation by surveying women who entered into nontraditional occupations, specifically women in engineering and technology occupations. Using a micro sociological analysis we seek to understand the reasons women choose to enter (and stay in) engineering occupations, and more specifically, what factors serve to encourage (and conversely, discourage) women from entering this nontraditional field.[1[1]] In doing so, we undertake a comprehensive investigation of women in engineering in which we focus on both their educational and workplace experiences. By gathering this data, we anticipate that we will not only better understand what why women enter certain nontraditional occupations, but also begin to formulate strategies to recruit and retain women in engineering fields.

[1[1]] While our focus in this paper is on explanations for sex segregation that center on individual factors, we do not ignore the role of macro sociological explanations. For an extensive discussion of sex segregation, see Jacobs, 1999.

An examination of women in engineering is able to highlight many significant economic and parity issues. Over the past years the disproportionate representation of women in science, engineering and technology has received much public attention. While women make up approximately 46 percent of the total American workforce, they fill only 19 percent of the science, engineering, and technology jobs (CAWSMET, 2000), and women hold only 10 percent of the highest level information technology jobs (Sandy and Burger, 1999). However attracting women to jobs in science and technology is only part of the problem. Studies find that women leave science, math, and technology careers twice as frequently as men (AWSEM, 1997). Therefore not only do we need to know what factors encourage women to enter the nontraditional field of engineering, we need to know what factors will keep them in this occupation. In fact, the need for this information does not just represent the need for equity in the workforce, but has become a business issue, as we are facing significant labor shortages in science, engineering and technology fields. Peter Freeman and William Aspray (1999) suggest that if the number of women in the information technology workforce increased to equal the number of men, the huge demand for labor in these jobs could be met. Therefore, it is imperative to understand the experiences of women in science, engineering and technology occupations, along with the reasons they enter and leave these occupations, in order to address both the pressing economic and equity issues facing the United States.

Women in Science, Engineering and Technology – Issues of Equity and Economics

Much research has demonstrated that it makes good business sense on the parts of workers and companies for women and minorities to enter into science, engineering, and technology jobs. Women who choose non-traditional careers can expect lifetime earnings of 150 percent more than women who choose traditional careers (Gatta, 2001). Corporations also

realize that attracting women (along with members of diverse racial and ethnic groups) to careers in engineering and technology fields helps to create a competitive market advantage. A survey of Fortune 100 human resource executives found that diversity in the workplace brings about better utilization of talents, creativity, team problem solving, and increased marketplace and leadership understanding (CAWSMET, 2000). This sentiment was echoed by William Wulf, president of the National Academy of Engineering, during a talk in which he clearly referenced the positive role women and diverse employees play in engineering jobs. As he states, "every time we approach an engineering problem with a pale, male design team, we may not find the best solution. We may not understand the design options or know how to evaluate the constraints…there is a real economic cost to that. It is measured in design options not considered, in needs unsatisfied…It is that a product that serves a broad…customer base may not be found." (Wulf, 1998).

With such benefits to both women and companies why do women continue to be underrepresented in these careers? Research finds that an individual's occupational choice is a function of many factors, including social influences that provide incentives and/or disincentives for individuals to pursue certain occupations and eschew others. We see two main categories[2[2]] of factors that may serve as barriers to women entering engineering and technology occupations, and may also cause them to leave these occupations:

-gender socialization throughout an individual's lifetime;

-gender attitudes and workplace climate;

-work and home integration.

In the next sections we briefly review some of the main research in these areas.

[2[2]] While research has documented that these two categories are critical to occupational choice they are by no means exhaustive.

Gender Socialization. A long standing tradition in understanding sex segregation has been a focus on gender socialization. This paradigm claims that women and men develop different occupational perspectives and skill sets based on what is culturally considered appropriate for each sex. Societal messages, parents, teachers, and other agents of socialization develop and reinforce traditional gender identity and gender typed behavior in men and women.

Much of the literature on gender socialization and occupational choice has emerged from the psychological and sociological disciplines over the past thirty years, with a focus on the formation of occupational gender roles in children. Helwig (1998) provides a succinct summary of three of the main explanations of gender role stereotyping and the development of occupational choice in children. One of the earliest theories, cognitive development theory (Kohlberg, 1966), asserts that children go through stages of awareness and understanding of gender before social experiences influences them. Children first identify their gender as distinctive from the identity of members of the other sex. Once they "know" their gender, they then experience gender stability. In this stage they gain awareness that they will eventually become a man or women. Finally, by age seven, children develop gender consistency. In this stage children learn that their gender will not change even though they may engage in cross-sex behaviors (Helwig, p. 404).

Cognitive development theory has received mixed support in the literature. While researchers have found that younger children are more likely than older children to gender stereotype occupations, older children continue to report personal occupational aspirations along stereotypical gender lines. In contrast to the predictions of cognitive development theory research demonstrates that gender role occupational stereotyping does not decrease as children

age. As a result of such inconsistencies, psychologists have searched for other developmental patterns of occupational choice.

O'Keefe and Hyde (1983), among others, proposed social learning theory in order to address the criticisms of cognitive development theory. They find that through differential reinforcement by parents, teachers, and other adults; imitations; and role modeling, young children are taught to engage in gender appropriate behaviors and pursue gender appropriate academic subjects and occupations. Gottfredson (1981) furthers this idea with his theory of circumscription and compromise. Gottfredson argues that career development occurs through different stages. At a young age children become aware of gender type, prestige level and skill sets required for occupations. As children age they undergo a "compromise" stage of development in which they adjust their occupational choices based on perceptions of gender, social value, intelligence, and their own unique traits.

While the theories may disagree on the variations in the process of gender socialization, most theorists argue on the importance of gender socialization in future occupational choices of women and men. Children tend to sex type occupations at a very young age, pointing to the importance of the role of parents in individuals' future occupational choices. However, this relationship is quite complicated. Numerous studies have found levels of support for the role of parents, especially the same sex parent, in occupational choices. Since there are many complicating factors such as, race, class, work status of mothers, and whether effects of parents can be generalized throughout one's career, future research is needed to explicate this relationship (Miller and Garrison, 1982). What is perhaps more widely supported is the role of both parents' and teachers' expectations of their children, especially in regards to nontraditional fields of science, technology and mathematics (Gutbezanl, 2001). As a result of differential

treatment based on gender in these fields, girls may be discouraged from nontraditional fields later in life.

Much research has also found that beliefs about gender appropriateness of careers are funneled in other societal venues. The media, for example, has been targeted in helping to form and reflect societal beliefs about men and women. Barbercheck (2001, p. 118) finds that male characters tend to be portrayed as independent, assertive, technical, and responsible in mass media. Alternatively women are more likely to be emotional, warm, domestic, weak, and helpless. Barbercheck finds that these advertisements then act as "achievement scripts" for women, providing them with gender appropriate behavior. For example, she finds that advertisements in Science, an academic journal, portray science as a masculine field and occupations; and when they do appear they often are conceptualized as objects to be studied or in stereotypical female roles. Similarly, Knupfer (1998) found that in advertisements on the Internet women serve a decorative role, such as background decorations on computers. Women tend to be portrayed as subservient, nurturing, or not using technology in a productive way. These media portrayals help to foster stereotypical beliefs about women, which then impacts women's occupational knowledge and role identification. However, while gender socialization is a significant factor contributing to an individual's occupational choice, it is only part of the puzzle. Not only do women not enter science, engineering and technology occupations in great numbers, they tend to leave these occupations at a faster rate than do men. In the following sections we review some of the literature focusing on workplace factors that may affect women's choices to leave engineering occupations.

Workplace Climate. Catalyst (1999) among other studies, reports that women often leave science and technology jobs (and similarly may not enter them at all) because of the cultural

climate in their workplaces. Many of the science, math, and technology workplaces do not provide an environment that is "female friendly." Central to a female friendly environment are formal and informal practices that promote a feeling among female workers that they are respected and valued within the company. These practices include policies that support family life, provide mentoring opportunities, and help in career development, promoting an overall feeling of value for the women scientists and engineers. Without a cultural backdrop that promotes the value of the female employees, women will leave the companies, and often the fields of science, math, and technology all together.

Often women assert that many science and technology organizations operate under the "old boys network." Many women report that they are left out of the important decision making meetings and opportunities. They felt that these decisions occurred in very informal and exclusionary settings, such as in hallway conversations, on the golf course and tennis courts, and in "invitation-only" meetings (WITI, 1997). Women felt they were not part of the organization and that their input was unimportant. This mentality of the "old boys club" is a long-standing tradition in science and technology jobs that has served to minimize women's roles in these organizations and justify their exclusion and marginalization. Clearly related to the undervaluing of women is that they do not fit into the image of the technical expert. Often, for example, female computer scientists are mistaken for secretaries or marketing personnel (Kalson, 2000).

Despite the fact that there is a large labor shortage in science and technology jobs, women continue to experience less labor market rewards than do men in this field. A recent 2001 Techies.com survey of 106,133 men and women in technology jobs from entry-level to executive positions across 39 major United States labor markets found that, while women have made some inroads in regard to pay equity in science and technology, there are still inequities.

Women averaged approximately $5,000 less in annual pay than their male counterparts. Among less experienced younger workers (workers with up to 5 years of experience) women's earnings were almost on par with men's earnings. However, women with 10 or more years of experience earned on average nine percent less than men with comparable skills and experience. The researchers found that the larger wage gap at the more senior levels indicates that women are not getting promotions at the same rate as men, and are not advancing into higher level executive and managerial positions. As such, the pay gap is reinforced by the glass ceiling at the highest levels.

The pay gap also differs across job category in science and technology. The Techies.com study found that professionals in software development and engineering were found to experience the smallest wage gap, while women in data management fields earned only 84 percent of men's salaries (approximately $12,500 a year less). Women also experienced an earnings gap in recruiting/HR positions in science and technology firms. In these areas women earn $11,300 per year less than their male counterparts.

Work and Family Life: Reaching a Balance. For decades much research has demonstrated that many women are concerned with ways to integrate work and family. Women work a "second shift" each day (Hochschild, 1989). That is, women work full-time in the paid labor force, and they continue to bear primary responsibility for the family and home. This double burden of home and work puts women at a disadvantage in all forms of paid labor. However, this second shift can be highly detrimental to success in science, engineering, and technology jobs.

The work climate in science and technology workplaces is based on the idea of heroic leadership: "the longer I can work, the better" (Thom, 2001). As such, many women perceive

that the greatest barriers to their success in information technology (IT) careers are long work weeks (50-60 hours per week), expectations to work late hours, and a high stress job environment (Sandy, and Burger, 1999). As a result of these factors, women report that they often leave IT careers because the long hours that they are expected to work are detrimental to their family lives. In addition, women find that if they stay home for one to two years to take care of family responsibilities, they cannot easily return to their jobs because of changes in the technology used. Finally, women feel that managers are reluctant to allow part-time work. Often, women may reduce their work hours to try to integrate family and work responsibilities. As a result of their new part-time status, women find that they are assigned to less desirable projects, causing their careers to stall or prematurely end.

Our Study

In May, 2002, we were asked by the Society for Women Engineers, in New Jersey (SWE-NJ), a professional organization, to survey their membership. The idea guiding the survey was that the women in the professional society represent a population of women who have chosen to enter science, engineering and technology occupations, and have remained in those occupations over time. By surveying these women in regard to issues of gender socialization, workplace climate, work/family integration and discrimination, we believe that we can better understand how these factors affect women's occupational choices in science, engineering and technology.

To study women in SWE-NJ we distributed our survey in the SWE-NJ newsletter, which is mailed to all members, and posted the survey on the SWE-NJ website. Our response rate to the survey was approximately 5 percent. (See Appendix for sample description.) While our

response rate is low, we are currently in the process of resampling our population to increase this rate. As such, this paper is a preliminary examination of the experiences of women in engineering based on the initial surveys.

Our Findings

Building on the research in this area, we constructed our survey to include questions that would allow us to ascertain both issues of gender socialization over each woman's lifetime that may have encouraged/discouraged her future occupational choices in engineering, and issues of parity and workplace climate during her career that may affect her decisions to remain in engineering occupations. While these areas are highly interrelated in understanding women's occupational choices, we will treat each separately here for ease of discussion.

Educational Experiences

The Role of Parental and Teacher (Dis)Encouragement. As evident from previous research, childhood experiences are critical in understanding why women may or may not choose nontraditional fields. Integral to these childhood experiences is the encouragement and/or disencouragement girls may receive from parents, teachers and other adults to pursue engineering. Our findings illustrate the importance of both encouragement and disencouragement from parents and teachers. Specifically, when asked if they could point to an individual who encouraged them to be an engineer, the women who did identify someone, often pointed to a parent or teacher. For example, a 38 year old electrical engineer told us that:

> *I thought about engineering as a career for myself as I started to choose a college major. My father was a big influence. He pushed strongly for technical/computers…thought I'd like engineering, maybe chemical.*

Other women also reported that their father was a big influence on their choice to enter the nontraditional field of engineering. A 50 year old civil engineer reported that:

Several of my father's friends were engineers. I liked to hear them talk about their work.

This sentiment was echoed by other women, who saw their fathers as role models in choosing engineering. Fifty-five percent of our sample reported that their fathers were engineers, and encouraged them to enter to professions.

In addition to the role of parents, teachers also play a significant role in encouraging women to consider entering engineering occupations. One respondent told us about the encouragement she received from her television class teacher, and that teacher served as a mentor throughout her career.

> *My high school had a TV station and my mom encouraged me to join. The teacher (of the TV class) became my mentor and told me that if I wanted a technical career in television I should be an engineer. To this day that teacher is still my mentor.*

However in addition to positive encouragement from parents and teachers, the women in our study also reported receiving negative reactions, especially from high school guidance counselors. Many women reported that their counselors discouraged them from entering engineering college majors and careers. Many times this behavior was based on cultural stereotypes about appropriate gender behaviors. For example, a female civil engineer reported that:

> *A high school guidance counselor once told me engineering was not a good career for a girl!*

This sexist behavior was experienced by many of the other women in our survey. A 35 year old electrical engineer relayed the following encounter she had with a high school counselor:

> *[A high school counselor told me that] I am a good Southern girl, why on earth would I want to become an engineer and go into the Air Force. My guidance counselor in high school thought/thinks I was/am nuts!*

Such beliefs about gender appropriateness of careers that are transmitted in elementary and high school interactions continue to funnel women out of engineering occupations. While the women in our study attended elementary and secondary schools anywhere from 15 to 40 years ago, research continues to show that girls continue to receive discouragement from teachers and guidance counselors when they show interest in nontraditional fields. The AAUW (2000) found that 71 percent of male teachers believe that their male students are more interested in the mechanics of computer technology, while only one percent of male teachers feel their female students are more interested. Over one-third of male teachers further believed that their male students enjoyed applied uses and experiences with computers more than their female students would enjoy such pursuits. Female teachers were more likely to consciously state that sex did not influence students' interests in science, math, and technology. Sixty-six percent of female teachers find boys and girls about equal in their uses of technology. However, even such conscious statements about non-gendered thinking do not always translate into non-gendered behavior in the classroom. For instance, the *Scholarly Communication Project* (1998) found growing evidence of sexism in the classroom. In this study researchers observed classroom interactions and then interviewed teachers and students on their interpretations of the events. Researchers found that "on two occasions during classroom observations, the boys monopolized the computer tools. In focus groups [conducted after the class], girls complained that boys often rushed to get supplies and made fun of girls trying to use the equipment. Further, the teachers allowed the boys to get away with it." Such discriminatory behaviors, whether conscious or unconscious, create an environment in which girls feel unwelcome.

In addition to discouragement from school personnel, women also reported that they also experienced negative reactions from parents. Similarly this behavior was based on gender biases

regarding occupational choice and women's abilities. For example, a 27 year old mechanical engineer told us that:

> *During my freshman year of college I was really struggling with my coursework, and my mom said that I should try nursing instead because it was more at my level. When I was struggling with the male dominated work environment, my dad suggested I should take up teaching.*

In addition to receiving negative feedback in regard to their nontraditional choices, the women in our study also reported that some teachers and school officials also tried to funnel them out of math and science classes in other ways. For example, a 38 year old electrical engineer told us of how she had to fight to enter higher level math and science classes in high school and college.

> *I switched from Catholic grammar school to the local public system after eighth grade. The [new] school district only tested my English (I placed into honors class) but shunted me to remedial math. Two of us transfers tried to get placed out of the remedial math class with no success. When I got into tenth grade, I was tracked into honors geometry, but was really a year behind where I should be. The honors geometry teacher asked me how I could be a year behind…I told her the story. She worked with the administration and got me into the next level math during what was a free period. So for the second half of the year, I was taking two math classes. This got me back on track so that I was able to take calculus and calculus based physics my senior year.*

> *Going off to college, I'd aced the calculus AP test, but the University scheduled me for calculus anyway. But I'd learned my lesson about sitting still for that back in high school. I was able to get the university to allow me to skip Calculus I and II.*

Harassment and Marginalization. As evident from our respondents, often the experiences women have in science and technology classrooms are riddled with many forms gender discrimination. In addition to battling gendered beliefs in the classroom, the women in our study also report both sexual and gender harassment in elementary, secondary and college classes. Sexual harassment includes unwelcome sexual advances, requests for sexual favors, and other verbal and/or physical conduct of a sexual nature. Many educational equity experts recognize sexual harassment as a gender barrier in education. In the report, *Balancing the*

Equation: A Report on Gender Equity in Education (1997), researchers found that sexual harassment significantly affects girls' experiences in all educational programs, but is particularly destructive in the nontraditional programs, such as science, math, and technology. Sexual harassment contributes to an environment of intimidation in these classrooms. After incidences of sexual harassment, girls often report that they will choose not to participate in science, math, and technology classes, clubs, after school activities, and eventually careers. Further gender harassment, although less recognized, is increasingly becoming a problem in many classrooms. Gender harassment refers to acts of verbal or physical aggression, intimations, and hostility, based on sex, but not involving sexual activity or language. The most prevalent forms of gender harassment include teasing and bullying. For instance, boys may make fun of girls or put down girls' abilities in science and technology classrooms often referring to girls' femininity and appearance in technology and science classrooms (Stein, 1999).

The women in our study reported instances of harassment throughout their educational careers. For example, a 27 year old project manager told us that:

> *In college there were occasionally off handed comments by older professors, but nothing that set me back. I did have a professor call me the dutiful secretary of my project team.*

Older women in our survey also experienced this type of behavior in classrooms. For example, a 51 year old executive manager reported that:

> *In college many guys made it clear they resented my being there. They would say 'you're taking space some qualified man could have, and everyone knows you're only here to find a husband.' My answer to them 'of all the colossal conceit, what makes you think I'd go through four years of engineering school just to get one of you.'*

In addition to harassment from teachers and peers, women also report other forms of biased behaviors during their education. Interestingly, the older women in our survey reported

more marginalization and isolation in science and technology than did younger women. For example, a 51 year old engineer told us that:

> *I was the only female in mechanical engineering program during my entire four year college program. It made it very difficult, no one wanted to study with me or help me with problems.*

Similarly a 50 year old engineer also stated that in college she was:

> *One of very few women, less than ten percent and often I was the only one. I [needed to be] bull headed enough to want to prove that I could do better than the men.*

In contrast, while younger women in our survey still reported some sex compositional imbalance in college classes, their experiences seemed not be as dramatically affected by their low numbers. A 38 year old electrical engineer told us that although:

> *There were just two women in my year in the engineering program, we certainly had visibility…we were friends and studied together.*

A 35 year old engineer reiterated the importance of the networks women can form in nontraditional classes.

> *I do remember engineering in college being mostly male, especially my electrical engineering classes. I do not remember ever feeling weird as one of a few girls---I had great girlfriends to study with.*

Work Experiences

Workplace Climate. While the women in our study reported having experienced discriminatory practices throughout their educational careers, they report that they still must deal with gender biased behaviors in the workplace. The CAWSMET (2000) report argues that the glass ceiling that serves as a barrier to women attempting to enter the higher levels of corporate management is being reinforced by the silicon ceiling. This "new" ceiling keeps women out of the high paying and high skill jobs in the science, math, and technology sector. The women in

our survey reported that indeed the silicon ceiling is a part of their work environments. Forty-four percent of our sample reported that they experience some form of pay inequity relative to comparable men. In addition to the pay gap evidenced within engineering occupations, one woman reported that taking time out of the workforce to raise her family had a negative effect on her pay equity relative to men of her age cohort.

> *If I compare my salary with a [comparable] 50 year old male who has worked continuously, mine will be less, as I took a twelve year hiatus to raise three children.*

In addition to pay inequity, the women in our survey also reported that they experienced other forms of discrimination in engineering firms. Most commonly women reported that they were not taken seriously by male colleagues. A 50 year old civil engineer reported that:

> *Occasionally I have had a project manager who would not take me seriously or try to assign work to me that was not part of my department's function…I also had one experience where the client's resident engineer did not want to talk to me when I was the lead engineer on the project, but would try to circumvent me by dealing with my subordinates.*

A 27 year old mechanical engineer reported similar experiences in which male peers did not take her seriously.

> *In the plant environment many times plant managers and floor supervisors would go to my technician to either validate what I said or ask questions that should be directed to me.*

Women also reported being funneled into gender appropriate departments within the engineering firm. For example, a female engineer reported that:

> *I was repeatedly asked to take on assignments in Human Resources, despite my clear indications that I was not interested. Every time I accepted these assignments (to help the organization for the greater good), it worked to my disadvantage.*

In addition to marginalization women in engineering occupations (as with other nontraditional occupations) must constantly battle many forms of sexual and gender harassment in their workplaces. A 29 year old ceramic engineer told us that:

> *I have had many men that I have worked with ask me out on dates, and I believe keeping your private life away from the office is appropriate. When these men do ask me out I almost feel it is a form of harassment because how dare they put me in a situation that will result in me rejecting him and potentially hurting our working relationship as a result.*

Another women told us that she experienced gender harassment in her work environment.

> *I have had older men tell me that for a women I am not that bad to work with, or make comments on my husband not being white. I had a boss for a while who every time he would interview women for an engineering job would give me excuses for not hiring her like 'women don't like it when their shoes get ruined.'*

These gender based beliefs are part of other women's workplaces. A 35 year old electrical engineering manager reported that she:

> *was fired from a consulting job because they could not handle me. They wanted a token female, and were not ready to deal with an outspoken, competent engineer like by architects and clients. The partner for whom I worked was fired three months after I was, and they asked me to come back [after that].*

Work and Family Integration. Similar to other research findings the women in our sample reported that integrating work and home demands is very difficult in engineering occupations. Specifically, engineering and technology firms tend to conform to the dichotomization of the social world into public and private spheres (Glazer-Raymo, 1999). Women are traditionally treated as occupying the private, domestic sphere, while men are seen as existing in the public, work sphere. Put simply, the workplace is structured around the idea that the male engineer has a full-time wife at home fulfilling the roles of childcare worker, eldercare provider, maid, launderer, and chef, among other duties. This then allows him to dedicate time to his work. With this ideology firmly in place for over a century, workplaces have largely

ignored the issue of family-work integration. In fact, for decades the solution to any possible work-family conflict probably seemed self-evident: have a wife at home in the private sphere. Joan Williams (2000) describes this in a somewhat different way, focusing on the "unbending" nature of gender: she describes a work-family system based on an ideology of domesticity. One the one hand, this system supports the existence of an "ideal worker," unencumbered by family responsibilities. On the other hand, those involved in caring work--typically but not always women--find themselves marginalized in market work, unable to make the commitments required by a workplace assuming the ideal worker (see also Appelbaum, 2002). The need to be an "ideal" worker was echoed by the women in our survey. A 27 year old engineer told us that:

> *It is hard to work with men who have a wife at home taking care of family issues. If you need to leave work early or work from home for things that their wives do, it has a bad perception. It is a very rigid work environment.*

This was reiterated by other women in our survey. For example, a mechanical engineer told us that engineering:

> *Does not allow enough flexibility to balance job and career.*

A 29 year old engineer further explained that:

> *I am single and find that if you want to do a good job, long hours are sometimes required, thus diminishing the amount of time available for fun.*

As evident from these women the work demands for 'ideal workers' is a feature of engineering firms, making it difficult for women (and men) to integrate work and family demands. As such women report that when they try to integrate work and family demands, they are not met with much support. A civil engineer told us that:

> *I worked for one small company in which I was the only mother employed. Both of the principals had wives who did not work after they had children. My children, at the time, were 6, 9, and 13. I was regularly cursed if I had to stay home with a sick child or leave work to take them to the doctor. I decided to find another job.*

In addition to changing firms, women also report that they change jobs within the field of engineering that will better allow them to accommodate work and family. For example a mechanical engineer told us that:

> *I have moved into a less technical role to accommodate my life outside of work. In a technical role I would be traveling every week sometimes, and have very rigid hours (must be in by 8 am, cannot leave before 5 pm, and really was not culturally acceptable to leave before 7 pm. As a project manager [now] I still work long hours as I did but not can occasionally work from home or shift my hours to fit family obligations. So moving to a less technical jobs has helped me integrate work and family demands.*

Indeed the vast majority of the women in our survey, married and single, reported that work and home integration was a significant factor facing women in engineering. A 42 year old software engineer finds that:

> *My last job was good about allowing flex-time, however the need for weekend work was becoming more frequent…working fifty hours a week had become the norm for me.*

Women in Engineering: What Have We Learned?

The women we surveyed have forged paths into the traditionally male occupation of engineering. Their stories highlight how various factors in their educational and work experiences contributed to their eventual occupational choices in engineering. While this sample of women are clearly aware of gender issues, and have taken an active role in assisting women in engineering occupations through the Society for Women Engineers, their experiences are able to shed light on potential strategies and practices to increase the number of women in the occupation.

Perhaps, most significantly, an overwhelming majority of the women in our survey reported that the problems associated with integrating home and work needed to be addressed in order to both recruit and retain women in engineering. Women report that the need to be an

"ideal worker"---working overtime and weekends, and putting work needs above family needs---must be examined and changed. The women in our survey all report that there must be a change in the workplace culture that helps to accommodate the needs of workers. Interestingly, many of the women report that this should not be considered a "women's issue" or a "women's problem". Instead the women see the need to alter the workplace demands for all workers. A 31 year old environmental engineer believes that:

> *I don't know that workplaces should "accommodate women" but I think that companies do need to be flexible with all employees to keep them happy and keep the playing field flexible.*

This was reiterated by a 42 year old software engineer who stressed that all workers, regardless of sex or marital status need flexibility.

> *The bottom line is that we all need to work as a team in a corporation to get the work done. I think people tend to forget this…As a single person I got tired of 'I have to leave early so I can pick up my child from daycare/school.'…The workplace needs to continue to allow flex-time for women and men so that they can attend to family, home and car issues.*

A 27 year old project manager adds:

> *Flex-time and telecommunicating need to be part of the corporate culture, not just a benefit extended to some people, otherwise it will carry a bad perception with those who are working traditional hours.*

The conceptualization of work and family integration as not solely women's issue demonstrates some changes in how women view work and family demands. The women in our survey are clear that all workers (male and female) must have the ability to integrate work and family. Similar to Williams (2001), our respondents report that changes need to be made that shift workplace expectations away from 'ideal worker' norms, and toward a worker-friendly corporate culture that encourages flexibility for all workers.

In addition to work and family integration the women in our survey also strongly suggest that more attention needs to be placed on younger women to encourage them to enter engineering occupations. The women expressed the importance of working to eliminate gender biases and stereotypes through the positive portrayal of women in science and engineering. They suggested ways to encourage young girls in engineering. For example, one respondent suggested that:

> *I would take a young girl to a Society of Women Engineers meeting, introduce her to my friends and help her see the doors open to her through an engineering education. I would also take her to engineering competitions, and to a science/engineering place, like an amusement park, and explain the impact of engineers.*

A 27 year old mechanical engineer suggests that we must:

> *Discuss and demonstrate some fun science projects in engineering. We have done this with the Girl Scouts demonstrating the fun side of engineering appears to make difference for girls.*

Additionally, it was clear that the experiences (both positive and negative) that the women had throughout their educational development helped shape their eventual choice of engineering as a career. The women we surveyed pointed to the importance of a parent or teacher would serve as a mentor, encouraging them to pursue engineering. These individuals would help encourage and foster a self-image in the women at young age so that they can be legitimate members of the engineering community. Interestingly many of the women in our study have taken on the role of mentor for a new generation of women. In doing so the women serve as role models for young girls demonstrating that a successful career in engineering is not only a possibility, but a viable option for women.

Conclusion

Women are clearly underrepresented in engineering occupations. Our paper is an exploration of what factors have encouraged and discouraged women to enter engineering careers. Indeed, it is only through the stories of these women that we can begin to understand the full extent of the daily struggles associated with being a woman in a nontraditional career, and begin to formulate effective policies to address inequities.

While our research is preliminary, we were able to highlight some strategies based on the responses of the women that will help recruit and retain women in engineering. These include programs that encourage girls and women to explore careers in science, mathematics and technology; that address gender biases in classrooms at all levels; the elimination of sexual harassment and gender harassment in all educational and work settings; and mentoring programs that encourage girls and women to persevere in science and technology fields. In addition, the women's stories point to the need to create workplaces that allow for the integration of family and work, and we must counter cultural stereotypes that paint pictures of women's and men's "natural" skills according to traditional gender beliefs.

We hope this paper will be the beginning of an extensive analysis of the experiences of women in engineering and engineering related occupations. In doing so we hope to contribute to a national dialogue on gender equity in science, engineering, and technology that will lead to new public policies, research initiatives, and educational reforms. Women are expected to make up over half the workforce by 2020. If we do not address these issues now, when will we?

APPENDIX

Table 1: Brief Sample Description

Mean Age	36.8
Percent Married	55.5
Percent With Children	22.2
Percent With Graduate Degrees	66.7

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