

Understanding the Gender Schema of Female Engineering Students: A Balanced Sex-Type and an Ideal of Autonomy

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Abstract— For both females and males, the decision to become engineers rests upon academic interest as well as encouragement from teachers, parents, or mentors. However, because engineering is still stereotyped as a predominantly masculine profession, females are faced with one additional prerequisite: flexible and accommodating gender schemas. These gender schemas form over time through socialization and may align very closely to, or even formally reject, the dominant social ideal. For women, this ideal is one of femininity, and women who have gender schemas that tightly adhere to it are unlikely to choose masculine-stereotyped careers. Do, then, the gender schemas of female engineering students stray from the social ideal? Research combining in-depth interviews and a standardized survey instrument identifies and explores such deviation. This paper presents the research findings and their implications on the broader issues of gender diversity in engineering.

Introduction

In our efforts to diversify the engineering population, it is easy to lose sight of the scope of our battle. Our endeavors of recruitment and retention are attempts to override engineering's ubiquitous stigma of being a masculine discipline with no room for anything feminine. Such a stigma acts as a double deterrent: females are deterred extrinsically through subtle (and not so subtle) discriminatory treatment, and intrinsically by the conflict between their gender and the masculine aura of the discipline. The former is the target of millions of research and outreach dollars, and significant headway has been made in the last three decades. The latter deterrent, as the effect of hundreds of years of social ideologies, is not nearly as straightforward to target. This intrinsic deterrent is the focus of my research.

We are constantly bombarded with information about what it means to be a "woman" or a "man." This information is woven into the stories told by the media, it is perpetuated with positive and negative reinforcements, and it is solidified through our interactions with others. There is nothing instinctual about our gender preconceptions; individuals learn their gender identities as the gender-polarized culture requires. These gender identities, or more precisely gender schemas, are the internalization of the gender-differentiated behaviors, expectations, and norms that exist in our social environment (Bem, 1993). Gender schemas are the lenses through which we filter all experiences; they are instrumental in interpreting the events and opportunities in our lives, and they organize our personal identity, interpersonal behaviors, and social preconceptions. Our "personalities" are part and parcel of the gender categories in which we place ourselves. Gender schemas begin with a pink or blue blanket at our birth and continue to

be defined through primary and secondary socialization. Of course, all members of a gender category do not have identical schemas, and rarely do these schemas flawlessly reflect our culture's concepts of the perfect man or perfect woman. However, there is a tremendous amount of pressure for both genders to align their gender schemas with the social ideals. Conformity brings praises of being a "real man" or a "perfect lady," and strong deviation is often chastised.

Not surprisingly, then, gender schemas play a pivotal role in major decisions for young adults. The combination of our culture's education schedule and social environment requires young women to make important decisions about their futures when they are statistically at their lowest self-esteem levels and most concerned with making the correct impressions on others. In times of tumult or tough decisions, many girls default to the behavioral guidelines enumerated by the cultural definitions of being "female" (Leslie, McClure, & Oaxaca, 1998). Those with more conforming gender schemas are keenly aware of which behaviors will draw them away from the social ideal. Quite simply, if the role of an engineer is in conflict with young women's gender schemas—if they cannot "see themselves" as engineers because they perceive engineering to be on the other end of the gender spectrum—they will not choose engineering as their career path.

The motivation behind my research was to find out if the reverse is also true. Do female engineers have gender schemas that *differ* from the social norm in important ways? Thirteen female engineering students from Montana State University-Bozeman, ranging from freshman to seniors were randomly selected (population: 209) for in-depth, face-to-face interviews. The questions sought information on the respondents' socialization, their gender perceptions, and the respondents' sex-types as quantified by the Bem Sex Role Inventory.

Findings

The first objective of the interviews was to assess the respondents' gender socialization. Children internalize the gender expectations of those in their immediate environments and mold their experiences through and around those expectations. Thus, social scientists widely regard children's experiences at home and at school as the dominant mechanisms of primary socialization. It was not surprising that the respondents had strong mothers, as having female role models made it much more likely that the respondents would grow up to be strong women themselves. Though the mothers did the majority of the household chores, they had equal authority in all major household decisions and were present, educated and employed. Questions aimed at socialization also probed the verbal and nonverbal enforcement of gendered attributes. The respondents were scolded to stop behaviors because they "weren't ladylike" or told "girls don't act like that" only occasionally, they were always allowed to "play with the boys," and wore dresses to elementary school an average of 18% of the time. Such results illustrate that their parent(s) neither heavily enforced feminine behaviors nor strictly forbade masculine behaviors. Gender-neutral parenting was also evident in the toys the respondents were given. 82% of the respondents said they played with traditionally feminine toys such as Barbie dolls and toy ponies and 92% listed traditionally masculine toys such as Lego's or trucks. Interestingly, over half the women mentioned that the toys they played with as children directly influenced their choice of engineering. Such a correlation is not surprising, as Dr. Judith McIlwee and Dr. J. Robinson emphasize the importance of tinkering to the development of interest in engineering-type activities (1992). Lastly, most women painted a self-portrait of their

childhood personalities as being marginal in some way, whether that meant being shy or a tomboy. Overall, the women's responses provided evidence of a primary gender socialization process that included exposure to and acceptance of traditionally masculine interests, with little reinforcement of rigidly "feminine" behaviors.

Our gender schemas are a manifestation of our gender socialization and the way we understand our experiences *through* our gender. This understanding is the intersection of who we believe ourselves to be and our conception of what we ought to become. The latter elements—our "ideals"—are at the core of gender schemas, they are individualistically drawn, and may be completely detached from the social ideal. To probe the respondents' ideals, I asked them to list three traits of the "ideal woman." Though this was an open-ended question, there was a noticeable trend in the results. Figure 1 lists the most popular traits and their frequency in the respondents' answers.

| Trait of the "Ideal Woman" | Frequency |
|-------------------------------|-----------|
| Independent | 62% |
| Strong | 46% |
| Smart | 31% |
| Caring | 31% |
| Self-Sufficient | 23% |
| Individualistic | 15% |

Figure 1: Frequency of Responses to the Question "Name Three Traits of the Ideal Woman"

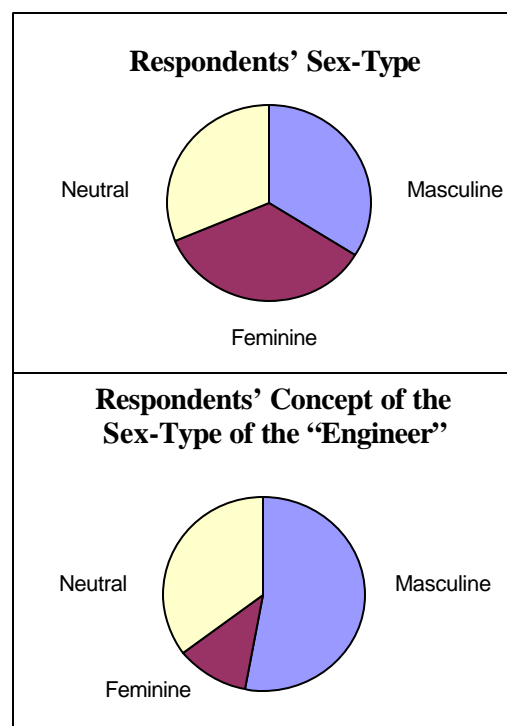
What is immediately noticeable is the lack of traditionally feminine traits such as sexy, fashionable, glamorous, thin, curvy, or emotional. Only one respondent mentioned "pretty." Caring was mentioned by almost a third of the respondents, but it is a much more gender-neutral term than the more feminine "compassionate" or "mothering." *At least two of the three traits mentioned by each respondent were traditionally masculine or neutral, and 54% of the respondents mentioned no traits for the "ideal woman" that are considered traditionally feminine.* This is a marked difference from the American cultural concept of the ideal woman, and a strong indication of the deviation of these women's gender schemas from the social norm (Coltrane, 1997).

Similarly, I asked the respondents to describe the ideal direction of a woman's life. Overwhelmingly, the responses centered on women choosing their *own* path, whether that path leads to a professional career or a career in the home. 85% of the respondents stated that women should follow their dreams or do whatever will make them happy. Only one respondent added family as a side note: "An ideal direction? Education. Family is always good, too." Admittedly, I anticipated more women to emphasize education as the ideal direction of a woman's life, but perhaps their openness to a woman following her own path—whether that be a degree, a family, or both—stems from their own struggles for acceptance.

The final element of interest was to determine how strongly the respondents' gender schemas adhere to the traditional ideal of femininity. To do so, I utilized Sandra Bem's Sex Role

Inventory, a quantitative measurement of respondents' "sex-type," or gender polarization. Bem postulated that the more unbalanced the ratios of feminine, masculine, and neutral traits, the more rigid the gender schemas of the respondents. Those with strongly polarized gender schemas are more willing to endorse behaviors that are gender-appropriate and faster at rejecting behaviors that are gender-inappropriate (Bem, 1993). Thus, evidence of *nonrigid* sex-types would indicate the respondents are more willing to accept gender-inappropriate attributes. The inventory asks the respondents if statements are true for them never, sometimes, often, or always; dividing the 60 statements equally between masculine, feminine, and neutral traits. The responses lend themselves easily to a 1-4 scale weighed index. Each response was added to its appropriate gender category, a total for each category was tabulated, and each category total was divided by the sum of all three category totals. This produced a ratio of the masculinity, femininity, and gender neutrality expressed by the respondents' gender schemas. The sex-types of the respondents were remarkably balanced—they expressed, on average, 33.8% masculine traits, 34.9% feminine traits, and 31.3% neutral traits. This was a very clear indication that the gender schemas of the respondents showed very little polarization, and they would be more willing to accept gender-inappropriate attributes in themselves and in others.

To supplement the inventory, I created a list of single adjectives out of the main concepts of each of the 60 inventory statements. This list was presented to the respondents and they were asked to "circle the traits that characterize an engineer." In this way, the traits that were addressed in the inventory were re-used to determine the sex-type of the woman's *image* of an engineer. Interestingly, the sex-type the respondents assigned to their abstract concept of the "engineer" expressed much more polarization than they had identified with themselves. The ratios were 52.4% masculine, 11.4% feminine, and 35.4% neutral.



I was initially puzzled by the difference between the two sets of ratios. How is such a large role conflict rectified in the minds of the female engineering students? An explanation emerged from the examination of which characteristics the women associated with the typical engineer they also assigned to themselves. For each circled trait that characterizes an engineer, I found the women's response to the corresponding statement on the sex-type inventory. I then took the sum of these responses and divided it by the number of circled engineer characteristics. This provided a number between 1 and 4 that illustrated whether the respondents' sex-types never, sometimes, often, or always corresponds with the traits they attribute to engineers. The result was a correlation of 3.11 (0.78), which meant that the masculine and neutral traits expressed by the women are almost precisely those that they believe to characterize an engineer. Thus, while their balanced gender schemas allow them to embrace their concept of the engineering role, they do not see the engineering role as being nearly as accommodating.

Conclusions

A note on generalizability: While the experiences of the respondents are similar to those documented in other studies (Leslie, McClure, & Oaxaca, 1998; McIlwee & Robinson, 1992), due to the small sample size and largely white population, the conclusions presented here cannot be applied with certainty to all female engineering students nationwide. Rather, this study develops a qualitative context within which to house more quantitatively rigorous studies. The research is exploratory in nature, identifying new platforms of inquiry and expanding the model of women's deterrents to include issues at the core of gender relations. I plan to duplicate this research on a national level and continue the application of gender theory to the study of female engineers.

What is immediately evident from the research is that the respondents have gender schemas that balance masculine, feminine, and neutral traits, and they have a core ideal of autonomy. From this information alone, it would be easy to generalize that the women were simply fortunate enough to avoid entirely the crushing social pressures that are ever-present in the lives of other members of their gender. Indeed, only 15% of the respondents reported feeling even moderate pressures to conform to the traditional feminine ideal. However, it was evident in the interviews that the women were very conscious of the dominant social pressures; they simply did not validate them. Most respondents noted that the conflict is real between what the social norm deems they ought to be and what they desire to be, but they critically denounce the former. This rejection of social norms, while satisfying, raises two very crucial questions: (1) What does having such balanced and independent gender schemas mean for the women and (2) what consequences does it have in the broader scope of retention and recruitment of female engineering students?

First, it is clear the women's socialization provided them with a relatively gender-neutral foundation from which to build up their interests and identities. Their family environments encouraged both masculine and feminine traits, and their early tinkering experiences helped them build skills in engineering-related activities. Their marginality in elementary school also aided in the development of their atypical gender schemas. As Sociologists Patricia Adler and Peter Adler found, the more socially engaged children are, the more they are subjected to specific peer

pressures to engage in gender-appropriate behaviors and are likewise rewarded for sex-typed personality traits. While the women's marginality threatened their self-esteem and efficacy, it did allow them to slip under the radar of more specifically-directed sex-typing pressures (Alder & Alder, 1996). This initial lack of polarizing pressures provided a balanced foundation that allowed the women to form concepts of the "ideal woman" based around more masculine traits than what is normally depicted in the dominant social ideal. When and how these traits themselves were introduced to the women is unclear, but somewhere along the way, those traits had to have been validated by a parent, teacher, or mentor as acceptable for the girls to express.

Are these atypical gender schemas more than just a characteristic of female engineering students? Might they aid the women in coping with negativity directed towards them? If female engineering students are more autonomous and likewise depend more on self-approval than on the approval of others, then they are more likely to survive in engineering programs that are traditionally void of abundant academic or personal encouragement. More importantly, their balanced gender schemas allow them to dismiss others' questioning of their femininity because of their occupations and to fight those who question their engineering skills because of their gender.

As driven recruiters of women engineers, we might be tempted to target these atypical gender schemas in younger women by either implementing programs that seek out women with such schemas or attempting to actively balance out the gender schemas of young girls. While these efforts would serve as effective scouting mechanisms, they miss the mark. The most troubling finding of this research is that the women in this study are *deviant* in the way they depict the characteristics of their gender. If the nature of the discipline requires women to be marginal in order to seriously consider engineering as an option, then we will never see the numbers we hope for. Even if we were to alter a significant number of young women's gender schemas enough for them to be able to "see themselves" as engineers, we would still be fighting only half the battle. The large deviation between the women's sex types and the way they sex-typed the "engineer" means they cannot be fully themselves within their role as engineers. While their self-expression can encompass the masculine and neutral traits of engineering, the role of engineer requires them to downplay their equally-represented feminine traits. In order to retain female engineering students and recruit a significant number of new ones, the culture of engineering itself must be altered to welcome women whose gender schemas are not so deviant from the social norm.

Sociologist Martha Trescott noted that "the common denominator for all women engineers in the United States in all time periods...is that they have gone against the popular image of what a woman is supposed to be and do. (Trescott, 1984)" Let us work from both directions to dampen this intrinsic deterrent. In order to make true headway, we must challenge *both* the popular image of the woman and the popular image of the engineer.

Acknowledgement

The author would like to thank Heidi Sherick and Scott Myers for their advice and assistance with this research.

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