

CHARACTERISTICS PERCEIVED AS NECESSARY FOR SUCCESS IN ENGINEERING:  
AN EXAMINATION OF OCCUPATIONAL SEX ROLE STEREOTYPING

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ABSTRACT

The demand for engineers is continually increasing, hence employers have tried to increase their efforts to improve the representation of women in the engineering occupation<sup>1</sup>. However, there is concern about the availability of women in male-dominated occupations. A possible explanation for the under representation of women in engineering may be due to sex role stereotyping and perceived requisite engineering characteristics. The goal of this study was to assess whether occupational sex role stereotyping occurs in the engineering profession. Results and implications, both in organizations and in education are discussed.

INTRODUCTION

Some suggest a reason for the under representation of women in non-traditional occupations is the lack of reinforcement for accepting or remaining in these jobs, as evidenced by the salary data on women in engineering<sup>2</sup>. Others contend the cold and discriminatory environment discourages women from entering the engineering occupation<sup>3</sup>. This is consistent with research which states the failure of women entering male-dominated occupations is primarily attributed to sex stereotyping and perceived discrimination<sup>4,5</sup>.

A 1992 study<sup>6</sup> found that the perception of discrimination, not necessarily discrimination itself, has a negative impact on employee's feelings about themselves and their jobs. This perceived discrimination can derail women from pursuing male-dominated



careers and may lead women to switch careers in an attempt to find equal opportunity<sup>7</sup>.

Another theory is that women may not be perceived as possessing the characteristics to be successful engineers. It has been found that stereotypes are developed not only about one's sex, but also about appropriate characteristics for an occupation<sup>8</sup>. This stereotyping involves personality characteristics, which are much harder to see than a person's gender. The culture of engineering is said to stress the importance of technology over personal relationships, and male over female traits<sup>9</sup>. If traits associated with success in engineering are primarily male, and women typically do not possess these traits, then women are at a disadvantage. Two studies examining management characteristics found that both male and female managers perceived successful managers as possessing similar characteristics to those of men<sup>8,10</sup>. Fifteen years later,<sup>11</sup> a similar study indicated male managers still adhere to a masculine managerial stereotype. However, females no longer sex-typed managerial jobs<sup>12,13</sup>.

The conclusion of these findings suggest women cannot achieve success in, or be selected for, jobs in male-dominated occupations, not exclusively because they are women, but because of the traits they possess or do not possess.

### HYPOTHESES

Three hypotheses were formulated:

- 1) Technical males and females (engineers) will perceive the characteristics of men in engineering to be more similar to those characteristics of exceptional engineers, than those perceived by males and females in non-technical occupations, where there is typically more female representation.
- 2) Since men adhere to a masculine managerial stereotype<sup>8,10</sup>, technical males (male engineers) will perceive the characteristics of exceptional engineers as more similar to those characteristics of men in engineering than women in engineering.
- 3) Consistent with research that women stereotype less than men<sup>12,13</sup>, females (both technical and non-technical) will perceive women in engineering as possessing characteristics more similar to those of exceptional engineers than average engineers.



## METHOD

### Subjects

Participants were 621 employees from various departments in a high tech Southern California company which develops, manufactures, markets, licenses, and operates advanced communications systems and products.

### Measures

The 92-item Schein Descriptive Index<sup>8,10</sup> was used to define sex role stereotypes and characteristics of engineers. Four forms of the index were used, all forms contained the same descriptive terms and included the same instructions. One form asked for a description of Women in Engineering, one for a description of Men in Engineering, one for a description of an Exceptional Engineer, and one for a description of an Average Engineer. Each subject rated only one of these forms. Demographic information included age, gender, ethnic origin and occupation (technical/engineering or non-technical).

Instructions stated, "We would like you to use the list of terms to tell us what a woman in engineering (man in engineering, an average engineer, or an exceptional engineer) is like. It may be helpful to imagine that you are about to meet this person for the first time and the only thing you know in advance is that the person is a woman in engineering (man in engineering, average engineer or exceptional engineer)".

## RESULTS

One-way ANOVA's indicated that women significantly stereotyped 30 of the 92 descriptive terms ( $p < .05$ ), and men significantly stereotyped 65 of the 92 descriptive terms ( $p < .05$ ).

A Discriminant Analysis determined if each of the 92 items discriminated between the four forms of the survey. A stepwise analysis yielded 12 significant descriptive terms using a Wilks' Lambda. From this analysis, the term, LOGICAL (.84) is the best predictor, out of the 92 descriptive terms, of success in engineering.

Hypotheses were analyzed using Intraclass correlations<sup>14</sup>. The degree of resemblance between the descriptions was determined by computing intraclass correlation coefficients ( $r'$ ). The larger the value of  $r'$ , the more similar observations in the same class are related. For example, the smaller the within item variability, relative to the between item variability, the greater the similarity between the mean item ratings of descriptions.

The results for Hypothesis 1 show a nonsignificant resemblance between the Technical incumbents (engineers) ratings of Exceptional Engineers and Men in Engineering ( $r' = .90$ , ns), and Non-Technical incumbents ratings of Exceptional Engineers and Men in Engineering ( $r' = .88$ , ns). This suggests that there is not a significant difference between by incumbents in Technical occupations (engineers) and incumbents in Non-Technical occupations, on their ratings of perceived characteristics of Exceptional Engineers and Men in Engineering.

For Technical Males (male engineers), there was a significant resemblance between the ratings of Exceptional Engineers and Men in Engineering ( $r' = .87$ ,  $p < .001$ ), whereas there was a nonsignificant resemblance between the ratings of Exceptional Engineers and Women in Engineering ( $r' = .55$ , ns). I performed a test of significance of  $r'$  by using a  $z$  test between two independent correlations ( $z = 3.53$ ,  $p < .001$ ). These results confirm hypothesis 2, that male engineers perceive the characteristics of Exceptional Engineers to be very similar to those of Men in Engineering, but not to Women in Engineering. This supports the idea that when men in engineering think of exceptional engineers they are thinking of men. Consistent with this information, research has indicated that if men dominate a profession, the image of a successful incumbent that most quickly comes to mind is a man<sup>15</sup>.

There was a nonsignificant resemblance between the ratings of Women in Engineering and Exceptional Engineers ( $r' = .90$ , ns) and between Women in Engineering and Average Engineers ( $r' = .85$ , ns). Thus, Hypothesis 3 was not confirmed.

The ratings of descriptions of Exceptional Engineers and Men in Engineering made by both the men and women respondents show a significant difference from those of Women in Engineering ( $z = 4.92$ ,  $p < .001$ ).

Intraclass Coefficients Between Respondents Grouped by Gender

Men Responding	Women Responding			
	1	2	3	4
1 Describing Exceptional Engineers	.97*	.84	.87	.87
2 Describing Average Engineers	.90	.91	.94	.89
3 Describing Men in Engineering	.91	.94	.97*	.90
4 Describing Women in Engineering	.65	.58	.63	.82*

\*  $p < .001$ .

## DISCUSSION

The results of this study have an impact both in organizations and in education. The similarity between characteristics of exceptional engineers and men in engineering may increase the likelihood of men in engineering, rather than women in engineering, being selected for jobs in their field. This raises concern about discriminatory selection decisions in the engineering occupation.

### Organizational Implications

Since results of this study provide information about traits perceived as characteristic of exceptional engineers, an objective assessment of an applicants possession of these traits is beneficial to obtain before making hiring decisions in engineering. Although hiring discrimination may be based on both traits and sex, it may be mediated, dependent on the relevance of traits to an occupation, and the availability of this information<sup>15,16</sup>.

Future research should involve administration of this study in additional organizations to determine if occupational sex role stereotypic thinking is widespread.

### Academic Implications

It might be advantageous to institute educational change programs designed to counter sex role stereotyping of the engineering occupation in undergraduate engineering curriculum. Research has found that sexism scores of men and women undergraduates were significantly lower at the end of a gender studies course, than for those who did not take the course<sup>17</sup>. Since stereotypes of women in the engineering occupation are evident, it is important to assess, and as a result, change the stereotypic attitudes of engineering students before they become engineers in industry.

Future research should focus on the administration of this study in education to determine if sex role stereotyping thinking occurs among engineering students. Identifying these perceptions, and designing interventions for change, may create a more supportive climate for women in engineering and increase the pipeline of female engineers.

### Summary

The results of my study indicate there are specific traits which characterize exceptional engineers, and these traits are not perceived



to be possessed by women in engineering. Unfortunately, without eliminating occupational sex role stereotypic thinking, women may be less likely to enter or remain in the engineering occupation.

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