

# Gender typing and engineering competencies

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***Abstract:** This study investigates the influence of gender typing on the status of engineering competencies. It uses responses from two surveys. Participants in the first survey did not need to generalise and their responses were considered to be relatively stereotype free. However, participants in the second survey did need to generalise and therefore their responses were assumed to include any subconscious gender typing of the engineering position. Competencies that are stereotypically gendered were identified using a reference group. Comparison of the two samples' ratings of the importance of each of 64 competencies revealed a tendency for the engineers in Survey 2 to "think engineer, think male". This reveals a phenomenon that could be undermining the development of stereotypically feminine competencies in engineering education.*

## Introduction

In recent decades, accreditation requirements for engineering programs have broadened beyond the purely technical, to include learning areas such as communication skills, teamwork, interaction with social and ecological environments, and sustainability (Engineers Australia, 2005). However, these areas have not gained high status among all engineering academics and students (Florman, 1997). We have found indications that gender typing of engineering jobs, among engineers, could be a factor (Male, Bush & Murray, 2009). To gender type engineering jobs would be to adopt a gendered mental image of a successful engineer, influencing assumptions about the competencies required to perform the engineering job well. This paper details the identification of stereotypically gendered competencies and outlines the overarching study which is described more thoroughly in a separate paper (Male, Bush & Murray, 2009).

## Theoretical Framework

Sex role stereotyping has been measured among management students since the 1970s (Schein, 2006). The phenomenon can be attributed to the theory of gendered organizations (Acker, 1990), in which cultures assume that the features of the dominant gender are ideal. These features include values, family responsibilities, and stereotypical characteristics. Gendered cultures have been observed in engineering organizations (Gill *et al.*, 2008) and engineering education (Godfrey, 2003, Du, 2006). This study investigated the possibility, of gender typing of engineering jobs, among engineers.

## Method

The study used men's responses from two surveys in which engineers rated 64 generic engineering competencies (Male, Bush & Chapman, 2009). The competencies are referred to as generic

engineering competencies because they had been refined to a list of competencies expected to be important for engineering jobs across multiple disciplines, and survey results confirmed their importance. In the first survey, engineers with 5 to 20 years of experience, since completing an engineering degree, rated the competencies on importance to their own work. In the second survey, senior engineers each rated the competencies for importance to the work of a typical engineer with 5 to 20 years of experience, in the area of work with which the senior engineer was most familiar. Participants in the first survey did not need to generalise and therefore their responses were considered to be relatively, although not entirely stereotype-free. However, participants in the second survey did need to generalise and therefore their responses were assumed to include any subconscious gender typing of the engineering job.

### **Coding the stereotypical gender of the competencies**

Opinions of a separate reference group of experts were used to identify each competency as stereotypically feminine, masculine or androgynous. A reference group of five women and two men was selected for the members' insights into gender issues and diversity in background. Members of the group were from disciplines including social sciences, management, and engineering. They were asked to "code the following [64 competencies] using stereotypes among professionals in Australia", by marking a 100mm scale (-50mm = *very feminine*; 0 = *androgynous*, 50 = *very masculine*).

## **Results and analysis**

### **Identification of stereotypically gendered competencies**

Using the reference group's ratings, competencies were identified as stereotypically feminine or masculine, if the 95% confidence intervals excluded 0. Twelve of the 64 competencies were identified as stereotypically masculine (Figure 1), and 17 as stereotypically feminine (Figure 2).

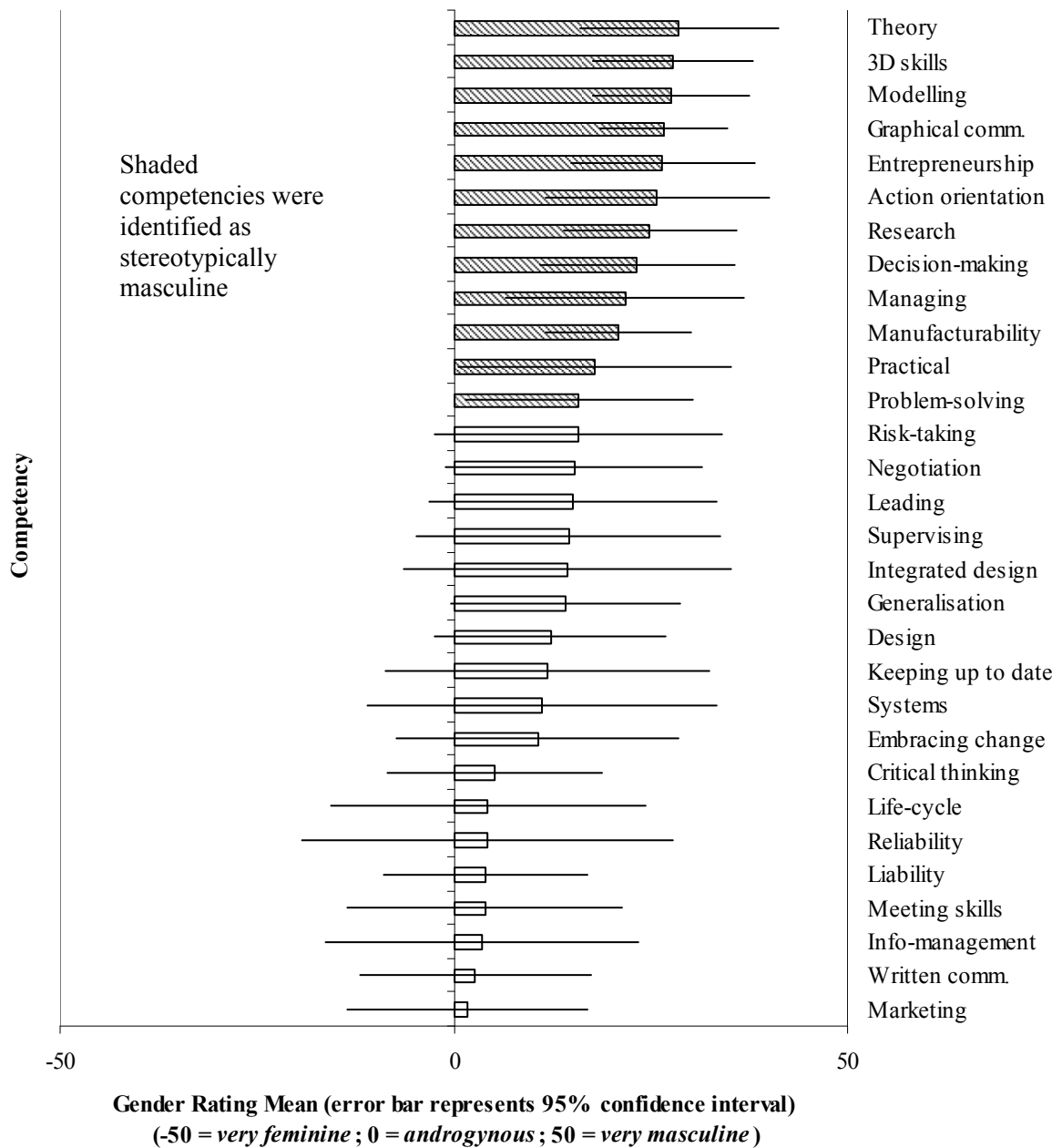
### **Comparison of Importance Ratings Across the Surveys**

For the stereotypically masculine and feminine competencies, a multivariate analysis of variance was performed to compare the ratings of importance across Surveys 1 and 2 (Male, Bush & Murray, 2009). To avoid bias due to a lower percentage of women in Survey 2 than Survey 1, only male survey responses were included. There were 245 usable male responses from Survey 1 and 246 from Survey 2. Compared with the engineers in Survey 1, who rated competencies for importance to their own engineering jobs, the engineers in Survey 2, who needed to generalise to rate the competencies, significantly under-rated a significantly higher portion of the stereotypically feminine competencies (6 among 17) than the stereotypically masculine competencies (0 among 12) (Figure 3).

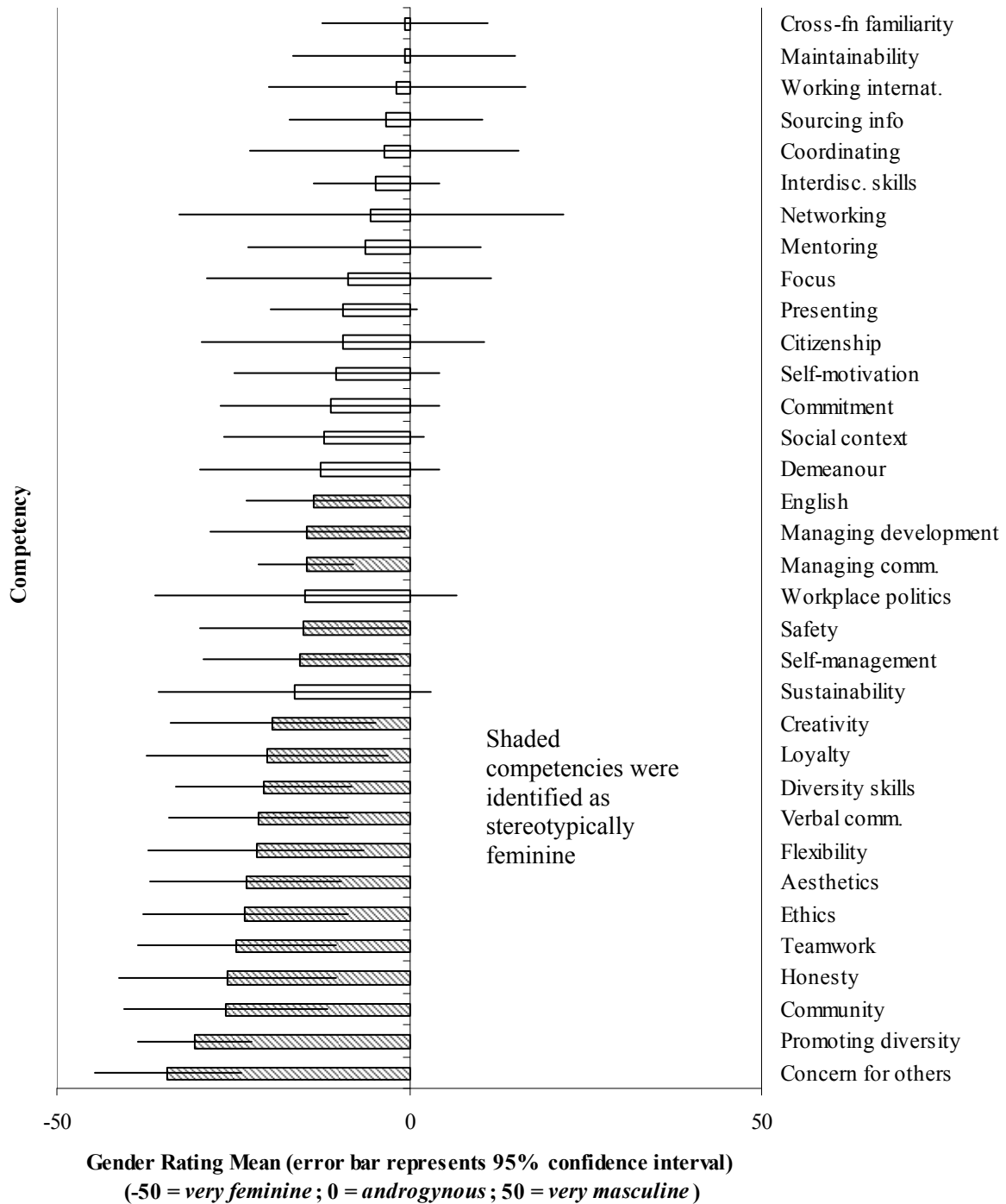
## **Discussion**

Many of the less technical competencies now included in engineering curricula were identified in this study as stereotypically feminine. Using the theory of gendered cultures, we interpret the significant difference between the portions of stereotypically male and female competencies that were significantly under-rated, as an indication of a tendency for the senior male engineers in Survey 2 to gender type engineering jobs.

It can be assumed that the phenomenon observed in this study is present in both engineering organizations and engineering faculties. Engineering academics were among the participants. Engineering faculties shape the values of future engineers. Education reinforces cultures, and cultures are not obvious to people who have been educated within them (Ihsen, 2005).



**Figure 1: Generic engineering competencies with masculine mean ratings for stereotypical gender as rated by the reference group (N=7)**



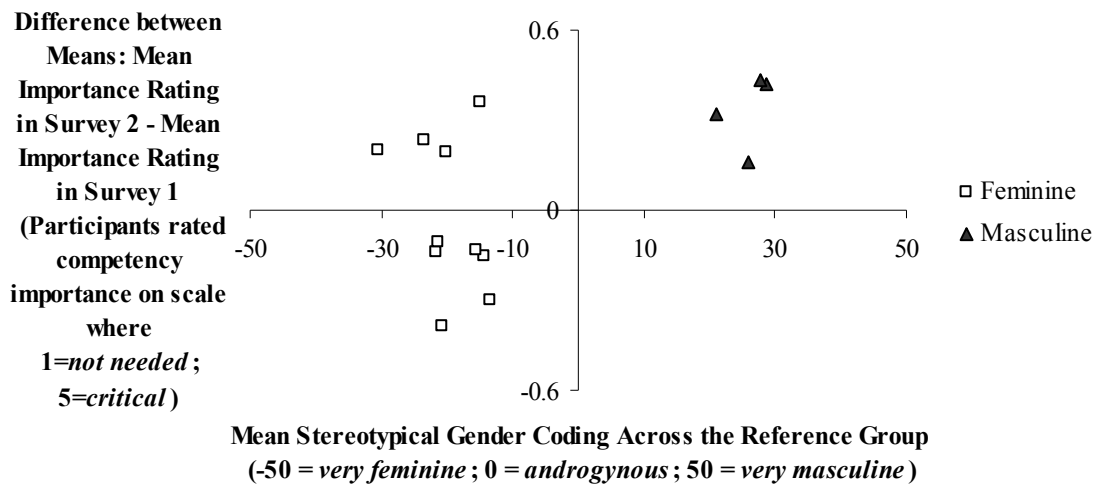
**Figure 2: Generic engineering competencies with feminine mean ratings for stereotypical gender as rated by the reference group (N=7)**

**Implications**

As previously described (Male, Bush & Murray, 2009), the presence of gender typing among engineers could be undermining the success of engineering education at developing important stereotypically feminine competencies. Therefore, as previously described (Male, Bush & Murray, 2009), the presence of gender typing among engineers could be undermining the success of engineering education at developing important stereotypically feminine competencies. The phenomenon could also contribute to identity conflict experienced by engineering students, and undervaluing of female students and academics. Engineering educators must be aware of the possibility of

gender typing in order to recognize its subconscious effects in faculty culture. The result highlights the need to investigate faculty and professional cultures, rather than focussing on women only, when seeking to improve gender diversity in engineering.

In engineering workplaces, gender typing could cause engineers to subconsciously under-rate the competence of female engineers, and hence subconsciously discriminate against female engineers. In a culture in which engineering jobs are gender typed, engineers would also subconsciously give less authority to female engineers than to male engineers.



**Figure 3: Competencies that were identified as stereotypically masculine or feminine, and received significantly different mean ratings of importance across men's responses in Survey 1 (N= and 245) and Survey 2 (N=246)**

**Note: 8 stereotypically masculine and 7 stereotypically feminine competencies were not rated significantly differently across the surveys and are not shown**

### Significance of the identification of stereotypically gendered generic engineering competencies

The stereotypical gender of the competencies, presented in this study, could be used in future studies to confirm the interpretation of results as gender-typing, or to test generalization of the results to a broader sample of engineers or engineering students. Engineering educators should be mindful of the risk of under-valuing the stereotypically feminine generic engineering competencies.

### Conclusion

This study revealed indication of gender typing among senior male engineers (Male, Bush & Murray, 2009). This paper detailed the identification of generic engineering competencies that are stereotypically feminine or masculine. Gender typing is likely to be undermining the status of stereotypically feminine generic engineering competencies, and consequently the success of engineering education reforms. Gender typing is also likely to be undermining the status of female engineers in the workplace.

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