



## ENGINEERS' PERCEPTIONS OF THE IMPORTANCE OF EMPATHY AND CARE: INITIAL INSIGHTS FROM ENGINEERS PRACTICING IN AUSTRALIA

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### ABSTRACT

Empathy and care influence aspects of engineering practice including collaboration and teamwork, stakeholder engagement, and quality of work. Empathy has been identified as a key employability skill for professionals, and is the foundation for many skills and attributes anticipated as required by future engineers. Therefore, the understanding of empathy and care, and consideration of the development of empathetic and caring competencies are increasingly relevant for engineering education. Recent studies have explored the conceptualisation of and value placed on empathy and care in engineering practice, from the perspectives of practicing engineers in US and German contexts. We broaden this to include the Australian setting. Engineers' perceptions of empathy and care within Australian engineering practice were collected using an online version of the Empathy and Care Questionnaire (ECQ) instrument developed by Hess, Strobel, Pan and Wachter Morris ( $N = 183$ ). Statistical analysis of survey questions relating to the perceived

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importance and benefits of empathy and care to engineers, and relevance within a range of engineering practice situations was undertaken. Analysis of gender, years of experience, and organisational role indicated that female engineers perceived empathy and care to be more important, and more impactful on engineering practice than male engineers. Perceptions of empathy and care did not vary with duration of engineering work experience, however engineers in positions of organisational leadership placed greater importance on empathy and care in their roles than others. These differences contrast with results of the US and German studies. Further analysis is required to understand where, when and why these differences occur.

## **1 INTRODUCTION**

### **1.1 Empathy and Care in Engineering Practice**

Empathy and care can be considered a core skill within engineering [1], underpinning many skills and attributes required by current and prospective engineers. The understanding of empathy and care, their role within engineering practice, and the consideration of the development of empathetic and caring competencies are increasingly relevant for engineering education.

The conceptualisation and relevance of empathy and care in engineering practice, from the perspective of practicing engineers, is an emerging research area. Research in the US and German contexts indicate that practicing engineers perceive empathy and care as most important within relational aspects of their engineering work [2, 3]. Empathy and care relate to improved understanding of others, broadened perspectives, enhanced relationships, effective two-sided communication, collaboration and teamwork, relevant to meeting clients' needs [2, 4]. Empathy and care are perceived to impact engineering outcomes. Empathic and caring orientations promote an other-centric focus, awareness of broader impacts of engineering decisions, and an altruistic orientation to design and solution generation, impacting engineering outcome quality [4]. Organisational, task-related and individual factors influence the perceived importance and impacts of empathy and care within engineering practice, indicating their contextual nature.

### **1.2 The Current Study**

This short paper builds on recent research on empathy and care within engineering practice in US and German contexts [2-4], by exploring perceptions of the importance and benefits of empathy and care within engineering practice in the Australian context. This study contributes to a more expansive understanding of empathy and care within engineering practice, offering an increasing contextual and granular view of these concepts by considering diverse geographic and demographic variables. The research questions that frame this paper are: i) do engineers in Australia perceive empathy and care as important to and impactful upon their engineering practice?, and ii) what are the differences in perceived importance and impact of empathy and care, by gender, years of working experience, organisation role, and national context?

## 2 METHODOLOGY

### 2.1 Empathy and Care Questionnaire (ECQ)

Engineers' perceptions of empathy and care within Australian engineering practice were collected using an online version of the Empathy and Care Questionnaire (ECQ) instrument [2]. The online questionnaire was created within the Qualitrics™ platform. The survey contained 37 scale items to investigate the existence, nature and importance of empathy and care within engineering practice. In addition, the questionnaire sought information relating to respondents' demographic and work-related characteristics, and provided opportunity for additional written comments. This short paper reports on statistical analysis of responses to closed questions relating to: i) 2 items rating perceived importance of empathy and of care to respondents as engineers on a 100-point scale; ii) 12 items rating perceived importance of showing empathy and care in a range of engineering practice situations on a 6-point scale, (e.g.: Based on your experiences in engineering, rate how important it is for engineers to show empathy and care in the following situation - Working in teams); and iii) 7 items rating perceived potential impacts of an empathic and caring approach in engineering practice on a 6-point scale (e.g.: If empathy and care are effectively incorporated into engineering, to what extent do you think the following impact will occur? – Engineered products will fulfil users' needs).

### 2.2 Participants

Data were collected progressively from November 2019 to March 2021. Respondent recruitment was both purposeful and opportunistic, leveraging the researchers' professional networks. An invitation to participate with a link to the online questionnaire was distributed, consistent with ethics approval, by researchers and email by senior engineers in organizations and networks, and in engineering faculty alumni newsletters of two universities. Participation was voluntary and anonymous.

Respondents were 248 degree-qualified engineers practicing as engineers or working in related roles in Australia. This was reduced to 183 respondents ( $n_{male} = 125, 68.3\%$  ;  $n_{female} = 58, 31.7\%$ ), with removal of 59 responses due to insufficient questionnaire completion and three responses due to lack of demographic data.

Respondents were well-distributed according to years of engineering work experience, with the largest proportion indicating that they had been working as engineers for under ten years ( $n = 57, 30.2\%$ ), across a range of engineering disciplines. The most common organisation role held by respondents was 'technical role' ( $n = 71, 38.8\%$  of respondents). Respondents frequently indicated two or more current organisational roles. For analysis purposes, organisational roles were categorised as: i) technical role only, ii) manager/leader of a technical team (including in combination with other roles), iii) technical role, and other business roles, iv) leadership of company, and v) other.

### 3 RESULTS

#### 3.1 Analysis

Mean scores were generated across the items for each of: *importance to respondents* ( $M = 79.22$ ,  $SD = 15.69$ ), *importance for practice* ( $M = 5.00$ ,  $SD = 0.66$ ), and *potential impacts* ( $M = 4.59$ ,  $SD = 0.93$ ).

To address the research questions, responses were compared by gender, years of experience, and organisational role. A multivariate analysis of variance (MANOVA) was performed (one for each of the potential moderator variables identified – i.e., gender, years of experience, and role). In each MANOVA, the three dependent variables were *importance to respondents*, *importance for practice* and *potential impacts*. Data were screened for conformity to multivariate analysis of variance assumptions, which produced satisfactory results.

The MANOVA for gender indicated a significant difference across males and females on the composite linear dependent variable,  $\lambda = .95$ ,  $F(3,179) = 3.04$ ,  $p = .03$ , partial  $\eta^2 = .05$ . Univariate ANOVAs indicated significant differences across males ( $M = 4.47$ ,  $SD = 0.97$ ) and females ( $M = 4.85$ ,  $SD = 0.79$ ) on the *potential impacts* variable,  $F(1,181) = 6.89$ ,  $p = .01$ , partial  $\eta^2 = .04$ , and also on the *importance to respondents* variable, ( $M_{male} = 77.27$ ,  $SD_{male} = 16.41$ ;  $M_{female} = 83.45$ ,  $SD_{female} = 13.18$ ),  $F(1,181) = 6.33$ ,  $p = .01$ , partial  $\eta^2 = .03$ , but not on *importance for practice*,  $F(1,181) = 1.41$ ,  $p = .24$ . Both significant results reflected higher ratings for females than for males.

The MANOVA for years of experience indicated no significant difference across groups on the composite linear dependent variable,  $\lambda = .91$ ,  $F(18,493) < 1$ . Therefore, years of experience was not a significant moderator of ratings across the three dependent variables.

The MANOVA for role indicated a significant multivariate difference across groups,  $\lambda = .88$ ,  $F(12,466) = 1.78$ ,  $p = .05$ , partial  $\eta^2 = .04$ . Univariate ANOVAs for each dependent variable indicated that using a Bonferroni-adjusted alpha level of .017, there was a significant difference across roles only on the *importance to respondents* measure,  $F(4,178) = 3.37$ ,  $p = .01$ , partial  $\eta^2 = .07$ . Follow-up Tukey HSD tests on this variable indicated that there were no differences that were significant or that approached significance across any groups other than differences in comparison to the 'Leadership of company or business' role group. Based on the Bonferroni-adjusted alpha level, this group differed significantly from the 'Technical and business roles' group ( $M_{lead} = 91.39$ ,  $SD_{lead} = 8.44$ ,  $n_{lead} = 14$ ;  $M_{techbus} = 72.25$ ,  $SD_{techbus} = 19.89$ ,  $n_{techbus} = 22$ ;  $p = .003$ ). Differences between those in the Leadership of company or business role group, versus those in the 'Technical role' and 'Manager / Leader of technical team' groups also approached, but did not reach significance ( $ps = .04$  and  $.06$ , respectively). All differences that reached or attained significance for role indicated higher scores for the 'Leadership of company or business role' than for those in other groups.



### 3.2 Discussion

The high mean rating for the three variables of *importance to respondents*, *importance for practice*, and *potential impacts*, indicate that Australian engineers perceive empathy and care to be important to themselves in their professional roles, and important and potentially beneficial to their engineering practice.

Female engineers in the Australian context perceive empathy and care to be more important to their professional role, and more impactful to engineering practice and outcomes, than male engineers. This contrasts with an absence of observed gender differences in the US study [2]. Gender has previously been associated with empathic tendencies. In the Australian engineering context, higher empathic tendencies have been reported in female engineering students [5]. Our findings suggest that female engineers' perceived value of empathy and care is sustained on entry to engineering practice rather than diminished through assimilation with male-oriented engineering values as suggested by [2].

The perceived value of empathy and care did not significantly vary with years of engineering work experience for Australian engineers. This contrasts with the greater levels of perceived prevalence and importance of empathy and care among more experienced engineers reported in both US and German studies [2, 3]. Engineers in organisational leadership roles placed greater importance on empathy and care within their professional role, in comparison to engineers in other organisational roles. Empathy is a vital leadership competency, and this finding may reflect effects of leadership development or presence of selective promotion processes within engineering organisations. The same level of value or relevance of empathic and caring orientations to engineering roles, other than organisational leadership, are not reflected by the respondents.

## 4 SUMMARY AND ACKNOWLEDGEMENTS

### 4.1 Implications and Further Work

Our study supports previous work that has established the importance of empathy and care to engineers and engineering practice, and the impetus for inclusion of these concepts into engineering education. Findings relating to perceptions of empathy and care and organisational role provide opportunities for both pre-professional and continuing engineering education. To progress the development of empathic and caring competencies in engineering, relevance of empathy and care to all engineering roles needs to be established and communicated through strategies targeted at students and practicing engineers. Our initial analysis reveals areas for additional research, including a detailed exploration of observed gender and organisational role differences, engineering practice situations and impacts. Interactions between the demographic variables should also be considered.

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