Teamwork Self-Efficacy and Gender in Engineering Students: A study on differences in group dynamics and their sources (0278)

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Abstract
The importance of group projects in engineering education can make them a central aspect of student experience. Targeting team work self-efficacy beliefs to explore gender dynamics, this survey of upper-level engineering students found that men and women reported differences in self-efficacy and the tasks they were likely to accomplish in a team project. Both genders appeared to have less confidence in female team members. Overall, the interaction between a person's gender and the gender composition of the team appeared more important than the person's gender. However in the three clusters which emerged in Hierarchical Clustering Principal Component analysis, there was no clear gender dimension. Thus, gender is one but perhaps not the most important influence in self-efficacy and group dynamics. This contradicts previous work which found more significant differences for gender and suggests avoiding an overemphasis of this aspect in group dynamics.

Summary
Team work skills and group project are widely seen as essential in engineering programmes (Crawley et al.,2014; Colbeck et al., 2000; Lehmannet al., 2008) and are part of accreditation criteria (ABET, 2013; Commission des titres d'Ingénieur, 2012). However, working in a group can pose challenges around negotiating leadership, free-riders, and conflicts (Colbeck et al., 2000). Prior work by some of the current authors found 58% of first-year engineering project teams reported tensions which had a strong impact on their group (Isaac & Tormey, 2015).

Gender cuts across this focus on group processes in interesting ways. All of the female students interviewed by Barnard et al. (2012) reported that the majority male environment of their engineering programmes had an impact, either positive or negative, on their experiences as students. This is pertinent as sustained efforts to promote engineering to women have failed to significantly increase the proportion pursuing engineering education (Barnard et al., 2012).

One way in which gender dynamics of participation in engineering education can be understood is in terms of self-efficacy beliefs (Mara et al., 2013). Self-efficacy beliefs contribute to what people do with the skills and knowledge they have (Bandura, 1997) and were thus taken as a measure for a teamwork setting, where the interplay of social interactions and expectations influence the dynamics.

METHOD: The study was conducted with final-year Bachelor and Master students of a large Swiss engineering school in the spring of 2016. The instrument addressed various aspects of teamwork self-efficacy, teamwork experience, and presented a team project scenario. Apart from demographic information, all items used a 5 point Likertscales. Central to the questionnaire were the scenario-based questions, where series of situations involving a project group were posed to respondents. There were two versions of the scenario: in version A, the other members of the group are three female students and in version B, it is three male students. This allowed us to compare four different situations: (a) female respondents in an all-female group, (b) female respondents in a predominantly male group, (c) male respondents in an all-male group and (c) male respondents in a predominantly female group. The term 'gender' did not appear in the questionnaire and so, while students were

asked to consider gendered scenarios, they were not asked to explicitly think of them in terms of the gender of participants. This meant we had a better chance of accessing their implicit gendered beliefs and assumptions. A total of 216 valid responses were obtained, including 52 responses from females (version A: 30 and version B: 22) and 164 responses from males (version A: 84 and version B: 80). All trends reported are statistically significant at $p<0.05$ level.

FINDINGS: Males were more likely than females to report confidence that their opinions would be valued by the rest of the group. Their reported self-confidence was higher when working with a group of females than with a group of males. Males also reported less concern than females about if their ability to accomplish a task met the team's standards. Men were also more likely than women to report that they would believe they were being monitored too closely if asked a lot of questions about their progress. There were also differences between male and female students on the tasks they saw themselves taking on in a group. Males were more likely than females to identify themselves as working on technical tasks while, females reported being assigned more frequently to report writing. Both male and female respondents appeared to have less confidence in female teammates: both males and females were more likely to assume responsibility for a female team member who was falling behind on their part of the project than for a male teammate, and females were more likely to want to know about all aspects of a project if they were working with a group of females than if they were working with a group of males (suggesting less trust in the abilities of other female team members).

The data was re analysed using clusters. Multiple Correspondence Analysis (MCA) was used to describe the data in a lower multidimensional space and the clustering algorithm (Hierarchical Clustering Principal Component, from the FactoMineR package for R) was used to recursively group respondents that were close to each other. Three clusters emerged: strong self-efficacy people, leaders without trust and low self-efficacy people. Interestingly, there was no clear gender dimension to these clusters.

DISCUSSION: Our findings suggest that, when explicitly looking for differences in teamwork self-efficacy and experience based on gender, a person's gender together with the gender composition of the team they are working with is more relevant than solely the person's gender. Exploring the way in which an individual's gender interacts with the gender of group members seems to show something more interesting than if we had only focused on the gender of the student themselves.

There is a pervasive belief that setting up group projects will implicitly teach engineering students effective group skills (Colbeck et al., 2000; Ford & Morice, 2003). However our data suggests that a student's experience of group work may depend on a range of gendered assumptions which they make about themselves, and which others make about them.

These findings suggest that sexism or gender bias is not only something that is imposed upon students by the culture of an institution, it is also something that students have internalised; it is built into their self-concept and their implicit beliefs about others. These assumptions may need to be made explicit in order that students can recognise gendered patterns of beliefs and behaviour in order to confront it and maximise their learning from group work.

However, it is possible to become too focused on gender as the key dynamic: the three emergent clusters in our sample had little to do with gender, implying that gender is one but perhaps not the most important influence. This contradicts previous work which found more significant differences for gender (Peinado Pére et al., 2015; Rosch et al., 2014).

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