The hidden gender effect in online collaboration: An experimental study of team performance under anonymity

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ABSTRACT

It has been argued that the generally positive effect that female participation exerts on team performance ceases to exist under conditions of anonymity. We evaluate this thesis in the context of an online learning environment in which the gender of fellow student team members was not disclosed to subjects. To circumvent selection effects in the composition of teams we employed an experimental design in which female and male students were randomly assigned to teams of varying gender composition. Against expectations, we find that under anonymity gender composition continues to impact team performance, with all-female teams being most productive. Counter-intuitively, this team effect occurred in our study without female students *individually* being more productive than their male counterparts. These findings indicate that the presence of females on anonymous teams can have a hidden effect on the productivity of other team members. Our results underscore that despite face-to-face interaction in higher education increasingly being substituted by Internet-enabled communication, a student's social environment continues to impact academic learning in important ways.

1. Introduction

The dramatic increase in the use of the Internet as a medium and meeting place for team work (Chu & Kennedy, 2011; Sulisworo, 2012) necessitates a better understanding of how conditions specific to online environments exacerbate or suppress features of group interaction traditionally observed in face-to-face settings. This question is relevant in a range of settings, from distributed organizations in which teams seek to effectively communicate despite being geographical dispersed to online educational settings where students' grades may be affected by the efforts of their classmates. A common feature of online groups is that members can participate anonymously or through non-identifying user names. Anonymous participation has been thought to reduce the salience of certain group processes that rely on member identification. Specifically, studies suggest that anonymity in online settings may reduce or even eliminate the otherwise positive effect of gender diversity on team performance (Caspi, Chajut, & Saporta, 2008; Dubrovsky et al., 1991; Perkowski, 2012; Wade, Cameron, Morgan, & Williams, 2011; Yang, Cho, Mathew, & Worth, 2011).

The thesis that the composition of a team matters net of the individual qualities and attributes of its members has repeatedly been confirmed in non-anonymous settings (Chen, Ren, & Riedl, 2010; DiTomaso, Post, & Parks-Yancy, 2007; Hannagan & Larimer, 2010; Van Knippenberg & Schippers, 2007). Gender diversity in particular has been demonstrated to positively affect the performance of face-to-face teams in various studies involving students (Dufwenberg & Muren, 2006; Hoogendoorn, Oosterbeek, & Van Praag, 2013; Ivanova-Stenzel & Kübler, 2011), with mixed groups outperforming both male-dominated and female-dominated groups. However, whether gender composition continues to significantly impact team performance when the gender identities of members are cloaked by a web interface is an open question. As interactions are more and more taking place through online discussion boards, wikis, and social media, knowing how and to what degree team composition can continue to matter even when member identities are not salient is an increasingly important question.

The provisional answer from past scholarship is that in anonymous settings, team gender composition is not consequential for

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team performance. In particular, several studies have successfully avoided the key methodological obstacle of selection effects in group composition through experimental, non-voluntary assignment of student members to online teams (Flanagin, Tiyaamornwong, O'Connor, & Seibold, 2002; Herschel, 1994; Klein & Dologite, 2000). All found no statistically significant relationship between female participation and performance. However, measurement of group performance was limited in duration and scope. Two studies measured performance as the quantity and quality of ideas produced during brief anonymous brainstorming sessions (Herschel, 1994; Klein & Dologite, 2000). This excludes important dimensions of team work such as shirking and the long-term coordination of work effort. The third study measured productivity indirectly as subjects's perceptions of group performance (Flanagin, Tiyaamornwong, O'Connor, & Seibold, 2002). Furthermore, no separate individual-level measures of productivity were analyzed, making it impossible to tease out group and member effects.

In the present article we report on research employing a similar experimental design but allowing an evaluation of gender composition effects on both the quantity and quality of work performed during a semester-long course project, while measuring performance at both the individual and team level. Teammates were able to observe others' contributions and interact by sending comments and revising content through a collaborative interface, or "wiki". We find that female participation has a positive effect on both quality and quantity of work; however, we do not find beneficial effects of gender *diversity* per se. Rather, we find that productivity *monotonically* increases with the proportion of female students on a team. Interestingly, despite all-female teams generating the most and the best work, female students individually were no more productive than their male counterparts. These findings indicate that, even though gender identities were undisclosed, team members were influenced by the gender of other members.

2. Prior work

Theoretical arguments for why a team's gender composition may matter in anonymous collaborative settings can be usefully grouped into three categories, as discussed in the next three subsections, respectively.

2.1. Skill diversity

Teams with members from more diverse backgrounds may combine a broader swath of non-overlapping competencies and experiences (Chen et al., 2010; Hong & Page, 2004; Jehn, Northcraft, & Neale, 1999) which could lead them to generally perform better than more homogeneous teams. Insofar as women possess different skills than men, a gender diverse team draws on a broader set of skills (Hamilton, Nickerson, & Owan, 2003; Hong & Page, 2004). As a result, gender diversity may enhance team performance.

Gender differentiation in skill sets is borne out of differences in socialization between men and women. This effect of gender diversity on team productivity transcends face-to-face interactions and continues to operate in anonymous online settings (Caspi et al., 2008; Friday, Friday-Stroud, Green, & Hill, 2006; Perkowski, 2012; Shollenberger, 2009; Wade et al., 2011; Yang et al., 2011). Gender-specific learning experiences simply equip a gender diverse team with more experience, whether or not gender is identified. Furthermore, individuals may continue to "do gender" (West & Zimmerman, 1987) as they are socialized to do, even when

they do not identify themselves. We may thus derive the following hypothesis:

Hypothesis 1. Team performance is higher in mixed-gender teams than in all-female or all-male teams.

2.2. Individual productivity

In some settings women tend to outperform men, which naturally aggregates to a situation in which all-female teams outperform other teams. This is particularly true in educational settings (DiPrete & Buchmann, 2013), where most experimental data come from. Over the past several decades, girls have come to receive higher grades than boys at most levels of education (Duckworth & Seligman, 2006). Starting from kindergarten all the way through college years, female students overall earn better grades (Perkins, Kleiner, Roey, & Brown, 2004). This owes not only to the fact that women display more advanced reading skills from an early age (Tach & Farkas, 2006) and recently have caught up with men in mathematics and science as well (Catsambis, 2005), but also to various noncognitive attributes where women seem to show an advantage over men. High school teachers consistently report that female students display greater interest in school and put more effort in their work than male students, who appear to be more disruptive during class. The difference in school grades between males and females may be partly attributable to these different characteristics (Downey & Vogt Yuan, 2005; Rosenbaum, 2001).

DiPrete and Buchmann (2013) argue that because boys receive intense peer pressure to take up a masculine identity, this often results in less emotional attachment to school. This kind of reinforced masculine identity may hinder them from developing close ties to school and coursework. Since these general differences between men and women have developed throughout years of education, one would expect that even when gender identity is not disclosed to group members, all these attributed differences should persist because roles have been internalized. Thus, we should observe that women in general outperform men in educational settings. We derive the following hypothesis:

Hypothesis 2. The performance of female team members exceeds that of their male counterparts.

It is important to note that it is difficult to observe a diversity effect on team performance in the presence of a strong individual gender effect. The latter may simply swamp the former, making all-female teams outperform other teams even when in mixed-teams female members do improve the performance of male members. It is thus critical that studies disentangle individual from group level effects.

2.3. Group-oriented behavior

A long tradition of functionalist and gender-role socialization theorists argue that through socialization, societal patterns of gender-role differentiation are produced and maintained (Bales, 1953; Parsons & Bales, 1955; Zelditch, 1955). Such socialization would generate, on average, a relatively uniform and stable set of differentiated gendered behaviors and behavioral expectations across individuals and social settings. For instance, women are thought to enact more expressive behaviors than men who perform more instrumental acts, mostly regardless of context (Walker, Ilardi, McMahon, & Fennell, 1996). Thus, even under anonymity, women would continue to use communication in a more collaborative fashion with others and for strengthening of their personal