Experimental Evidence Regarding Gendered Task Allocation on Teams

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Abstract

Student teams negotiate many aspects of collaboration, including task division on teams. Some studies have found that there are gender differences in task allocation on engineering student teams, with men performing more technical work, and women performing more communication and project organization based tasks. It is unknown, however, if this is due to students volunteering for tasks in which they perceive they are competent (and gender differences in real expertise or in self-perception), or whether there is a more insidious tendency for students to assume male students should do the technical tasks and female students should do organizational and communication work, and to encourage teammates to work in these gender-consistent manners. In this student-directed project, participants (n=119) of varying technical backgrounds were surveyed. Participants read about a hypothetical team, with teammates given names (gender-stereotypical white and non-white names: Deondre, Destiny, Jake, and Katie). Critically, the profiles of these team members were kept constant while names were swapped, and participants were asked to assign tasks to team members. This study investigates whether there are gender or race differences regarding task allocation, when experiences/expertise are held constant and self-perceptions are irrelevant. We find no significant difference in technical tasks assigned by name. However, we find a significant difference in who is assigned managerial work (with "Katie" assigned the most, for each set of characteristics) and a marginally significant difference in who is assigned the writing work (with "Katie" again doing more of this than the other names). These results suggest that participants used assumptions about teammate demographic information as they made decisions regarding task division, at least regarding who would do managerial and writing work.

Introduction

Group-based learning is a common aspect of undergraduate engineering curricula, and is a critical part of both first-year introductory engineering courses and senior-level capstone design courses at many institutions across the country and around the world. Engineering education research based on these courses has provided a solid understanding of the manner by which student teams often allocate tasks and the manner by which gender and race influences these decisions. Implicit bias on student teams is often theorized to influence the prioritization of ideas expressed by white male students over those expressed by their female counterparts or teammates of color [1]. In addition, a gender-correlated division of work often occurs on student-teams, with men doing the more technical tasks of the project, leaving women to often fill the remaining organizational and managerial positions on the team [2], [3], [4]. Reasoning for this type of behavior is often linked to differences in student learning goals for a course, whether that be mastery orientation (motivation to understand the material), performance orientation (motivation to earn grades or favor) or performance-avoidance orientation (motivation to avoid appearing less competent than fellow peers) [3]. Previous literature suggests that gender-based variations in self-efficacy also play a role in task allocation on teams [2].

The manner by which student teams assign roles, whether intentionally or unconsciously, is a critical component of undergraduate education. It has important repercussions regarding equitable student preparation for the professional workforce. Despite this, research has not yet clarified how gender-based and other inequitable task allocation occurs. We see three possibilities: 1.) students' background or personal experience affect what roles they opt for, or 2.) differences in students' expertise affects their teammates' opinion of what they can do and are therefore assigned, or 3.) other identity differences affect teammates' opinion of what they can do and are therefore assigned. This study attempts to experimentally determine if the latter can occur experimentally, by holding a student's "relevant profile" constant while changing respondents' expectations regarding race and gender. Specifically, our research questions are:

Are tasks assigned differently on a team if the hypothetical teammate is perceived as male or female?
Are tasks assigned differently on a team if the hypothetical teammate is perceived as White or Black?

Methods

Survey
The survey featured a scenario where a team of three collegiate engineering students must design, build, and test a small robot that is able to map the floor of a classroom. Participants were provided a detailed description of each team member's experience levels and general characteristics, as well as a breakdown of the tasks required for the project. Then, they were asked to divide each task across team members. The generic profiles for each team member can be seen in Figure 1.

Persona 1	**Persona 2**	**Persona 3**
• Aerospace Engineer • Member *of [Aeronautics Design Team]* (Business Manager, Software Team) • Completed AP Physics and AP Computer Science in high school • Very vocal during first meeting, talked over teammates at times • Consistently early for class, has not missed class or labs	• Computer Science Major • Member of *[Research Program]* (Computer Engineering, assists in chip design and architecture) • Commuter student • Fairly quiet in first team meeting, unsure if it has to do with relevant background or insecurity • Occasionally struggles to share ideas	• Mechanical Engineer • Member of *[Research Program]* (Mechanical Engineering, assists in writing patents for microelectromechanical systems) • 4.0 GPA • Member of high school debate team

Figure 1. The three distinct team member personas that were provided in the scenario-based survey. Each of these personas was held constant while the names associated were rotated.

In the scenario, the team must:

- assemble the robot based on a kit provided by the instructor and add a physical component of the team's choice to the structure

- customize Arduino code for the robot's desired function and add a corresponding software component that goes along with the physical addition to the robot
- successfully integrate the hardware and software components
- create a written report that details the description of design choices as well as the overall design and performance
- manage project deadlines and organize group meetings.

Prior to viewing the scenario, survey participants were divided into four random groups. The names assigned to the hypothetical teammates were selected from lists of baby names popular in 1996. For each group, the names were varied between a traditionally white female name (Katie , traditionally white male name (Jake), traditionally non-white female name (Destiny), and a traditionally non-white male name (Deondre) for each of the team members. Names were systematically counter-balanced so that each name occurred with each profile at the same frequency.

Participants

Participants were recruited in a non-random convenience sampling format. Authors sent an inquiry out to various on-campus academic research groups, off-campus academia forums, previous and current student bodies, and general peers to complete the survey and in exchange be placed in a raffle for one of four $15 gift cards to Amazon Marketplace. Our final sample included 119 participants; demographics can be observed in Table 1.

Table 1. Demographics of respondents (N=119)

Demographics – 119 respondents	Number	Percentage
Gender		
Female	58	49%
Male	60	50%
Other	1	1%
Ethnicity		
Caucasian/ White	85	71%
Asian	22	18%
Hispanic / Latino	6	5%
African-American / Black	5	4%
Other	1	1%
Discipline		
Engineering Related	102	85%
Non-Engineering Related	17	15%
Occupation		
Professional	16	13%
Student	103	87%
Age		
Under 18	1	1%
18-24	103	86%
25-34	10	8%
35-44	3	3%
45-54	1	1%
55-64	1	1%

Results

ANOVA was used to compare the percent of each task assigned to each persona, based upon the name given to the persona. The entire data table is available in Appendix 1.

There was a significant difference in how much of the management was assigned to each profile, based on name (p=0.007), as seen in Figure 2.

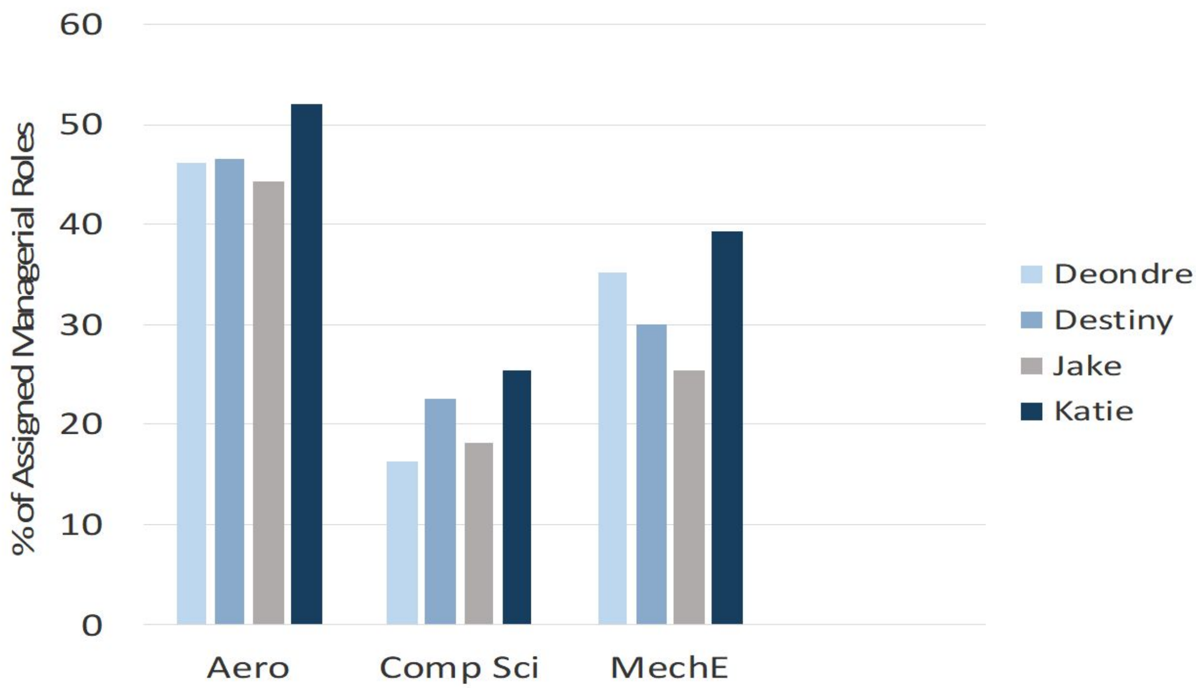

Figure 2. While respondents clearly used information from the profiles to determine which relevant background prepares someone to be manager (with the Aero persona having more of that background), they also used gender and race information: "Katie" and "Destiny" (women) are given more of the management work than "Deondre" and "Jake" (men).

As can be seen in the figure, there was a main effect of profile (respondents saw the Aero profile as having skills relevant to managerial work). There was also, however, a main effect of name: "Katie," the name intended to represent a white woman to our participants, was assigned more managerial work than the same "person" with a different name (intended to represent a man or a woman of a different race).

There was also a difference, approaching significance, in how much writing was assigned to each persona, based on name (p=0.062), as seen in Figure 3. No other differences were significant.

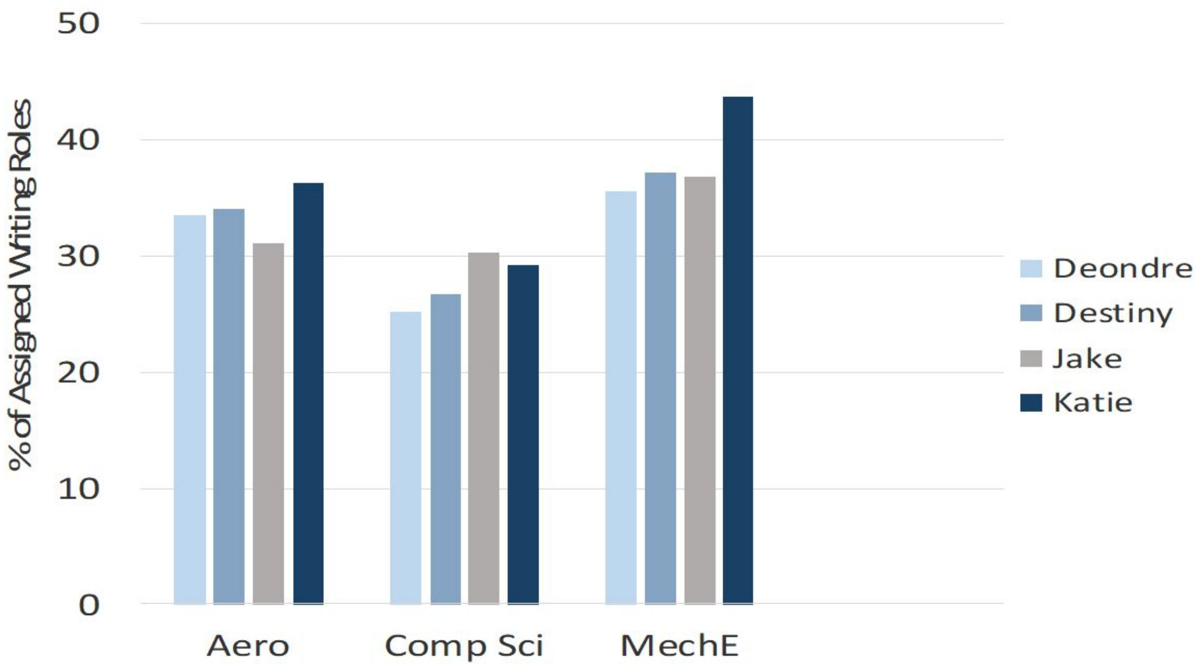

Figure 3. While this difference was only marginally significant, there is a tendency for women "Katie," and to a lesser extent "Destiny," to be assigned more writing work than men "Deondre" and "Jake."

There was no significant difference between student names for the hardware portions of the assignment, as seen in Table A1 in the appendix. The percentage of hardware workload was highest for the MechE persona regardless of name, followed by the Aero persona and then the CompSci profilet; variation by name within the profiles were not significant. In addition, there were no differences between names for either the software or integration project tasks (Tables A2, A3 in the appendix); in this case the Comp Sci person received the highest percentage of workload, followed by the Aero persona and then the MechE persona.

Discussion

This study, which holds respondents' knowledge of team member skills and expertise constant, finds that implicit bias explains some variation in task allocation on teams. Specifically, respondents assigned more managerial work and more writing work to team members with the same skill sets, if that team member was identified as a woman.

This gendered variation in workload only occurred in non-technical tasks; this finding suggests that women are not necessarily discouraged by teammates from participating in technical aspects of the project, at least when respondents know about their relevant technical skills. However, this finding also suggests that women are more often presumed by teammates to be the ones to assume the organizational and writing roles on the team. In this study, gender does affect respondents' presumptions of their abilities, and this implicit bias is at minimum a contributing factor in the inequities of task assignments on student teams. The results from the scenario-based survey are unable to provide conclusive evidence that ethnicity does not play a large role in influencing teammates' opinions of their capabilities. However, we did not find a significant effect of ethnicity in this study.

In the future, we will further analyse this data to determine whether gender or other demographic information of the respondents affected their allocation of tasks. Additionally, we will code the open-ended responses (which asked about what participants were aware of considering as they made their allocation choices). With a different counterbalancing (and more participants), we could quantify the relative contributions of gender, of various background characteristics, and more as each affects task allocations in this experimental setting. We would also like to consider other groups, including under-represented / historically marginalized groups but also groups who are not, such as Asian students and non-native speakers of English, to better understand how those groups are perceived by teammates and how they are allocated tasks.

Future research should try to move this very clearly experimental setting (a survey, without actual teammates, and one omniscient responder assigning the work) to a more naturalistic setting, such as bringing participants in to complete a team-based task, with actors (male and female, White and Black) participating as other characters in a scripted fashion, to better understand the actual negotiation of task distributions.

References

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[3] Fowler, R. R., Su, M. P. (2018). Gendered Risks of Team-Based Learning: A Model of Inequitable Task Allocation in Project-Based Learning. *IEEE Transactions on Education,61*(4), 312-318. doi:10.1109/te.2018.2816010
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Appendix 1. Percent of each project task completed by each persona-name combinations

Table A1. Percent (and standard error of the mean) for the **Hardware task**

	Persona 1	**Persona 2**	**Persona 3**
Deondre	35.2% (2.9%)	25.2% (1.8%)	47.6% (3.3%)
Destiny	28.0% (3.1%)	23.6% (2.6%)	42.0% (3.1%)
Jake	33.3% (2.3%)	24.4% (1.5%)	43.0% (3.3%)
Katie	33.4% (2.2%)	22.8% (1.9%)	41.6% (3.2%)

Table A2. Percent (and standard error of the mean) for the **Software task**

	Persona 1	**Persona 2**	**Persona 3**
Deondre	28.1% (2.5%)	48.7% (3.4%)	19.1% (2.0%)
Destiny	24.5% (3.4%)	45.5% (3.7%)	22.1% (2.6%)
Jake	28.7% (2.3%)	56.4% (4.0%)	23.6% (3.4%)
Katie	30.9% (2.7%)	49.9% (3.5%)	22.7% (2.2%)

Table A3. Percent (and standard error of the mean) for the **Integration task**

	Persona 1	**Persona 2**	**Persona 3**
Deondre	33.6% (2.2%)	35.8% (2.1%)	26.7% (3.0%)
Destiny	37.3% (3.2%)	36.0% (2.9%)	33.7% (2.4%)
Jake	31.6% (2.9%)	36.0% (3.8%)	29.4% (2.8%)
Katie	34.5% (3.5%)	32.7% (2.2%)	32.6% (2.0%)

Table A4. Percent (and standard error of the mean) for the **Management task**

	Persona 1	Persona 2	Persona 3
Deondre	46.1% (3.2%)	16.4% (1.7%)	35.2% (5.5%)
Destiny	46.6% (5.3%)	22.6% (1.9%)	30.0% (2.0%)
Jake	44.3% (4.6%)	18.1% (2.8%)	25.4% (3.1%)
Katie	52.0% (4.2%)	24.0% (1.8%)	39.3% (4.1%)

Table A5. Percent (and standard error of the mean) for the **Writing task**

	Persona 1	Persona 2	Persona 3
Deondre	33.6% (2.2%)	25.2% (1.8%)	35.6% (3.3%)
Destiny	34.1% (3.7%)	26.7% (1.9%)	37.2% (2.4%)
Jake	31.1% (2.0%)	30.3% (3.5%)	36.9% (3.3%)
Katie	36.3% (2.4%)	29.2% (1.9%)	43.7% (2.4%)