Context of All in Which You Live: How Women Engineering Students Perceive Gender-Based Patterns in Teams

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Abstract

Gender-based patterns of marginalization are prevalent in engineering student teams, affecting both task division and group conversations. Historically, men are often perceived to handle technical, hands-on work, while women are delegated to organizational or social roles. Furthermore, societal conversational norms permit men to be direct leaders, whereas women adopting similar styles may be viewed as "bossy." Previous studies identified that teams with two or more women report lower satisfaction levels than teams with only one woman, despite guidelines against isolating marginalized students (Keough, M., Hirshfield, L., & Fowler, R. (2021)). Interviews suggest this may occur because women are more likely to recognize problematic team dynamics affecting other women, revealing issues they might overlook without female peers (Keough, M., Hirshfield, L., & Fowler, R. (2021)).

This study extends these insights by exploring whether women engineering students can identify problematic team dynamics in a contrived meeting transcript and relate these to their personal experiences. Eight female engineering students analyzed a transcript of a fictional team demonstrating poor dynamics by evaluating their perceptions of each member. Our analysis reveals that participants instinctively assigned gender roles: the percived “leader” was identified as female, while aggressive members were thought to be male; roles perceived as nurturing or organizational were associated with women.

Our findings underscore the entrenched gender stereotypes shaping women's perceptions in engineering teams, highlighting the need for more inclusive and supportive environments. By understanding these dynamics, we propose actionable steps to improve team experiences for

women in engineering. Future research will explore strategies to empower women to recognize and counteract marginalizing behaviors, even when isolated within teams.

Introduction

Team-based or project-based design courses are common in engineering programs, often in first year and senior year curriculum. Such courses allow students to learn engineering design in a motivating context, while providing opportunities for students to develop collaborative skills. However, not all students have positive experiences in team-based courses. In particular, students who are already marginalized in engineering may encounter dissatisfying or problematic dynamics in team projects, furthering their feelings of otherness, inadequacy, or questioning their persistence in the major. In this project, we investigate women's experiences on such teams, exploring their assumptions about gender and team dynamics through interpretation of a transcript designed to highlight these problematic, team behaviors.

Literature Review

Gender Stereotypes in Team Roles

Gender stereotypes deeply influence the distribution of tasks and the roles individuals assume within engineering teams. As highlighted by Meadows and Sekaquaptewa (2013), these stereotypes often lead to women being assigned non-technical tasks, such as organizing, summarizing, or note-taking, while men are seen as natural leaders with technical expertise. For instance, in group project settings, men frequently dominate discussions around calculations or design specifications, reinforcing the perception of technical aptitude as inherently male (Kaplan,

2019). These dynamics perpetuate a troubling pattern, where women are sidelined from technical areas and limited in their opportunities to showcase expertise.

This inequitable task allocation is further compounded by implicit biases that devalue a woman's technical contributions. Dabić et al. (2024) found that work preformed by women are often subject to greater scrutiny than their male counterparts, which can stifle their confidence and participation. Such biases not only marginalize women's voices but also create team environments where their contributions are undervalued or ignored altogether. It's disheartening to see how these dynamics persist despite growing awareness of gender disparities (Charlesworth & Banaji, 2019), especially when women bring equal technical competence to the table. These patterns underscore the critical need to challenge gendered expectations and cultivate more inclusive team dynamics in engineering education and beyond.

Collaboration and Communication Patterns

In male-dominated engineering environments, women often adopt communication strategies that emphasize collaboration and interpersonal relationships, in attempts to foster more effective teamwork and inclusive environments. As Rahman and Susilo (2024) found, women in leadership roles are more likely to engage in consensus-building and ensure that all team members' voices are heard. This style contrasts with the more competitive, task-focused communication often seen in male-led teams. Similarly, a study on women's strategies in masculine environments reveals that women students frequently prioritize team chemistry and interpersonal cohesion, focusing on fostering harmony and avoiding conflict (Wolfe & Powell, 2014). By emphasizing these relational strategies, women help maintain a collaborative atmosphere, even in the face of gendered communication barriers.

These approaches contribute to a supportive dynamic in engineering teams, where women can excel in creating balanced, inclusive spaces despite frequent marginalization in technical conversations. This highlights the unique and crucial role women's communication styles play in shaping the success and cohesion of engineering teams.

Self-Efficacy and Peer Comparisons

Further, women in engineering often report lower self-efficacy compared to men, a disparity attributed to limited exposure to visible role models or peers succeeding in technical roles (Meadows & Sekaquaptewa, 2013). This lack of vicarious experience undermines confidence and engagement in technical tasks. Team-based project courses have been found to increase a woman's self-efficacy and closes this gap (Fowler, R., & Alford, L. (2020)); however, this does not mean that women having equitable or satisfying team experiences. Additionally, microaggressions and marginalization during team activities further erode women's participation, as highlighted by studies linking reduced self-efficacy to unequal encouragement from peers (Dabić et al., 2024)

Gender-Based Team Dynamics

Additional studies found that the gender makeup of the team can impact team satisfaction. While it is common practice to avoid isolating any students of marginalized identity (for example forming teams with more than one woman) (Oakley, 2004), it has been found that teams with only one woman are significantly more satisfied with their team than teams with two or more women (Keough, M., Hirshfield, L., & Fowler, R. (2021)).

Motivated by that finding, prior work in this study aimed to identify factors that contribute to dissatisfying team experiences and relating those factors to the gender makeup of

the team by interviewing women about their prior team experiences (Keough, M., Hirshfield, L., & Fowler, R. (2021)). One common theme found was what the authors termed "co-awareness," where women were more conscious of gender-based stereotypes or discriminating behavior in their teams when there was at least one other woman team member with whom they could empathize with. Without the presence of another team member, women were more likely to accept problematic treatment, and thus, were more satisfied with their team (Keough, M., Hirshfield, L., & Fowler, R. (2021)). Further, this situation insinuates that women are more likely to speak out against or identify problematic behavior if it is happening to someone else, rather than to themselves. This theme specifically motivated our study, inspiring us to investigate how women identify and attribute gender-based stereotypes, marginalization, or dissatisfaction in team dynamics.

Method

Eight participants, all women engineering students, were recruited to take part in this study. Eight participants are acceptable for qualitative studies that aim to capture diverse perspectives without the need for statistical generalization, which is why we accepted this number. Participants were selected using purposive samplings highlighting that the focus was on female participants who had significant experience in team-based projects and could provide rich insights into team dynamics. Recruitment targeted undergraduate and graduate students enrolled in engineering programs at the University of Michigan. All participants had engaged in one or more significant team-based or project-based engineering design courses.

Before participants were given the transcript they were read a consentment statement with details restricted to the types of questions they would be asked, including information

pertaining to personal experience on engineering teams. Participents were not aware that a key point in the study was gender based.

Data Collection

A fictional team meeting transcript was developed to represent a team exhibiting poor team dynamics (see Appendix). The transcript depicted a team of five individuals (Skylar, Jordan, Alex, Robbie, and Cameron) demonstrating behaviors consistent with documented challenges in engineering teams, such as unequal task delegation, lack of inclusive communication, and stereotypical role assignments. The transcript did not explicitly assign gender or racial identities to the characters, and names were selected to be interpreted as any gender. This approach allowed participants to interpret the characters freely based on the depicted behaviors and dialogue. Additionally, participants often noted if their interpretations might have been influenced by personal experiences, such as acquaintances or friends with these names.

We conducted eight semi-structured interviews, lasting approximately 30–60 minutes. Each session began with participants reading the fictional team transcript. Following this, participants were asked open-ended questions to understand their perceptions of the team dynamics. They were then asked to describe the roles and characteristics of each character. At this point, if the participants were not yet using gendered language to describe each character, they were asked if they made any assumptions about gender for each of the characters in the transcript. If they had made assumptions, they were asked to explain those assumptions. The interview progressed to explore participants' interpretations of the group interactions.

To ensure rich and nuanced data, participants were also prompted to reflect on how the depicted dynamics resonated with their past team experiences. Questions included: "Can you describe past team experiences for me, in terms of gender makeup of the team?" and "What positive aspects did you find on that team that were specific to that team experience? What challenges?"

Data Analysis

Interviews were audio-recorded and transcribed verbatim. An inductive coding approach was employed to identify recurring patterns and themes in participants' responses. Initial coding was conducted independently by three researchers to ensure reliability. Codes were iteratively refined and grouped into broader themes, focusing on participants' interpretations of gender and attributions of gendered behaviors and actions, then discussed until consensus.

Results and Discussion

Table 1 reveals how participants attributed gender for each character in the transcript, based on perceptions of specific behaviors in group dynamics. For example, Skylar's leadership and organizational skills were largely attributed to her identity as a woman, as these traits are often associated with women's roles in collaborative settings. In contrast, Alex's persistence, thoughtfulness, and intelligence were linked to characteristics of men, as such traits are stereotypically seen as more masculine in technical fields. Jordan's role as a note-taker was seen as feminine due to stereotypes that relate womanhood to supportive or detail-oriented behavior. Similarly, Cameron's aggressive and judgmental behavior was seen as masculine, aligning with

the stereotype of male dominance in competitive environments. These gendered perceptions demonstrate how deeply ingrained societal norms influence individuals' interpretations of behavior within team dynamics.

Table 1: Participant presumptions of transcript characters' gender

Name	**Gender Interpretation by Number of Participants**		
	Man	*Woman*	*No Assumption*
Skylar	1	7	1
Jordan	1	8	0
Alex	9	0	0
Robbie	8	1	0
Cameron	8	1	0

Table 2 reflects participants' attributions of characteristics or roles for each character in the transcript. Skylar was typically seen as a communicator, helper, and a planner, with some viewing them as bossy or aggressive, suggesting a mix of leadership traits. Conversely, Jordan was mostly recognized as a notetaker and supportive team member, while Alex was associated with being smart, persistent, and idea-driven, though sometimes dismissed. Robbie, frequently overlooked, was characterized as helpful but also judgmental and close-minded, while Cameron was seen as the main instigator of negative dynamics, with traits like aggressiveness and condescension dominating their perception. These descriptions highlight the complexity of role assignment and the influence of gendered expectations in team settings.

Table 2: Participants' descriptions of transcript characters' characteristics and roles

Name	**Characteristics** *(number in parentheses is number of participants who used this term)*	**Group Dynamic**
Skylar	- Communicator (4) - Helpful (3) - Planner (2) - Bossy (2)	Keeps team on track
Jordan	- Note Taker (8) - Supportive (3) - Smart (2) - Idea person (2)	Secretary Type Reminds team of limitations
Alex	- Idea person (5) - Smart (3) - Communicator (2)	Persistent with ideas
Robbie	- Helpful (3) - Close Minded (2)	Often forgotten
Cameron	- Judgmental (5) - Mean (4) - Aggressive (4)	Main instigator of negative dynamics

Transcript characters that were perceived as a woman, such as Jordan and Skylar, were often perceived as taking on supportive and administrative tasks, like notetaking and facilitating. This aligns with stereotypical assumptions about women in collaborative roles. One participant remarked how "In any group you are ever in, you're never gonna have a guy taking notes, they don't want to do it and they don't think that's their role." Jordan was described as "intuitive" and "supportive" when taking notes, reinforcing the expectation that women fulfill these roles naturally. Conversely, transcript characters who were interpreted as men, like Cameron and Alex, were often seen as natural leaders or decision-makers, frequently described as idea-driven and taking initiative. This dichotomy highlights the persistence of gendered stereotypes in team dynamics.

Communication Styles

Participants indicated that characters perceived to be women communicated in a "nice" or accommodating way to avoid conflict. For example, Jordan's softer language was seen as non-threatening and aligned with expectations for women to exhibit a more collaborative communication style. Conversely, Skylar was labeled as "bossy" or "aggressive" when assertive, while similar behavior from characters assumed to be men, such as Cameron's bluntness, was interpreted as natural leadership.

Competition versus Collaboration

Participent selected men, such as Cameron and Robbie, were often described as competing or dominating conversations, reinforcing the stereotype of men asserting dominance and control in group settings. This pattern of behavior aligns with traditional expectations of leadership from men, where individuals are seen as more assertive, decisive, and focused on

winning or achieving control. One participant noted, "Some men just automatically think they know more because it's a more male-dominated field, so I feel like the man-splaining and undermining women automatically shines through." This comment highlights how dominance of men in technical fields like engineering is often accompanied by a tendency to dismiss or overshadow women's input, creating an environment that is more challenging for women to assert themselves in. The notion of "man-splaining" encapsulates how men may feel entitled to take control of conversations, often disregarding the value of women's perspectives.

Conversely, subjects of the group that were perceived as women, such as Skylar, were more frequently seen as fostering collaboration and inclusivity within the team. However, these collaborative efforts were sometimes met with criticism. For instance, women's inclination to facilitate group cohesion and consensus was occasionally viewed as a weakness, especially in an environment that valued more assertive, competitive leadership styles. One participant noted that "There is a difference between a leader and a boss" when referencing Skylar's leadership style. This shows how women's leadership approaches—rooted in collaboration—can be misunderstood or undervalued. The expectation that women must navigate a fine line between dominance and collaboration in male-dominated fields adds complexity to their ability to assert their authority effectively. This tension further complicates a woman's roles in team dynamics, as her contributions are often scrutinized in ways that a man's isn't.

Varied Perceptions Based on Ascribed Gender

Another phenomenon observed was how participants would discuss character roles or characteristics differently based on the gender they ascribed to that character.

For example, from participants who perceived Jordan to be a woman, her role as a note-taker was described as "supportive" and "intuitive," but these positive traits were tied to traditional gender norms. For example, one participant noted, "Women often get assigned note-taking." and “I find a lot of the time assumptions are made about a woman's handwriting over a guy's as an excuse.” reinforcing stereotypes about women in administrative roles. When Jordan was perceived to be a man, the task of note-taking was viewed neutrally, without emotional associations such as "supportiveness" or "intuitiveness."

When participants labeled Skylar as a woman, Skylar’s efforts to guide the team were described as "helpful" and "collaborative," emphasizing the expectation for women to lead in a constructive and non-threatening manner. Participants highlighted phrases like "Sounds like a great, productive meeting, guys. Thanks for coming!" However, when Skylar was determined to be a man, Skylar’s leadership was more likely to be framed negatively, with descriptors like "bossy" and "controlling." For example, a participant remarked, "There’s a difference between a leader and a boss," critiquing assertive behavior when Skylar was perceived as a man.

Participants who assumed Cameron to be a woman expected her to proactively handle the Google Drive issue, reflecting societal expectations for women to excel in organizational roles. One participant noted that if Cameron were a woman, she would not have waited until the meeting to ask about the Google Drive. Additionally, woman Cameron was described as "judgmental," this was framed less harshly compared to whenCameron was assumed to be a man. In that case, Cameron was characterized as "blunt" and "demanding," with the Google Drive incident framed as neglectful or careless. This aligns with stereotypes of men being less detail-oriented in administrative tasks.

Conclusion and Future Work

Participants' interpretations demonstrated that gendered stereotypes or assumptions about roles, communication style, and dynamics persist in engineering teams; organized, nurturing team members are perceived to be women, while aggressive, intimidating team members are perceived to be men. Our findings also demonstrated that the participants' value or judgment of the roles taken on were influenced by their perceived gender of the team member.

These findings reinforce our initial hypothesis: women are able to identify problematic behavior when it is observed happening to others as opposed to themselves, and are able to link that to gender-based assumptions, stereotypes or discrimination. Future work will investigate if this carries over or affects their own experiences; even if women are isolated on teams, what can be done to equip them with the skills to identify and push back on marginalized treatment?

References

Meadows, L., & Sekaquaptewa, D. (2013). The influence of gender stereotypes on role adoption in student teams. *2013 ASEE Annual Conference & Exposition Proceedings*. https://doi.org/10.18260/1-2--22602

Dabić, M., Posinković, T. O., Maley, J. F., Vlačić, B., Marzi, G., & Kraus, S. (2024). Exploring the multifaceted challenges of women in engineering: A comprehensive literature review. *IEEE Transactions on Engineering Management*, *71*, 3325–3339. https://doi.org/10.1109/tem.2023.3342980

Ingram, S., & Parker, A. (2002). The influence of gender on collaborative projects in an engineering classroom. *IEEE Transactions on Professional Communication*, *45*(1), 7–20. https://doi.org/10.1109/47.988359

Charlesworth, T. E. S., & Banaji, M. R. (2019). Gender in science, technology, engineering, and mathematics: Issues, causes, solutions. *The Journal of Neuroscience*, *39*(37), 7228–7243. https://doi.org/10.1523/jneurosci.0475-18.2019

Wolfe, J., & Powell, B. (2014). Identifying successful interpersonal communication strategies for women in masculine settings. *2014 ASEE Annual Conference & Exposition Proceedings*. https://doi.org/10.18260/1-2--20579

Kaplan, S. (2019, May 27). *How gender norms are maintained in engineering culture*. Gender and the Economy. https://www.gendereconomy.org/gender-norms-in-engineering/

Oakley, B., Felder, R. M., Brent, R., & Elhajj, I. (2004). Turning student groups into effective teams. *Journal of student centered learning*, *2*(1), 9-34.

Keough, M., Hirshfield, L. E., & Fowler, R. A. (2021). How male students talk about the female student experience on teams. *2021 ASEE Virtual Annual Conference*.

Appendix

Transcript

Skylar: Who is going to take the meeting notes for this meeting?

Robbie: Why doesn't Jordan do it again? The notes were good last time!

Jordan : Okay, I guess I can do it again.

Skylar: What materials do we think would be best, team?

Jordan: I think we should consider balsa wood or polycarbonate.

Alex: Polycarbonate seems alright, but I think there's something better.

Skylar: I think aluminum is definitely the best. We only need to make it out of ⅛ inch, at the most.

Cameron: You guys clearly have never seen a bridge before. Why don't we do steel cables?

Robbie: Wouldn't that be out of our budget?

Jordan: We are allocated X amount, so we might not be able to get other stuff if we go with steel cables.

Alex: I'm doing some research here, and steel cables would be a good option for a suspension bridge.

Cameron: I think it would be much sturdier than balsa wood or polycarbonate.

Skylar: Guys, this is ridiculous. We're getting off-topic. So far, we have come up with polycarbonate, aluminum, and steel cables. What do we think is the best out of that?

Robbie: All those are really expensive. Why don't we do balsa wood instead? It's cheaper, it's aerodynamic, you don't need to machine it, and all around is just the best option.

Cameron: I think balsa wood alone would be too unstable.

Alex: Aluminum reinforcement is feasible based on my research. If we use 1/16th, it should be light and easy enough to manipulate.

Jordan: Yeah, that sounds good. I think Robbie has the best idea.

Skylar: Okay, sounds like we found our material. Let's just use balsa.

Cameron: I agree with Skylar, but we can end the meeting here and explore reinforcements later. Make sure you write that down in the meeting notes, Jordan .

Alex: I can do some more research to get some more concrete solutions as well.

Skylar: Sounds like a great, productive meeting, guys. Thanks for coming!

Robbie: Jordan, make sure you send the meeting notes.

Jordan: I will! It'll be in the team's Google Drive.

Cameron: I'm still not added to that. Weren't you supposed to send me the invite link?

Jordan: I did, but I can resend it.