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Exploring the Impact of Social Threat on Women's Educational Experiences Participating in Majority Male or Female Teams

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Abstract: This paper explores how stereotype threat affects the performance and learning of undergraduate women participating in majority male or female teams. Our Design program purposely builds all women development teams with participants stating that the experience was a highlight in their educational career.
We hypothesize that women who participate in majority female group work have: an increase in team; decision-making and management responsibilities, effective communication and influence, technical tasks and project ownership. They will also improve their self-perception by amplifying positive emotional attributes, and increase their courage, confidence, subject knowledge, and cultural fit.
A survey was distributed to 38 female undergraduate students asking them questions about their experiences in both majority male and female group work. The results show female students benefit from working on female majority teams. Instructors should understand how social threat affects educational performance and adjust team organizations to enhance learning.

Keywords: Stereotype Threat; Women Design Teams; Identity Theory; Social Identity Threat

1. Introduction

1.1 Personal Background

I am currently a student at XYZ University studying Industrial Design. Within my small cohort of 16 design students, only 4 of us are women. This skewed gender ratio is anecdotally not uncommon within design programs at US universities.

Throughout my educational career I have personally felt friction related to my gender. Regardless of the root cause, there are prevalent and damaging cultural perceptions that

women are less skilled at math, engineering or understanding mechanical processes (Steele, 2011) I am aware of stereotypes about women and yet have continued to pursue a career in which competency in understanding mechanical processes is critical. I have often felt self-conscious and fearful that my actions in technical classes will be used to confirm negative stereotypes about women's abilities within the field. As I speak with more women in design related fields and read existing academic literature on the topic of gender in design, I have found that my experience is not unique. In fact, my experience is seemingly related to broader patterns of female experience within the design field.

One of the most positive experiences in my design education was a group project I collaborated on with an entirely female team of designers consisting of six industrial designers and two mechanical engineers. Our instructors intentionally grouped us together, leaving the gender ratios in the other five groups skewed heavily male. It was a benchmark experience for me to learn without the presence of gender-related pressures I had experienced in group projects up to that point. Within this all female team, my self-perception as a designer and experience working in a design team improved significantly.

My experience working on an all-female team was unique, individual and anecdotal. It has however, prompted me to study in greater depth how gender composition within educational group work could affect a female designer's educational experience.

As women, we often compare ourselves to our male counterparts to gage our success. When we inevitably see differences in our approach to design, we see these differences as a problem to be fixed. However, once we realize that this "problem" is not a problem but an innate difference between male and female designers, we can begin to understand how best to enhance collaboration between males and females within design education (Siggard, 2014).

1.2 Stereo Type Threat

There has been extensive research done on the effects of stereotype threat on the individual, but we have chosen to focus on the most relative research. Claude M. Steele's book, *Whistling Vivaldi*, discusses the role that stereotypes play in our day to day life (Steele, 2011). In the book, Steele explains that 'stereotype threat' occurs when a person experiences a threating situation within a context in which a negative stereotype exists about one of their identities. Being in such a context elicits psychological arousal as the individual is wary of doing anything that may confirm to the negative stereotype. Steele also collaborated in other research and shares the effects that being in an environment where there are few women faculty or students, or where the curriculum marginalizes the experiences of women students, are enough to trigger a stereotype threat that undermines performance in math, science, and engineering fields (Murphy, Steele & Gross, 2007).

Research by Woodcock and Bruce determined that stereotype threat experienced over an extended period of time tends to lead to individuals leaving their field of study and a

dissociation from that area of study or profession (Woodcock, Hernandez, Estrada & Shultz, 2012) (Bruce, 1985).

Although there is already an existing body of academic work addressing gender disparities facing women, we feel that the issue deserves more research within the design field. There is good indication for this when examining the number of practicing female designers. In the USA the number of professional women designers in the broader design field is unknown, in the UK it is 22% of the total design workforce, even though 7 in 10 design students are female (Fairs, 2018). The Society of Women Engineers reports that women currently make up 13% of the professional workforce in the USA (Ricon, 2018).

The amount of existing research that focuses specifically on the female experience in design itself is very limited, with only a small number of papers being published within the last fifty years (Walters, 2018). Due to this, we have pulled from existing research on the experience of women in other male-dominated fields as well to support the framework of our own study. The existing research covers the topics of stereotype threat and environmental cues, critical mass and the detriments of tokenism.

The new knowledge we hope to provide through our research is related to these broader issues of gender representation and stereotype threat but confined to a narrower context. Our study aims to investigate how these larger issues of underrepresentation and stereotype threat manifest within group dynamics between students at the undergraduate level.

This is an exploratory paper, and we hope to continue to conduct research that will help us identify practical, actionable interventions that can be taken to reduce the stereotype threat that female industrial designers are experiencing. We have chosen to focus on an educational context, particularly on undergraduates, viewing this time as a critical point of retention.

We've identified two hypotheses about the effect gender ratios within design teams may have on female experience:

1. Teamwork - We hypothesis that in female dominant groups women will result in female students having an increased level of participation in group work.
2. Self-Perception - We hypothesis that women will experience increased feelings of confidence when they are in all female teams.

Existing research demonstrates that not only are there few practicing female designers, but also explains why that gender imbalance is problematic. Research on stereotype threat offers insight into one aspect of women's experience in the design field and perhaps also insight into why women are underrepresented overall in the field.

2. Methods

The primary method of data collection was through a survey of 63 female volunteers. The questions used in the survey stemmed from interviews with female undergraduate students

and professionals in design and engineering fields. The final survey was designed to provide a broad view of how the participant's educational experiences were influenced by the gender compositions of their teams during group projects.

2.1 Participants

Of the 63 female students who participated in the study, 58 were currently enrolled undergraduate students at a local college or university. Five participants were not, and their responses were removed from the survey. Fifty-four of the respondents indicated they were enrolled in a STEM-related discipline, either science, technology, engineering or math and four participants were enrolled in something other than a STEM major. Fifty-seven of the respondents had participated in group projects in which they were in the minority as a woman. One respondent indicated she had not experienced this condition. Thirty-eight participants reported having experiences working in a predominantly female team for a group project in school. Nineteen participants indicted they had not experienced this condition and one participant did not respond to the question.

For the purposes of our research, we only considered data from the 38 respondents who reported experience with group projects under both gender composition conditions. None of the students received compensation for participation in this survey.

2.2 Survey

As part of our initial research we conducted semi-structured, in-depth interviews with a variety of female designers. Due to the sensitive nature of those interviews, and at the request of the interviewees, the information gathered was anonymous. We interviewed seven female design professionals, all of whom were within the first five years of their career. Additionally, we interviewed three current industrial design students. Each interview was roughly an hour in duration, and each woman interviewed had experiences to share about how their gender impacted either their educational or professional career. These interviews informed the content of our study questions. We were able to synthesize insights from these interviews and identify common themes and concerns. These themes became the framework for our 29-question survey which was distributed to current university enrolled female students.

The survey was comprised of 62 questions. The first four questions, or Section 1, confirmed university enrolment, whether or not participants were studying in a STEM field, and whether or not participants had experience participating in both male and female majority team projects. Section 2 of the survey (Questions 5-33) evaluated the respondent's experiences working on male majority teams. Section 3 of the survey (Questions 34-62) evaluated the respondent's experiences under the inverse condition where the ratio of women was greater than the number of men. One question asking participants about their increase or decrease in 'self-trust' was discarded due to a formatting error in the survey. Thus, the final survey was comprised of 28 identical questions. Participants were asked to

respond to the questions based on their recollection of their experiences in both the male and female majority team conditions.

2.3 The 28 Questions

We found that the majority of questions asked could fall under two primary categories, 'team dynamics' and 'self-perception'. Those categories were further sub-divided into themes of team decision making and management, team relationships, team inclusiveness, emotions, courage and confidence, knowledge and cultural fit.

Team Dynamics:

Team Decision-Making & Management: participation in team decision-making and opportunities to lead.

1. I am Included in Decision-Making,
2. I Have Opportunities for Leadership
3. We Share Management Roles

Team Relationships: the effort required to persuade others, success in offering alternative solutions, quality of communication, and ease of communication.

4. My Peers are Persuaded by my Input
5. My Ideas are Considered
6. We Have Quality Communication
7. Communication is Easy

Team Inclusiveness: distribution of technical and management tasks in the team, sense of collective project ownership, and level of team participation.

8. We Have a Fair Distribution of Technical Tasks
9. We Share Project Ownership
10. I am Engaged with My Team

Self-Perception:

Emotions – feelings of inclusion, anxiety, intimidation, personal inadequacy, and self-consciousness.

11. I feel I am Included
12. I have an Absence of Anxiety
13. I am Not Intimidated
14. I Feel I am Adequate
15. I Feel Self Assured

Courage and Confidence – willingness to expose personal weakness, nervousness in asking others for help, feeling of technical mastery, feeling that group members trusted them, growth of a personal network, and feelings of confidence

16. I am Willing to Show Weaknesses
17. I Feel Secure in Asking Others for Help
18. I am Confident in my Technical Skills
19. My Peers Trust Me
20. My Personal Network is Growing
21. I Feel Confident

Knowledge – how team members perceived their knowledge and competency, and their own sense of self-efficacy.

22. My Peers View me as Knowledgeable
23. My Peers View me as Competent
24. I Feel a Sense of Self-Efficacy

Cultural Fit – changes in clothing choices, changes in speaking patterns, feeling they belonged in their major, and feeling their personal performance would be seen as indicative of the abilities of anyone of their gender.

25. I Don't Change the Way I Talk
26. I Don't Change the Way I Dress to Fit In
27. I Feel Confirmation that I Belong in this Major
28. I Do Not Feel I Have to Represent all Women

2.4 Procedure

Participants were recruited through invitations sent out by the study organizers through their social media channels. An online link to the Qualtrics survey tool, was embedded in the invitation. The questions were not randomized, thus all participants responded to the series of questions in identical order. First, they answered the background questions, second, all 28 questions concerning their experiences with a male majority teams, and third, all 28 questions concerning their experience with a female majority team. Respondents completed the survey on their own, in their chosen environment. The survey was created to be completed in around 15 minutes or less.

2.5 Data Analysis

The data was gathered and synthesized using Excel spreadsheets to calculate the average response scores for each survey question. We chose to use averages for our analysis since our sample size only yielded 38 usable responses. This method allows us to see potential

trends and gain insight into female student's experience in group work to inform future studies.

Each question was designed so participants could rank their experience on a scale of 1-9, with 1 being 'strongly disagree' or the least favorable condition, and 9 being 'strongly agree' or the most favorable condition. For example, question 5 asks, "In groups with more men than women I am included in decision making" The value '1' indicated the 'strongly disagree' that they were included in decisions making, while the value '9' indicated they 'strongly agree' that they were included in decision making.

For the sake of discussion and ranking, a score of 5 will be noted as neither a positive nor negative experience. Scores lower than 5 will be discussed as less favourable experiences while scores above 5 will be discussed as more favourable experiences.

3. Results

The first column in the tables below list the question that respondents were asked to score. The second column lists the average scores given by participants about their experiences being a gender minority on a majority male team, the third column lists average scores given by participants being a gender majority on a majority female team. The final column shows the positive or negative impact between scores under the two gender majority conditions.

The tables are divided by the major categories, either Team Dynamics or Self-Perception and then sub-divided by their accompanying themes: Team Decisions & Management, Team Relationships, Team Inclusiveness, then, Emotions, Courage and Confidence, Knowledge, and Cultural Fit.

3.1 Impact of gender composition on Team Dynamics

Table 1: Team Decisions & Management

	Majority Male	Majority Female	+/-Impact
I am Included in Decision-Making	5.08	6.49	1.41
I Have Opportunities for Leadership	4.50	6.59	2.09
We Share Management Roles	5.05	6.79	1.74

Table 2: Team Relationships

	Majority Male	Majority Female	+/-Impact
My Peers are Persuaded by my Input	3.75	5.26	1.51
My Ideas are Considered	4.13	5.72	1.59

We Have Quality Communication	5.28	7.18	1.90
Communication is Easy	5.05	7.05	2.00

Table 3: Team Inclusiveness

	Majority Male	Majority Female	+/- Impact
We Have a Fair Distribution of Technical Tasks	5.10	7.21	2.11
We Share Project Ownership	6.08	7.69	1.62
I am Engaged with My Team	6.05	7.67	1.62

3.2 Impact of gender composition on Self-Perception

Table 4: Emotions

	Majority Male	Majority Female	+/- Impact
I feel I am Included	5.7	8.00	2.30
I have an Absence of Anxiety	4.59	6.00	1.41
I am Not Intimidated	4.97	6.33	1.36
I Feel I am Adequate	5.87	6.92	1.05
I Feel Self Assured	4.23	6.26	2.03

Table 5: Courage & Confidence

	Majority Male	Majority Female	+/- Impact
I am Willing to Show Weaknesses	3.00	5.49	2.49
I Feel Secure in Asking Others for Help	4.85	6.74	1.89
I am Confident in my Technical Skills	5.15	6.77	1.62
My Peers Trust Me	6.00	7.63	1.63
My Personal Network is Growing	5.15	6.59	1.44
I Feel Confident	5.00	6.44	1.44

Table 6: Knowledge

	Majority Male	Majority Female	+/- Impact
My Peers View me as Knowledgeable	4.80	6.54	1.74
My Peers View me as Competent	5.25	6.79	1.54
I Feel a Sense of Self-Efficacy	5.75	6.90	1.15

Table 7: Cultural Fit

	Majority Male	Majority Female	+/- Impact
I Don't Change the Way I Talk	4.55	6.77	2.22
I Don't Change the Way I Dress to Fit In	7.43	8.28	.86
I Feel Confirmation that I Belong in this Major	4.50	7.36	2.86
I Do Not Feel I Have to Represent all Women	3.79	4.85	1.05

3.3 Favourability of Experiences between Majority Male and Majority Female Teams

Participants were asked to rate how strongly they agreed or disagreed with the questions respective to their experiences on male majority teams compared to their experiences on female majority teams. The graph in Figure 1 shows how women rated these statements in relation to each team context. The greater the number the more positive the experience, the lower the number the more negative the experience. A number of variables received similar scores and are grouped on the closest appropriate line.

Without exception, participants reported that all the variables are considered more agreeable or favourable when experienced on all female teams.

Figure 1 Favourability of experience between male & female majority teams. The greater the number the more positive the experience and vice versa.

Strongly Agree - One variable, or 3.57% of all variables, was rated within the strongly agree or most favourable range on male majority teams whereas nine variables, or 32.14% of all variables, were rated as strongly agree or most favourable on female majority teams.

Agree - Fifteen variables, or 53.57% of all variables, were ranked as agree or favourable experiences on male majority teams, whereas eighteen variables, or 64.29% of all variables, were rated as agree or favourable on female majority teams. It's also significant to note the relative averages within the "agree" range. Participants rated the variables on the low end of the favourable range for male majority team contexts, giving an average score of 5.48. On female majority teams, variables were ranked on the higher end of the favourable range with an overall average score of 6.41 – close to a full point higher.
Disagree – Eleven variables, or 39.29% of all variables, were rated as disagree or less than favourable on male majority teams whereas only one, or 3.57% of all variables, was rated as disagree or less than favourable on female majority teams.

Strongly Disagree - One variable, or 3.57% of all variables, was rated as strongly disagree, or least favourable experience in the male majority context, while no variables scored in this zone in the female majority teams.

The graph also provides insights for individual variables that had outstanding or extreme scores.

- "I don't change the way I dress to fit in" - was included in our survey because several women mentioned it during in depth interviews. However, this is the only variable that participants strongly agreed with in both gender composition settings. This result indicates that this is less of a concern than we thought, and the variable may be omitted during further research.
- "I am willing to show weakness" – is the single question that is scored 'strongly disagreeable' or the least favourable experience of all the questions. Women feel unwilling to show weaknesses when they are on majority male teams. This variable is nearly 2 points below the lowest variable on the female majority team and 2.5 points below the identical variable score on the female majority team. It has been established that learning outcomes improve when students feel comfortable showing weakness and asking for help (Dweck, 2006). It is deeply troubling to have confirmation that female design student's learning experiences are hindered in this way when on majority male teams.
- "I do not feel I have to represent all women" – was considered disagreeable, or less than favourable, in both conditions. Follow up conversations with women led us to hypothesize participants continued to feel this pressure as they were still in male-dominated classes and majors. There micro-climate on an all-female team may have eased certain pressures, but they continued to be affected by the broader context. However, more research is required to confirm this position.

3.4 Impact score differences for each question

Figure 2 charts the impact score differences for each question between the two conditions. It is organized in two columns representing the two primary categories of assessment, self-

perception, listed in the first column, and team dynamics, listed in the second column. Notably, this chart indicates there is not a single variable that performs better in a majority male team. This chart positively answers our hypotheses and shows the impact of students' learning experiences between the two conditions. As in the first chart, we will also assess the extreme question scores on this chart in both categories.

The "Self-Perception" category scores indicate this is where the most impactful differences between the two states occur. The top four most impact questions were in this category.

- "I feel confirmation that I belong in this major" – is the question with the greatest difference between the two states with a score of 2.9. Programs with a high female attrition rate might be well advised to implement all women development teams in their classrooms.
- "I am willing to show weakness" – has a score of 2.5. As in the first chart, this state is a hindrance to effective learning.
- "I feel included" – has a score of 2.3. In a team setting, feeling and being included in a team's activity is a primary aspect of its function. We feel this is also related to the statement that I belong in this major.
- "I don't change the way I talk" – has a score of 2.2 and was a surprise to us. In follow on interviews with Our need to change how we talk to try and fit in.
- "I do not change the way I dress" – was the lowest score on the chart at 0.8 indicating that women do not feel the need to dress differently between the two states.

The "Team Dynamics" category scores indicate that learning opportunities are greatly reduced when women participate on majority male teams.

- "I have the opportunity for leadership" and "We have fair distribution of technical tasks" scored equally high at 2.1. While these scores are less than those in the self-perception category, they directly indicate that women experience impeded learning experiences, contrary to educational expectations.

Both the first and second hypothesis for this study, that teamwork participation will increase and that women will experience increased feeling of confidence when they participate in female majority teams is conclusive. The data suggests there are no benefits for women to participate on male majority teams when viewed through the lens our questions explored.

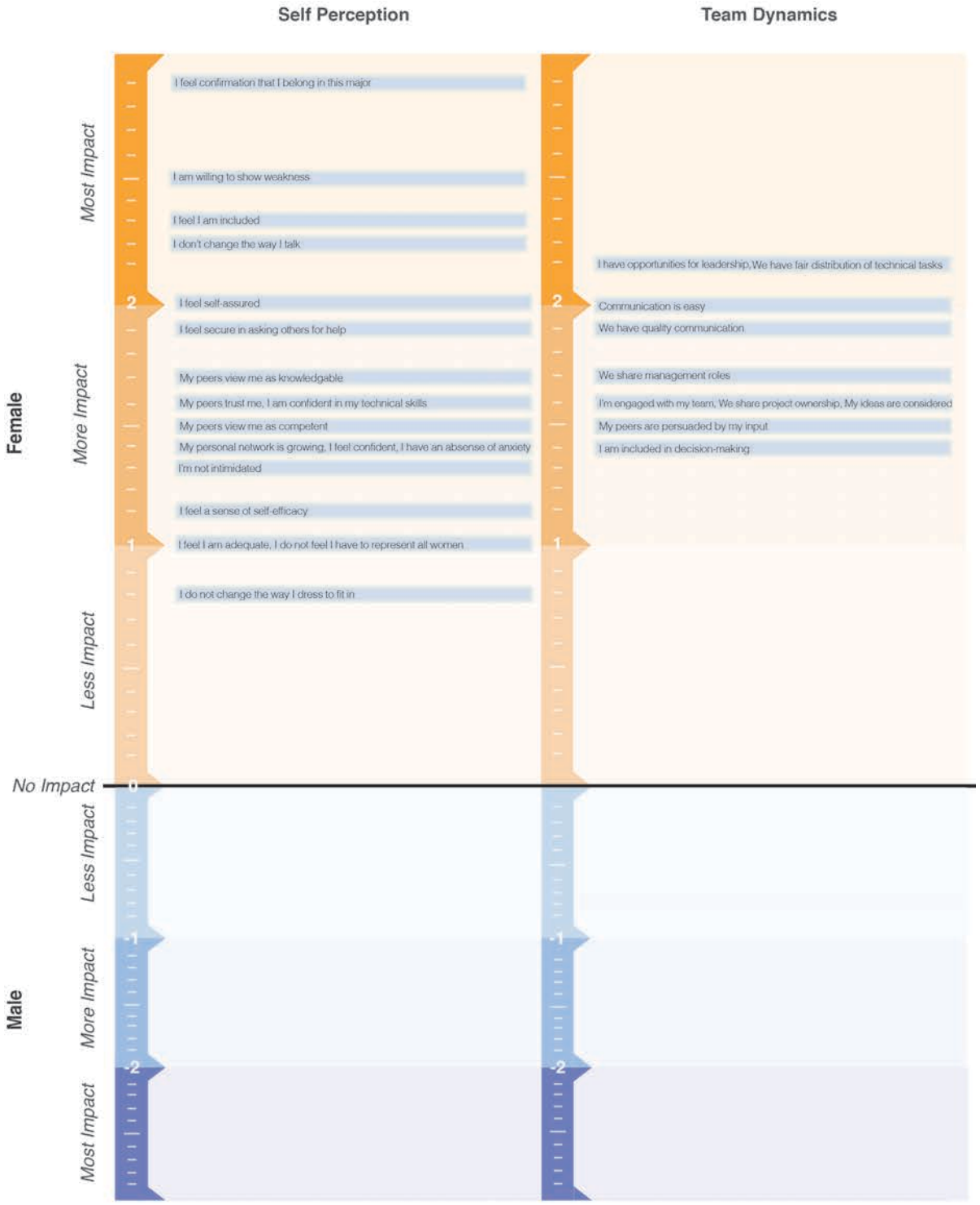

Figure 2 Positive (+) or negative (-) impact score differences between a majority female team (top, yellow) and the majority male team (bottom, blue).

3.5 Rank order of statement difficulty

Figure 3 indicates the order of difficulty of any given question in either state.

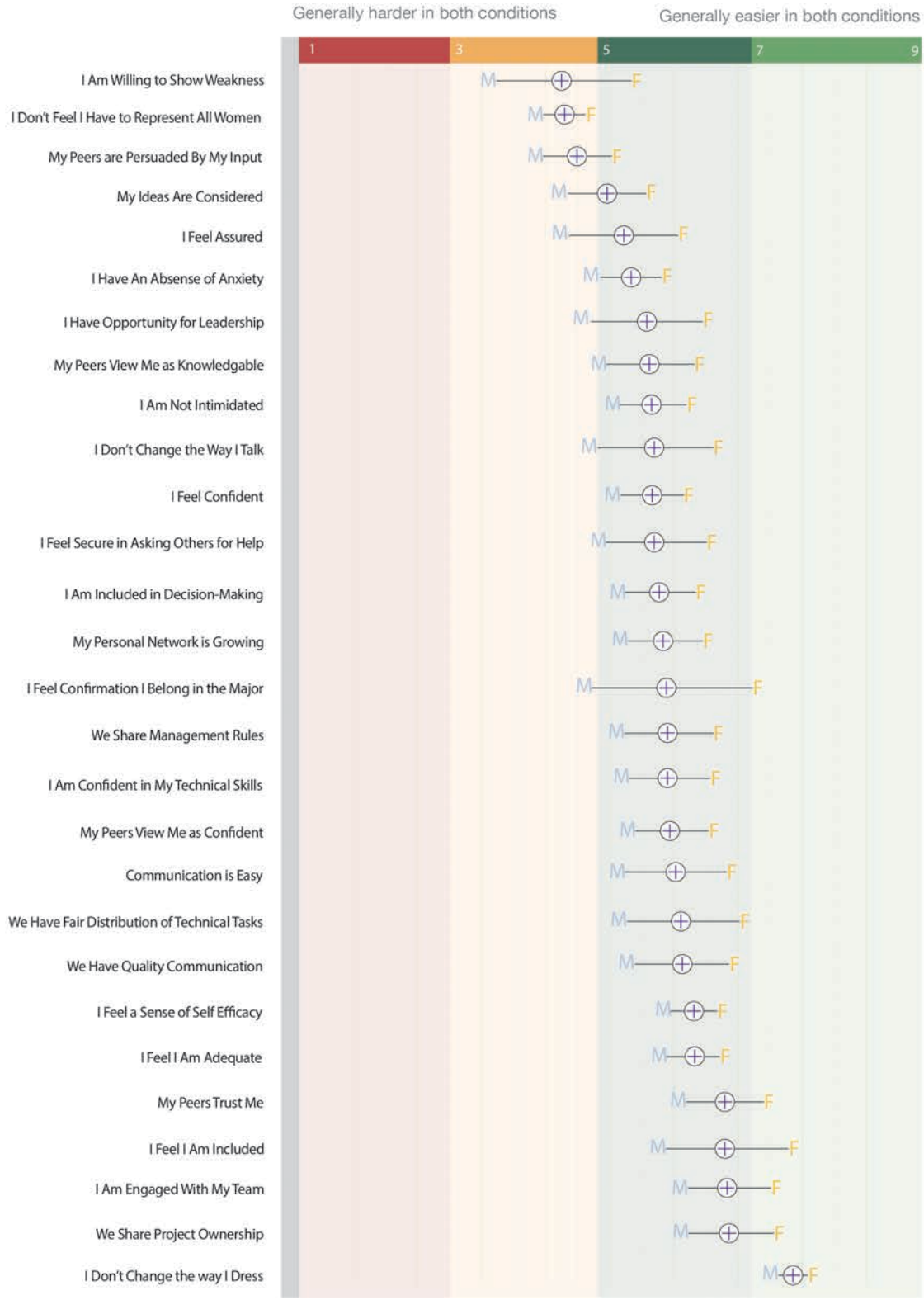

Figure 3 Rank order of variable difficulty when both male and female conditions are combined. The top variable is the hardest to deal with in both conditions and vice versa.

The score for each question in both the male and female majority were averaged and the lower the score, the more difficult that question is to address in either state.

Three questions scored in the "disagree" zone indicating that these are generally harder to deal with in both conditions.

- "I am willing to show weakness" – scores the highest. While the difference between the two states is larger than normal, this question is the most difficult to deal with in both conditions. Educators might want to address this topic in general to improve their students educational experience.
- "I don't feel I have to represent all women" – scores second highest. In either condition, women feel they are always representing women. This could be driven by the male dominant context in which they are working.
- "My peers are persuaded by my input" – scores third highest. Persuasion is always a difficult task.

One question scored in the "strongly agree" zone indicating this question in easy generally easier to deal with in both conditions.

- "I don't change the way I dress" – scored the lowest. How one dresses is of little concern in either state.

4. Discussion

4.1 Critical Mass

The majority of design programs at a university level—such as Industrial Design, Mechanical Engineering, IT, or Electrical Engineering—have significantly higher male enrolments compared to their female counterparts (Fairs, 2018) (Rincon, 2018). Additionally, these majors rely heavily on group work projects in their curriculum in order to prepare students to collaborate on teams during their careers.

In a studio course with 4 female students and 12 male students, the design educator has a variety of options as to how they choose to group students for a team project. Our experience suggests that instructors tend to spread the women students out among the male majority teams. This appears on the surface to be the fairest and equal treatment of all the students. However, based on the findings in this study, this is neither fair nor equal, but places women at a distinct disadvantage.

Fouad (2017) found that two of the top three reasons women decide to leave engineering jobs are "unmet achievement needs that reflected a dissatisfaction with effective utilization of their math and science skills, and…unmet needs with regard to lack of recognition at work and adequate opportunities for advancement".

Seron, (2015) reports that effective strategies to improve women's "fit" in the culture of engineering is to address their experiences in college "coursework rituals and team projects".

Both of these study results support, in our view, our findings that team dynamics and self-perception significantly increase for women when they participate on a female majority teams. Steele found that in order for women to feel comfortable and involved in teams, their team should have "critical mass", which he defines as no less than 40% female. In order to achieve a fair and equal educational experience for all students in a classroom, educators should be more mindful of the gender composition of the teams they organize and explore for themselves how the educational outcomes shift.

When we first organized all women teams, the women felt they were being unfairly called out based on their gender and rebelled against the situation. They feared the untraditional situation, the prejudice against them for their gender, and perhaps were concerned about their own capabilities to succeed. However, the instructor insisted on keeping this organization, and within weeks of beginning the project, the loudest student dissenters had reversed positions and became evangelizers for all women teams.

Women teams are not perfect, they have their own unique issues, but when it comes to equalizing educational experiences, enabling women to hold leadership roles, perform the technical tasks, have their voices heard, and feel like they fit in, this option leads to outstanding outcomes. We seriously propose that adjusting the practice of assigning groups to reduce the impact of social threat is a positive way to afford female design students a more equitable educational experience.

4.2 Imposter Syndrome

Being aware of the female condition observed in the results of our study can aid instructors in understanding and addressing the effects of Imposter Syndrome. Imposter Syndrome is a condition observed most commonly in women, where in they feel inadequate, like they don't belong, and that they are a fraud, believing they accidentally fooled someone into allowing them into the position they currently hold (Weir, 2013). As a female industrial design student, I have felt these sorts of feelings often. Through discussion with my male and female classmates, I have found that the majority of female students feel the effects of Imposter Syndrome where male students feel little to none of these feelings in relation to their major. Having a knowledge and understanding of the questions and situations highlighted in this study can aid students in understanding what specific factors contribute to these feelings of inadequacy can help female students invalidate their self-doubt and diminish the effects of Imposter Syndrome—ultimately improving the female condition within design education.

4.3 Male Social Threat

This study focused on women in STEM fields. The same social threat and behaviour and performance differences can occur with men when participating in a female majority context. After some of our co-collaborators reviewed the findings of this study, a few of them indicated they have witnessed the lone male student on their majority female team behave and perform at a noticeably reduced capacity, matching many of the behaviours outlined in this study such as fear of voicing their opinion, insecure in fitting in, afraid to ask for help, and excusing themselves from decision making activities.

4.4 Professional Employment

On a personal level, I believe this study will have a significant impact on my values and goals when I begin applying for professional employment. If a company cannot demonstrate they have a gender-balanced working environment, I will decline any offers I receive. I have come to understand that avoiding living under the pressures of social threat on a daily basis is more important than any salary or job description.

5.Conclusion

At our own university, the entering freshman class has consisted of 20 - 21% women over the last 8 years. When viewing those cohort's graduation rates five years later statistics indicate that undergraduate degrees awarded consisted of 9 – 10% women. At some point during their educational experience, roughly 50% of the women entering our college decide it is no longer a "fit" for them. We do not yet have data on why they are leaving, but we would suggest that their ongoing exposure to social threat experienced on male dominant teams in our programs will play a significant role in that decision.

Social threat is real, and it can impact both male and female students. Instructors who believe treating everyone equally is appropriate are ill informed about the consequences of social threat and are blindly promoting a highly unequal educational experience. This paper is a call to be thoughtful about the micro-climates you're creating and explore methods to provide women outstanding educational experiences.

Acknowledgements: This section is optional. You can use this section to acknowledge support you have had for your research from your colleagues, students' participation, internal or external partners' contribution or funding bodies, etc. [Leave blank for initial submission] [X Acknowledgments]

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