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The Study of Women's Perceptions of Performance and Experience in All-Female and Mixed-Gender Engineering Teams

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ABSTRACT

This thesis delves into the factors that affect women's perceptions of team performance and personal experience in all-female and mixed-gender engineering teams. For this study, two surveys were designed to capture how women perceive several factors that affect performance and experience in teams of differing gender compositions. Data was collected from a combination of 130 female engineering students and alumni from The Pennsylvania State University. The data was analyzed using correlations and other types of analysis to draw conclusions about women's perceptions of what leads engineering teams to have high performance and good overall experiences. It was observed that the female participants felt very positive emotions and thoughts on their experiences in all-female engineering teams. These research findings have many potential applications for teams in both academia and industry. As engineering continues to diversify, this knowledge can help foster high quality team dynamics and supportive environments for women in engineering teams, thus leading to better team performances and personal experiences.

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Chapter 1

Introduction

This study was designed to gain knowledge on how women compare team performance and personal experience between all-female and mixed-gender engineering teams. Two surveys were designed for two slightly differing demographics of women. There were 130 participants in this study who were a mix of female engineering students and alumni from The Pennsylvania State University. The two surveys were designed specifically to collect key information targeting a set of research questions in this thesis. These research questions were focused around discovering key factors that affect women's perceptions of both their performance and experience in teams of differing gender compositions. Each survey used several scales, check-all-that-apply questions, and open-ended questions to capture all the participants' responses.

After the data collected from these two surveys were analyzed, statistics were applied, values were calculated, and graphs were drawn. Correlations were discovered, and a better understanding was formed on how various factors affect women's perceptions. This understanding has numerous potential applications in engineering teams in both academia and corporate environments. As engineering continues to diversify, this knowledge can aid team members, professors, managers, etc. in fostering these superior team dynamics and team cultures for women in engineering teams. This can then lead to better performances and personal experiences of team members which will bring many benefits, including financial benefits, to the institution or company.

Overall, this study was developed through a creative process of design and driven by personal motivation. The study had many systematic components that had to align in order for it

to run smoothly and effectively. Throughout the decision-making process for each component, ethics were fully applied. Additionally, this study had many design considerations including those for the public health, safety, and welfare of the participants. When initiating this design project, it was clear it would be a human subjects research study. Before developing any component to the study, the proper training and certification was received. When going through the design process, lab directors with expertise in human subjects research were consulted to ensure that each step of the process was professional and protected the safety and well-being of each participant of the study.

Chapter 1.1 Motivations for the Study

I am a fourth-year female engineering student at The Pennsylvania State University. I participated in the Women in Engineering Program Orientation (WEPO) as a first-year student, and it truly changed my life. WEPO is an award-winning and well-recognized orientation program that engages students in building personal, academic, and professional development resources. This program consistently generates unparalleled retention rates for women in engineering studies.

Before WEPO, I was not fully convinced that I wanted to pursue an engineering career, but this single event validated my decision. This event was incredible for many reasons, but mainly because of the students attending and the inspirational leadership team---all female engineers. I can truly describe the event and its atmosphere as magical. When the hundreds of women came together to collaborate in teams during workshops and activities, it was an experience unlike any other I have experienced.

I have been very fortunate to participate in WEPO leadership positions each subsequent year. When reflecting on all of my college experiences, I believe the moments I have had working in all-female teams at WEPO each year were unsurpassed. The other moments I highly cherish are the times I have worked in other all-female teams through our chapter of the Society of Women Engineers (SWE). Through SWE, I have traveled to several conferences, participated in workshops, attended all types of events, and more. Truly, I believe some of the most significant experiences of my life were when I was surrounded by all-female engineers in teams and organizations.

In my personal experience, I found these teams to consistently be high performing and to have many other positive attributes. Every time I was in an all-female team, I experienced very positive feelings and had a great overall experience. Throughout my life, I have also gained a lot of experience working in mixed-gender teams through courses, clubs, and internships. While I have had some good experiences in mixed-gender teams, they have not matched the exceptional experiences I have had in all-female teams. I developed this research study to explore whether other women had similar experiences to those I have witnessed and to delve into the reasons behind any differences that female engineers might have experienced in teams of different gender compositions.

Chapter 2

Literature Review

To prepare for this study, existing literature regarding the topics explored was reviewed. The topics explored in this review were the effects of gender diversity in engineering teams, the impact of gender diversity initiatives in collegiate levels, modeling team cohesion, understanding psychological safety in teams, and Likert scales. These were all subjects that sparked interest when diving into designing this study and topics that desired to be explored more deeply.

Women have consistently been underrepresented in the Science, Technology, Engineering and Math (STEM) fields in both collegiate enrollment rates and positions in industry. While some progress has been made in the past few decades and women in STEM enrollment rates continue to grow, a significant gap still exists. Many efforts have been made to try to close this gender gap, but researchers struggle to identify the variety of reasons for the gap and are unable to determine how to fully eliminate it. A career in STEM fields is not performed in isolation. It is rather a career filled with teamwork. It is crucial to study an individual's experience on a team when trying to understand this gap.

Chapter 2.1 Effects of Gender Diversity in Engineering Teams

Recent evidence suggests that group collaboration is greatly improved when women are present in the group [1]. These findings suggest that promoting the role of women in STEM improves the quality of collaboration and will lead to significant and positive results in productivity. To both promote successful collaborations and improve the gender gap in STEM, it is important to study the effects of gender diversity in teams.

Overall, evidence suggests team collaboration is significantly improved by the presence of women, primarily because of related benefits to group processes [1]. Women often have higher social sensitivity, where they more easily detect nonverbal cues and make inferences on what team members are thinking and feeling. Additionally, women were usually more engaged by smiling more than males when speaking and listening. It was determined that groups with more women had more equality in taking turns in their conversations. This study found women exhibit egalitarian behaviors such as equal amounts of communication between team members and shared leadership [1]. This then caused the group to take advantage of the knowledge and skills of each team member.

It is shown that teams with more women have enhanced interaction and communication that improve group processes and increase the group's collective intelligence. It is important to note that collective intelligence is not related to the intelligence of each individual team member but instead the quality of the social interactions within the group [1].

Overall, these research findings suggest that to collect the benefit from gender diversity, it would be most beneficial to have women equally represented with men in each team [1]. This research suggests that gender-balanced teams lead to optimal outcomes with higher collective intelligence when both male and female team members have equal influence, participate at the same rate, and are satisfied with the overall group collaboration experience.

Chapter 2.2 Impacts of Gender Diversity Initiatives

Discrimination and a lack of role models are a few reasons that were discovered for why there are not as many women entering a STEM field [1]. Additionally, women who have careers in STEM often have issues related to work-life balance and family responsibilities. Workplaces

and universities have tried to combat these reasons by creating and offering resources such as mentoring and career development programs.

Within the past decade, there has been a significant increase in the number of initiatives designed to raise awareness of diversity-related challenges that specifically face women. Organizations in both academia and industry around the globe continue to emphasize the importance of reaching a 50%-50% male-to-female distribution. These organizations recognize that diverse and inclusive skills are beneficial for problem solving and leadership. To reduce stereotyping in a traditionally male-dominated industry, initiatives set in place include quotas for women in board positions, promoting equal job opportunities, and establishing friendly mixed-gender work environments. Despite these efforts, the growth in the number of females in STEM is still very small [2].

In the UK, a survey was conducted to understand the impact of these initiatives and their influence on the environment at universities. The survey recorded responses from women's groups to identify issues they consistently face. Results from this survey provide recommendations to STEM fields on how they can best increase the number of females in their programs. Overall, the survey showcases a clear need for prominent role models, mentoring, and promoting engagement of women in STEM at an early age [2].

Engineering is often described as having a masculine culture where women may feel marginalized. Another research study explored how undergraduate female engineering students at four universities interpreted their status using personal journaling [3]. They found that these women recognized their marginality with clear and strong criticisms of their experiences. They interpreted that the women's criticisms centered around meritocracy and individualism, despite their direct experiences with sexism. These women rejected the idea of feminism, as they view it

as a voice to ask for special treatment. They felt as if the special treatment would mean their talents and experiences do not meet the existing standards [3].

Chapter 2.3 Modeling Team Cohesion

Team cohesion can be described as the extent to which team members bond and strongly connect with one another or with the purpose of the team. This concept has been investigated as a team construct as it has been strongly associated with team effectiveness and performance. It also has been used as a type of tool to predict whether team members are willing to work together in this same group at a future date [4].

There are two types of team cohesion. Social cohesion is a collective sense of belonging where team members feel as though they are a part of the team and have social relationships with each other. Task cohesion is a bonding between team members based on a shared commitment to achieve objectives where team members have working relationships with one another [4].

Organizational success is found to depend on the ability of teams to work together and consistently highly perform. For decades, researchers have stated that team cohesion is a large driver for team performance. That being said, research has also shown that the relationship between team performance and team cohesion varies across studies [5].

A study synthesized findings from design studies and analyzed: (a) whether team cohesion and performance were related reciprocally over multiple time periods, (b) the relative magnitude of those relationships, and (c) whether they were stable over time. The study used included three interpersonal-oriented statements: (a) there is a feeling of unity and cohesion in my team, (b) there is a strong feeling of belongingness among my team members, and (c) members of my team feel close to each other. It also included three task-oriented statements: (a)

members of my team share a focus on our work, (b) my team concentrates on getting things done, and (c) my team members pull together to accomplish work. The choices provided for each statement were a 7-point Likert agreement scale (with scale anchors from strongly disagree to strongly agree) [5].

The results showed that cohesion and performance were positively and reciprocally related over time. The results also showcased that the cohesion-to-performance relationship was significantly higher than the performance-to-cohesion relationship. The cohesion-to-performance relationship became stronger over time whereas the performance-to-cohesion relationship remained somewhat consistent over time [5].

This model also includes shared leadership and members' competence variables. They were considered influential factors in team effectiveness models. Shared leadership positively related to team cohesion but did not directly relate to team performance. Although the average team member academic competence was positively related to team performance, it was not related to team cohesion [5].

Chapter 2.4 Understanding Psychological Safety in Teams

Researchers have previously studied the importance of trust in teams. Trust can be defined as, "the expectation that others' future actions will be favorable to one's interests, such that one is willing to be vulnerable to those actions" [6]. Psychological safety is a shared belief held by team members that it is safe for interpersonal risk-taking [4]. Psychological safety involves an aspect of trust but goes beyond interpersonal trust. It describes a team culture characterized by trust and mutual respect, where people are comfortable being themselves. In teams that are psychologically safe, members can freely ask questions, share ideas, and be

vulnerable without the fear of being punished or penalized. This concept of psychological safety is meant to reflect “a sense of confidence that the team will not embarrass, reject, or punish someone for speaking up” [6]. This confidence is formed by mutual respect and trust among the team.

A scale was developed to measure team psychological safety. To create the scale, observations were made during data collection and pre-existing assessment features. Team psychological safety is a group-level construct, so it characterizes the team rather than individual members. The scale itself uses opposing wording and reverse scoring to lessen bias in responses. The choices measurement provided for each statement was a 7-point Likert accuracy scale. The choices provided for each statement ranges from very inaccurate to very accurate [6].

The research models the effects of team psychological safety together with team efficacy on both learning and performance in teams. Results from this study show psychological safety is associated with learning behavior. It also showed team psychological safety is not associated with team efficacy [6].

Psychological safety is important to study and reveal the various effects of the concept in teams. Teams that are more psychologically safe learn more and have a higher performance. Several research studies showcase that teams with high psychological safety have increased task performance, work engagement, creativity and information-sharing. In a team with high psychological safety, team members are found to be more committed to their team and more satisfied by the experience with the team overall [7].

Chapter 2.5 Likert Scales

Likert scales are an ordinal level of measurement, meaning the response categories have a rank order, but the intervals between these responses are not to be presumed equal [8]. Likert scales are often used in human subjects research. While researchers frequently assume that there is equal spacing between them, it is not technically correct to assume that the feeling between two responses is equivalent throughout the scale. While ordinal data can be in the form of numerical values, they often represent verbal responses like in the Likert scale. This discussion of legitimacy is a very important ethical topic to consider. Appropriate statistics must be applied in order to avoid wrongful assumptions and inaccurate conclusions.

Due to the inability to assume equal spacing between categorical variables, calculating values like the mean and standard deviation are inappropriate for ordinal data. Calculating frequencies and percentages of responses in each category is applicable to ordinal data. Parametric tests require data with interval ratio levels, so appropriate inferential statistics for ordinal data are non-parametric tests, such as Chi-square and Spearman's Rho Correlation tests [8]. In order to ensure the quality of the research study, ordinal data must be addressed by authors when approaching their methodology to analyze datasets.

Chapter 3

Study Design

This study was completed with human subjects. In designing each aspect of this study, the importance of ethics was realized and applied. It was understood that there were two intended demographics (first-year female engineering students and a mix of alumni and older female engineers) that were easily accessible before designing the two surveys that would be analyzed for this study. Survey 1 was designed to collect women's perceptions of an experience in an all-female engineering team. Survey 2 was designed to collect comparisons of women's perceptions between all-female and mixed-gender engineering teams.

Chapter 3.1 Ethics in Human Subjects Research

This study involved human subjects research, so it was critical that ethics were applied in every avenue. Before beginning the study, Human Subjects Research (HSR) training was completed. This training included the historical development of human subject protections, ethical issues, and current regulatory and guidance information. The training was completed through the Collaborative Institutional Training Initiative (CITI Program). The CITI Program provides the training needs for universities, healthcare institutions, technology, and research organizations, and governmental agencies. Each researcher who had access to the data collected from this study was required to complete the HSR training through the CITI Program.

This study was a part of a larger research study conducted jointly by Stanford University and Pennsylvania State University under the Institutional Review Board (IRB) approved study: Mapping the High Performance Design Team Genome.

The sole medium used to collect data for this study was two online surveys that prompted participants to provide information to capture the different aspects of this study. At the beginning of each survey, a fully-detailed consent form describing the subject's rights, description, confidentiality, risks, and benefits of the study was provided. Participants of this study were required to be at least 18 years of age. Each participant was required to review and provide an electronic signature to the consent form. If consent was not given, they were unable to move on to complete or submit the survey.

After each participant read the consent form and decided to participate in this project, they were informed that their participation was voluntary and they had the right to withdraw their consent or discontinue participation at any time without penalty. Participants were informed that all information collected would be kept confidential. They were told the data from this study would be analyzed and reported in a scientific publication. The participants were protected by having all the data be anonymized before it was reported.

It was explained that participants would not receive any benefits from this study. They were informed that their decision to participate or not participate in this study would not affect their grades in school, and they would receive no payment for completing the survey. They were also told that their active participation in this study would take approximately 15-30 minutes.

They were provided information for two Protocol Directors to contact if they had any questions, concerns or complaints about this research study, its procedures, or the risks and benefits. They were also provided an independent contact if they were not satisfied with how this study was being conducted or if they had any concerns, complaints, or general questions about the research or their rights as a participant. They were given the contact information for the Stanford IRB if they wanted to speak to someone independent of the research team.

The two surveys were put through several rounds of editing with several people to ensure all the questions were asked properly and clearly with ethics in mind. All questions were reviewed in detail and approved by two lab directors, Dr. Kathryn Jablokow (Professor of Engineering Design and Systems Engineering, Penn State) and Dr. Susan Mohammed (Professor of Psychology, Penn State), who have extensive experience and expertise in human subjects research using similar surveys.

Chapter 3.2 Survey 1 Demographics

Eighty-six out of 171 WEPO participants completed Survey 1. All Survey 1 participants were first-year female engineering students at The Pennsylvania State University. Each participant had recently participated in WEPO. Due to the 2020 coronavirus pandemic, WEPO was held completely virtually for four days in August 2020. Zoom was the online platform used to carry out the orientation. On this platform, participants and the leadership team interacted live using microphones and cameras.

Within the immersive WEPO orientation experiences, students participated in teams in many activities and workshops. The participants were broken into “super teams” as well as smaller teams during different times of the orientation. The super teams had about 12 participants and three leadership team members. The smaller teams had about six participants and one or two leadership team members. There were 13 super teams and 26 smaller teams.

One workshop in the program was an engineering design workshop where participants worked in smaller teams. Survey 1 was distributed to each of the WEPO participants asking them to reflect on their experience in the smaller teams during their engineering design workshop. Survey 1 was distributed through email by the WEPO director. Multiple emails were sent out to

encourage students to participate in the study. Only students 18 years old and above participated in this study. All participants stated their gender was female, and each team from WEPO was represented in this study.

Chapter 3.3 Survey 1 Questions

Within Survey 1, there was a large number of questions asked and data collected. Due to the scope of this study, not every dataset was fully analyzed nor incorporated in answering the particular set of research questions within this thesis. Please refer to Appendix C to view the full survey used. Below are the survey questions that collected data that was studied in detail for this thesis, but please note the numbering system differs from the original survey.

Question 1

Team members were asked to identify their general ability to "be yourself" while working with their team during the WEPO workshop. For this particular statement, they were provided with a scale labeled 1-5, with 1 representing "I could not completely be myself" through 5 which represented "I could completely be myself."

Question 2

Participants were asked to choose what best represented the accuracy level of 7 statements using a 7-point Likert accuracy scale. These statements are the 7 components that factor into determining psychological safety. Notice there is a mix of negatively and positively worded items used to mitigate response set. The specific statements are listed below:

- If you make a mistake on this team, it is often held against you.
- Members of this team are able to bring up problems and tough issues.
- People on this team sometimes reject others for being different.

- It is safe to take a risk on this team.
- It is difficult to ask other members of this team for help.
- No one on this team would deliberately act in a way that undermines my efforts.
- Working with members of this team, my unique skills and talents are valued and utilized.

Question 3

Participants were asked to choose what best represents their agreement level on a 7-point Likert scale to 6 statements used to determine team cohesion. The first 3 statements used were to determine team cohesion for interpersonal-oriented items. The second 3 statements used were to determine team cohesion for task-oriented items. These specific statements are listed below:

- There is a feeling of unity and cohesion in my team.
- There is a strong feeling of belongingness among my team members.
- Members of my team feel close to each other.
- Members of my team share a focus on our work.
- My team concentrates on getting things done.
- My team members pull together to accomplish work.

Question 4

Participants were asked to represent how they felt after the engineering design workshop at WEPO by checking all of the emotions they felt from a list of 14 emotions featured in Table 1.

Table 1 The Emotions Studied in All-Female Teams

List of Emotions
Accomplished
Confident
Empowered
Happy
Included
Inspired
Proud
Supported
Valued
Annoyed
Excluded
Overwhelmed
Sad
Scared

Chapter 3.4 Survey 2 Demographics

Fourty-four participants completed Survey 2. These participants were a mix of female engineering students with at least one year of schooling and alumni from The Pennsylvania State University. They had expected or actual graduation years ranging from 2019 to 2024. Students were provided the survey online through email chains and communication apps of previous WEPO Leadership Teams and WEPO participant teams. Each participant had been involved with WEPO in some form. They each had been a participant, a leader, or both at some point in their undergraduate journey. The only requirements for a participant to engage in this survey was that they were at least 18 years old and had both all-female and mixed-gender engineering team experiences. All participants stated their gender was female.

Chapter 3.5 Survey 2 Questions

Survey 2 had one question that collected data that was not fully analyzed or used in this thesis when answering a particular set of research questions. Please refer to Appendix D to view the full survey used. Below are the survey questions that did collect data that was studied in detail for this thesis, but please note the numbering system differs from the original survey.

Question 1

Participants were asked to choose what best represents their agreement to each of the following statements comparing their experience in all-female teams versus mixed-gender teams using a 7-point Likert agreement scale:

- In an all-female team, it was easier for me to completely be myself.
- In an all-female team, there is more of a feeling of unity and cohesion.
- In an all-female team, there is a more strong feeling of belongingness among my team members.
- In an all-female team, members feel closer to each other.
- In an all-female team, it is more safe to take a risk.
- In an all-female team, members are more able to bring up problems and tough issues.
- In an all-female team, it is easier to ask other members for help.

Question 2

Participants were asked to represent how often they felt the emotions featured in Table 2 in certain teams. They were provided 3 options for how often they felt each emotion. They could say they felt this emotion more often on an all-female team, the same in an all-female team or mixed-gender team, or more often on a mixed-gender team.

Table 2 The Emotions Studied for Comparison Questions

List of Emotions for Comparisons
Included
Valued
Supported
Confident
Overwhelmed
Scared
Annoyed

Question 3

Participants were asked what are two key factors that make an all-female team successful in an open-ended question.

Question 4

Participants were asked what are two key factors that make a mixed-gender team successful in an open-ended question.

Question 5

Participants were asked to compare their personal experience when working in all-female engineering teams versus in mixed-gender engineering teams in an open-ended question.

Question 6

Participants were asked to compare their team performance when working in all-female engineering teams versus in mixed-gender engineering teams in an open-ended question.

Chapter 4

Research Questions

After completing a literature review and being driven by personal curiosity and motivations, the following research questions were formed:

RQ1: Are there significant relationships among women's perceptions of aspects of cohesion, psychological safety, and their ability to be themselves when comparing all-female team experiences to mixed-gender team experiences?

RQ2: Within all-female teams, are there significant relationships among women's perceptions of aspects of cohesion, psychological safety, and their ability to be themselves?

RQ3: Is there a difference in what women perceive as key factors for success when comparing all-female teams to mixed-gender teams?

RQ4: How do women's perceptions of personal experience differ when comparing all-female teams to mixed-gender teams?

RQ5: How do women's perceptions of team performance differ when comparing all-female teams to mixed-gender teams?

RQ6: How do women's emotions differ when comparing their experiences in all-female teams to mixed-gender teams?

Chapter 5

Evaluation Methods

There are four hierarchical scales of measurement used in this study: nominal, ordinal, interval, and ratio. Nominal data can only be categorized, while ordinal data can be categorized and ranked. Interval data can be categorized, ranked, and evenly spaced, while ratio data can be categorized, ranked, evenly spaced, and have a natural zero. The hierarchy signifies the complexity and precision of the levels of measurement. Depending on which scale of measurement was used for each variable in each study of this thesis, the types of analyses to be performed were chosen accordingly.

Chapter 5.1 Open-Ended Questions

Between the two surveys used in this thesis (Survey 1 and Survey 2), participants were asked seven open-ended question. The participants could freely write as much as they would like in response to these seven questions. With two survey datasets with larger sample sizes and extensive qualitative responses, a sorting procedure was used before analyzing the open-ended question responses. The open coding procedure was used to identify and sort all the categories participants spoke about in their lengthy individual responses. This way, the raw extensive qualitative data was segmented into meaningful specific categories. These specific categories were then used in the data analysis to study what the participants were talking about in regard to each question.

There were various steps taken to carefully carry out the open coding procedure to have a high level of accuracy and ensure that ethics were applied to properly document each

participant's response. Two experts in the domain, both undergraduate female engineers who participated in WEPO previously, carried out this open-coding process.

The first expert read each response and generate a list with up to 90 specific categories for each question. Then, each response was read again, and the original category list was condensed into approximately 20-25 broader categories for each question. The second expert in the Penn State Do iT Lab then read each response and created 20-25 broader categories. These two experts' then reached a consensus on a categorical list to be used for a test run.

Each expert individually performed a test run using the agreed upon categorical list with each survey question for an estimated 15% of the survey responses. During the test run, each expert thoroughly read the response, then interpreted and identified which categories the participant spoke about and how they spoke about them. The experts developed a marking system to represent how each category was discussed. Survey 2 Questions 3 and 4 are non-comparison questions, whereas Survey 2 Question 5 and 6 asked participants to compare their personal experiences and team performances between two types of teams. Thus, two marking systems were used and can be seen in Tables 3 and 4.

Table 3 The Marking System Used for Non-Comparison Questions

For Non-Comparison Questions	
How the Participant Discussed the Category	**The Marking System Used**
Discussed positively	P
Discussed negatively	N
Discussed neutrally	X

Table 4 The Marking System Used for Comparison Questions

For Comparison Questions	
How the Participant Discussed the Category	**The Marking System Used**
Discussed positively in all-female teams	PF
Discussed negatively in all-female teams	NF
Discussed positively in mixed-gender teams	PM
Discussed negatively in mixed-gender teams	NM
Discussed neutrally between both teams	X

Please note that in the comparison questions, the markings were specific to what team the participants exactly referred to. Some may assume that a person discussing a factor positively in an all-female team is equal to discussing it negatively in a mixed-gender team and vice versa. This assumption was not made in order to ensure the exact responses were captured.

After completing the test runs, the experts came together to compare their results and discuss where and why they differed. The two experts then made changes to their categorical lists and were able to standardize the lists into two lists. Only the one list (the master list) was used for all of the questions analyzed in this thesis. The master list has 23 categories and can be seen in Table 5, but keep in mind some categories were not used and not directly applicable to specific questions.

Table 5 The Master Categories List Used for Open Coding

Master List of Categories
Cohesiveness
Communication and collaboration
Confidence
Conflicts
Diversity of team members
Efficiency
Focus and drive
General experience
Grades
Group relationships
Idea quality and generation
Inclusivity and acceptability
Inspiring and empowering
Leadership and power dynamics
Listening and feeling heard
N/A
No difference
Other
Performance and outcomes
Sense of community
Shared backgrounds of team members
Trust and reliability
Work division and effort given

The two experts then individually began coding each question without consulting each other to avoid bias during this process. Once finished coding all the questions, the two experts held several meetings to discuss everything they did and did not agree about the findings. The inter-rater reliability goal was 70%; the inter-rater reliability for the procedure described here was 73.29%, achieving the goal that was set.

On any data that was not initially agreed upon, each response was discussed in detail to come to an agreement on how it should be coded on the final list. This final coded list was the final dataset of nominal data used to analyze each open-ended question.

Chapter 5.2 Likert Questions

There were two different types of Likert scale anchors used within the surveys. Survey 1 Question 2 used a 7-point Likert scale with levels of accuracy, while Survey 1 Question 3 and Survey 2 Question 1 both used a 7-point Likert scale with levels of agreement (see Table 6). In all of the data analysis for these questions, it was never assumed that these were linear scales with equal spacing between each anchor. This data remained ordinal, but for some of the analysis, numbers were assigned to simply replace the wording of each scale anchor for convenience. The conversion system used is displayed in Table 6. Only statistical tests and graphs that had assumptions that the data input was ordinal data were generated using the following ordinal transformation seen in Table 6.

Table 6 How Likert Scales were Converted to Ordinal Data

Ordinal Data Transformation	
Scale Anchor	**Numerical Value Given**
Levels of Accuracy	
Very inaccurate	1
Inaccurate	2
Somewhat inaccurate	3
Neither inaccurate or accurate	4
Somewhat accurate	5
Accurate	6
Very accurate	7
Levels of Agreement	
Strongly disagree	1
Disagree	2
Somewhat disagree	3
Neither agree or disagree	4
Somewhat agree	5
Agree	6
Strongly agree	7

Chapter 5.3 Displaying Data and Performing Non-Parametric Tests

For all the datasets, tables were generated in Excel with raw counts and percentages of responses for each nominal or ordinal category. Common graphs generated included clustered and stacked column and bar graphs. Additionally, box and whisker plots were generated for the ordinal datasets.

Non-parametric statistical tests were used for all ordinal and nominal datasets. These tests did not assume anything about the distribution of the datasets. Minitab was used to run Spearman's Rho Correlation tests on the both ordinal and ratio data sets, which include Survey 1 Questions 1, 2, and 3 and Survey 2 Question 1. These tests produced p-values and correlation values. The p-values range between 0 and 1. The p-value is a measure of how likely it is that the observed correlation is due to chance. If the p-value is close to 0, then it is very unlikely that the observed correlation is due to chance. Thus, in this study, only p-values less than 0.05 signified that the tests' outcome was statistically significant. The correlation value ranges between +1 and -1. The sign of the value determines if the two items are positively or negatively correlated. The magnitude of the value represents the strength of the correlation, where higher magnitudes signify stronger correlations.

Chapter 6

Results and Key Findings

This section shares key findings from the data analyses performed in this study. Observations were made to answer the set of research questions previously described. Various tables and graphs were generated and are shown below to illustrate the data collected from the survey questions and communicate what is significant between the participants' perceptions. Additionally, some statistical tests were performed to determine correlations.

Chapter 6.1 Research Question 1 Findings

RQ1: Are there significant relationships among women's perceptions of aspects of cohesion, psychological safety, and their ability to be themselves when comparing all-female team experiences to mixed-gender team experiences?

To answer this question, Question 1 from Survey 2 was studied in detail. In Question 1, participants were asked to choose what best represents their agreement to each of the seven statements comparing their experiences in all-female teams versus mixed-gender teams. These the 7 statements represented factors (also referred to as items) of their ability to be themselves, team cohesion, and individual psychological safety. To be concise and for display purposes, Table 7 showcases the short naming system that was used in this analysis.

Table 7 The Scales and Coding Systems Used in Survey 2 Question 1

Item Scales and Specific Items	Coding System
Item Scales	
Ability to be themselves scale (singular item)	AT
Cohesion scale items	C
Psychological safety scale items	PS
Specific Items Female Participants were Asked About	
In an all-female team, it was easier for me to completely be myself.	AT-P
In an all-female team, there is more of a feeling of unity and cohesion.	C-P-Team unity
In an all-female team, there is a more strong feeling of belongingness among my team members.	C-P-Belongingness
In an all-female team, members feel closer to each other.	C-P-Team closeness
In an all-female team, it is more safe to take a risk.	PS-P-Safety level for risks
In an all-female team, members are more able to bring up problems and tough issues.	PS-P-Bring up problems
In an all-female team, it is easier to ask other members for help.	PS-P-Asking for help

Figure 1 showcases how all of the participants agreed or disagreed with the comparisons of aspects of AT, C, and PS between all-female teams and mixed-gender teams. Please note that each statement is referring to the item being more positive in an all-female team when compared to mixed-gender teams. It is clear that an overwhelming number of female participants felt a degree of agreement more than a degree of disagreement to all of these statements. Overall, this means that the participants felt a stronger ability to be themselves, more team unity, a stronger sense of belongingness, felt safer to take a risk, more able to bring up problems, and felt more comfortable asking for help *in all-female teams*. These are all extremely positive actions and feelings that they assert to have more of in the teams that consist of only women.

It can also be observed that female participants strongly agreed the most amount of times in the two items of PS, which are their ability to bring up problems and how easy it is to ask for help. None of the participants strongly disagreed with any of these statements, but there were some who said they neither agreed nor disagreed with these statements. Approximately 15% of

participants claimed they neither agreed nor disagreed with the feeling of being safer to take a risk on an all-female team. To observe the same dataset displayed in another format, please refer to Appendix B.

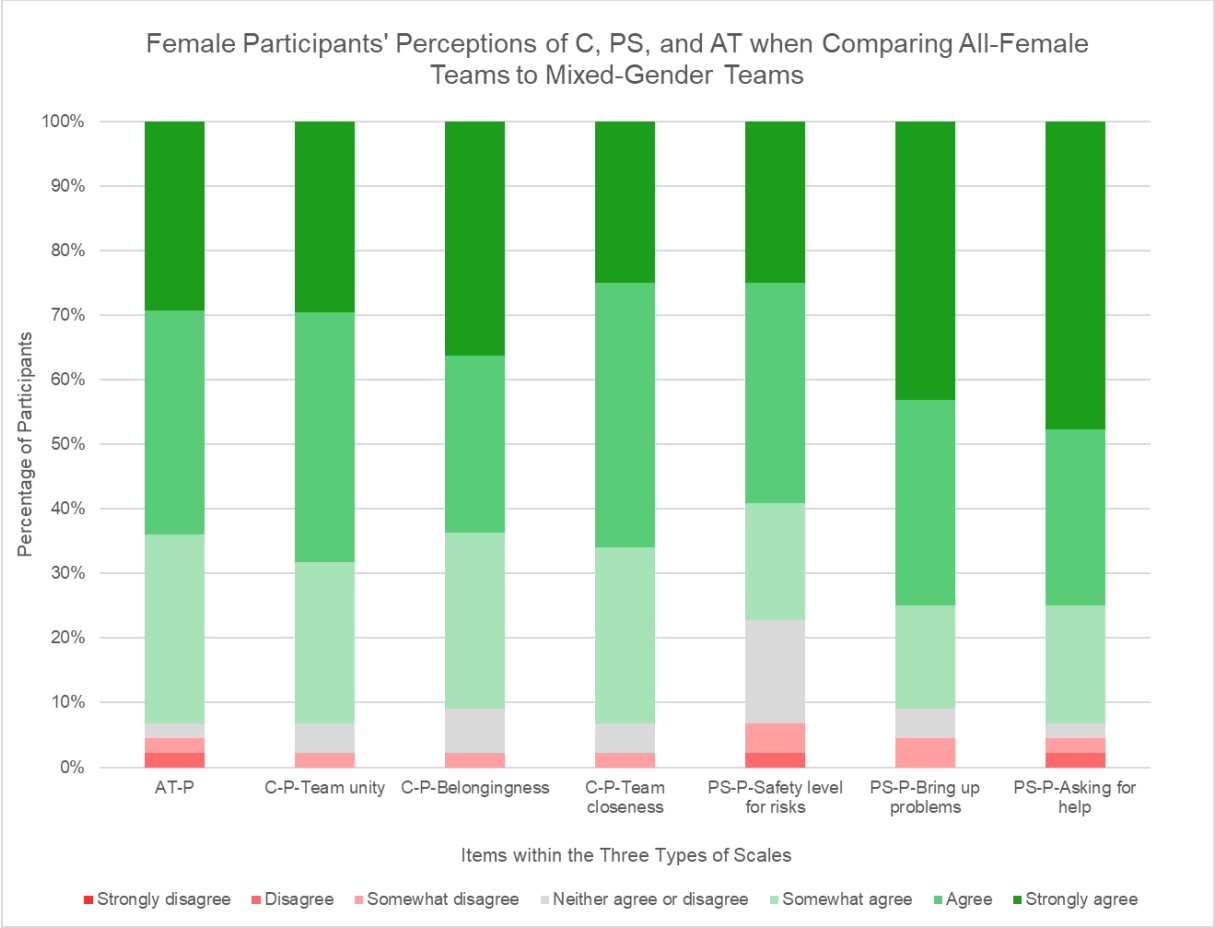


Figure 1 A Comparison of Two Types of Teams Between Dimensions of Cohesion, Psychological Safety, and their Ability to be Themselves

A box and whisker plot, seen in Figure 2, was generated using this same dataset from Question 1. As a reminder, Likert scale anchors were transformed into ordinal data values; the conversions can be seen in Table 6. Here, the distribution and outliers of each item are very visible. AT and two items of C (items of team unity and sense of belongingness) have the same interquartile range (IQR). This is where 50% of their data lies. The other statements have smaller

IQRs and at least one outlier. Within cohesion, the team closeness item has the same IQR and whiskers as the psychological safety item of their safety level to take risks. Additionally, the other two items of psychological safety (their ability to bring up problems and their ability to ask for help) have the same IQR and whiskers.

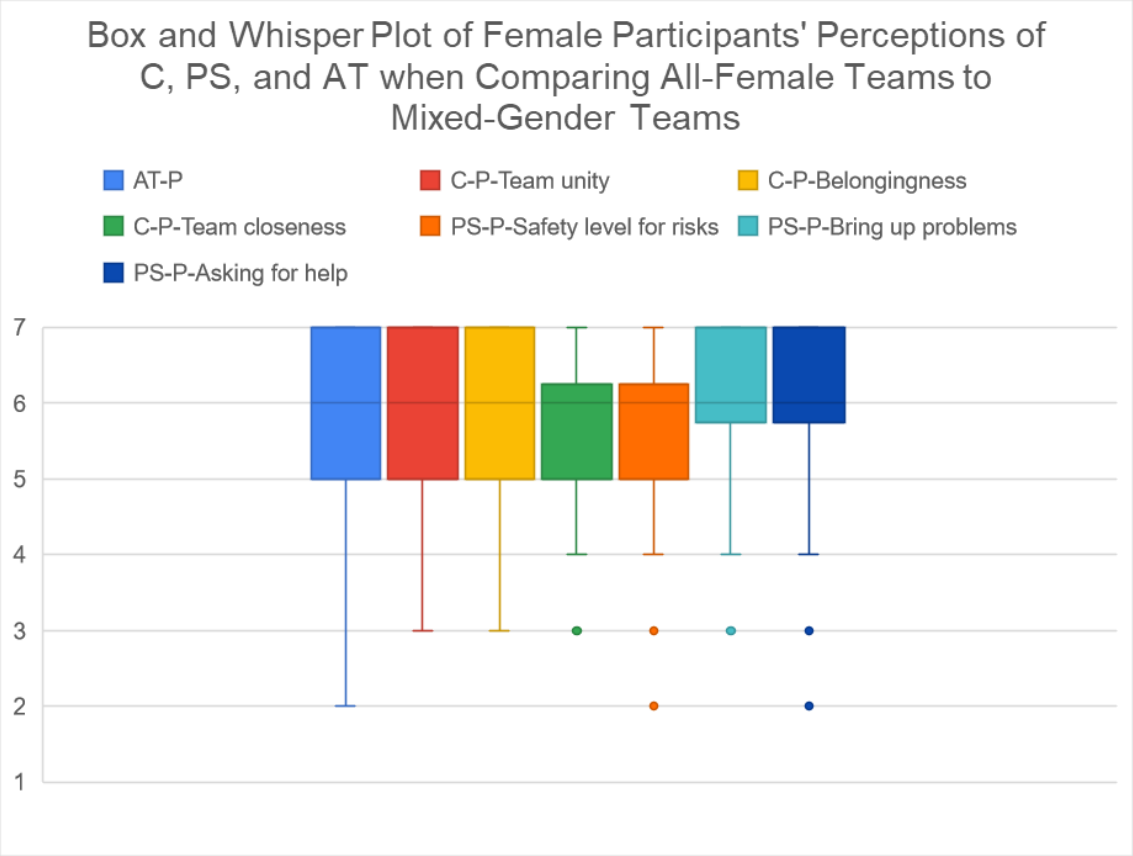


Figure 2 Box and Whisker Plot of Comparisons of Two Types of Teams Between Dimensions of Cohesion, Psychological Safety, and their Ability to be Themselves

Spearman's Rho Correlation tests were performed on all of the possible combinations of these statements. A portion of these tests resulted in p-values that were not statistically significant. Only tests that produced statistically significant results will be discussed in this thesis. Table 8 is included below to show the types of correlations and the color-coding system

used. To refresh the details of this type of statistical test, please refer back to Chapter 5.3 Displaying Data and Performing Non-Parametric Tests.

Table 8 How Correlations were Interpreted

Interpreting the Strengths of Correlations		
Value of Correlation Coefficient (Rs)	**Type of Correlation**	**Highlighted Color**
-1.00 to -0.90	A very strong negative correlation	
-0.89 to -0.70	A strong negative correlation	
-0.69 to -0.40	A moderate negative correlation	
-0.39 to -0.20	A weak negative correlation	
-0.19 to 0.00	A very weak negative correlation	
0.00 to 0.19	A very weak positive correlation	
0.20 to 0.39	A weak positive correlation	
0.40 to 0.69	A moderate positive correlation	
0.70 to 0.89	A strong positive correlation	
0.90 to 1.00	A very strong positive correlation	

Tables 9 and 10 display the tests run comparing pairs of items within the cohesion and psychological safety scales, with their respective results. All of these tests of items within the same scale produced a moderate positive correlation. It was expected that the correlations would be positive, but stronger due to the fact they were within the same scale as each other.

Table 9 Survey 2 Outcomes of Correlation Tests Within the Cohesion Scale

Spearman's Rho Correlation Tests Within C					
Item 1	**Item 2**	**N**	**Correlation**	**95% CI for ρ**	**P-Value**
C-P-Belongingness	C-P-Team unity	44	0.676	(0.448, 0.821)	0
C-P-Team closeness	C-P-Team unity	44	0.521	(0.247, 0.718)	0
C-P-Team closeness	C-P-Belongingness	44	0.416	(0.123, 0.642)	0.005

Table 10 Survey 2 Outcomes of Correlation Tests Within the Psychological Safety Scale

Spearman's Rho Correlation Tests Within PS					
Item 1	**Item 2**	**N**	**Correlation**	**95% CI for ρ**	**P-Value**
PS-P-Bring up problems	PS-P-Safety level for risks	44	0.497	(0.218, 0.702)	0.001
PS-P-Asking for help	PS-P-Safety level for risks	44	0.482	(0.199, 0.690)	0.001
PS-P-Asking for help	PS-P-Bring up problems	44	0.619	(0.371, 0.785)	0

Spearman's Rho Correlation tests were also run to identify correlations between the scales. Tables 11, 12, and 13 summarize the results of the tests run with all the possible combinations between the three different scales. Within all three of these tables, each combination produced moderate positive correlations, except for one, which had a weak correlation. The weak correlation was between the psychological safety item of their ability to ask for help and the cohesion item of their team's closeness. This means that those who felt it was easier to ask for help, did not have a strong feeling of the team members being closer in all-female teams.

Table 11 Survey 2 Outcomes of Correlations Tests Across the Cohesion and Ability to Be Themselves Scales

Spearman's Rho Correlation Tests Across C and AT					
Item 1	**Item 2**	**N**	**Correlation**	**95% CI for ρ**	**P-Value**
C-P-Team unity	AT-P	44	0.596	(0.340, 0.769)	0
C-P-Belongingness	AT-P	44	0.55	(0.282, 0.738)	0
C-P-Team closeness	AT-P	44	0.497	(0.217, 0.701)	0.001

Table 12 Survey 2 Outcomes of Correlations Tests Across the Psychological Safety and Ability to Be Themselves Scales

Spearman's Rho Correlation Tests Across PS and AT					
Item 1	**Item 2**	**N**	**Correlation**	**95% CI for ρ**	**P-Value**
PS-P-Safety level for risks	AT-P	44	0.521	(0.246, 0.718)	0
PS-P-Bring up problems	AT-P	44	0.426	(0.135, 0.650)	0.004
PS-P-Asking for help	AT-P	44	0.552	(0.285, 0.740)	0

Table 13 Survey 2 Outcomes of Correlations Tests Across the Psychological Safety and Cohesion Scales

Spearman's Rho Correlation Tests Across PS and C					
Item 1	**Item 2**	**N**	**Correlation**	**95% CI for ρ**	**P-Value**
PS-P-Safety level for risks	C-P-Team unity	44	0.443	(0.154, 0.662)	0.003
PS-P-Bring up problems	C-P-Team unity	44	0.471	(0.187, 0.683)	0.001
PS-P-Asking for help	C-P-Team unity	44	0.55	(0.282, 0.738)	0
PS-P-Safety level for risks	C-P-Belongingness	44	0.426	(0.135, 0.650)	0.004
PS-P-Bring up problems	C-P-Belongingness	44	0.455	(0.168, 0.671)	0.002
PS-P-Asking for help	C-P-Belongingness	44	0.656	(0.421, 0.809)	0
PS-P-Asking for help	C-P-Team closeness	44	0.349	(0.049, 0.591)	0.02

Chapter 6.2 Research Question 2 Findings

RQ2: Within all-female teams, are there significant relationships among women's perceptions of aspects of cohesion, psychological safety, and their ability to be themselves?

Within Survey 1, participants were asked three questions to collect information on their perceptions of three item scales. Please refer to Table 14 to observe the naming system that was used to analyze this question. Within this table, please take note that the statements are both positively (denoted by -P-) and negatively (denoted by -N- and italicized) worded.

Table 14 The Scales and Coding Systems Used in Survey 1 Questions 1, 2, and 3

Item Scales and Specific Items	Coding System
Item Scales	
Ability to be themselves scale (singular item)	AT
Cohesion scale items	C
Psychological safety scale items	PS
Specific Items Female Participants were Asked About	
Identify your general ability to "be yourself" in working with this team during the workshop.	AT-P
If you make a mistake on this team, it is often held against you.	PS-N-Mistake causes consequences
Members of this team are able to bring up problems and tough issues.	PS-P-Bring up problems
People on this team sometimes reject others for being different.	PS-N-Reject others
It is safe to take a risk on this team.	PS-P-Safety level for risks
It is difficult to ask other members of this team for help.	PS-N-Asking for help
No one on this team would deliberately act in a way that undermines my efforts.	PS-P-Actions respect individual's efforts
Working with members of this team, my unique skills and talents are valued and utilized.	PS-P-Valuing and utilizing skills
There is a feeling of unity and cohesion in my team.	C-P-Team unity
There is a strong feeling of belongingness among my team members.	C-P-Belongingness
Members of my team feel close to each other.	C-P-Team closeness
Members of my team share a focus on our work.	C-P-Shared focus
My team concentrates on getting things done.	C-P-Concentration
My team members pull together to accomplish work.	C-P-Accomplish tasks

Survey 1 participants were asked in Question 1 to identify their general ability to "be yourself" while working with their team during the WEPO engineering design workshop. They were provided with a scale labeled 1-5, with 1 representing "I could not completely be myself" through 5 which represented "I could completely be myself." Figure 3 displays the distribution of responses to this question. To see this dataset displayed in another format, please refer to Appendix B.

It can be seen that over 95% of the female participants ranked themselves at least a 3 or above. Approximately 60% of the participants felt like they were at a 4 while about 15% of participants felt like they were at a 5 where they could completely be themselves in this all-female team.

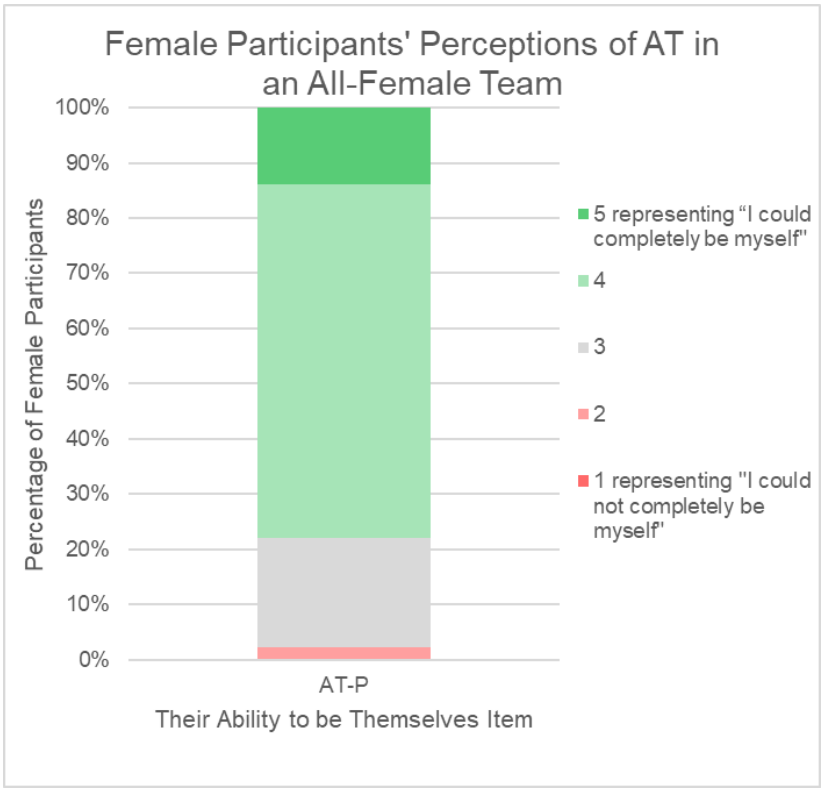


Figure 3 The Participants' Perceptions of their Ability to Be Themselves in an All-Female Team

Additionally in Survey 1, participants were asked Question 2 which asked them to choose what best represented the accuracy level of 7 statements using a 7 point Likert accuracy scale. These statements are the 7 components that factor into determining psychological safety. Notice there is a mix of negatively and positively worded items used to mitigate response set. Figure 4 displays the distribution of responses to this question. To see this dataset displayed in another format, please refer to Appendix B.

In Figure 4, it is clear that all the positively worded psychological safety items have about 90% of participants responding that they feel these statements are accurate to some degree in this all-female team. Reversely, all the negatively worded psychological safety items have about 95% of participants responding that they feel these statements are inaccurate to some degree in this

all-female team. This was expected from personal past experiences and validated through these findings. To view the box and whisker plot generated for this dataset, please refer to Appendix B.

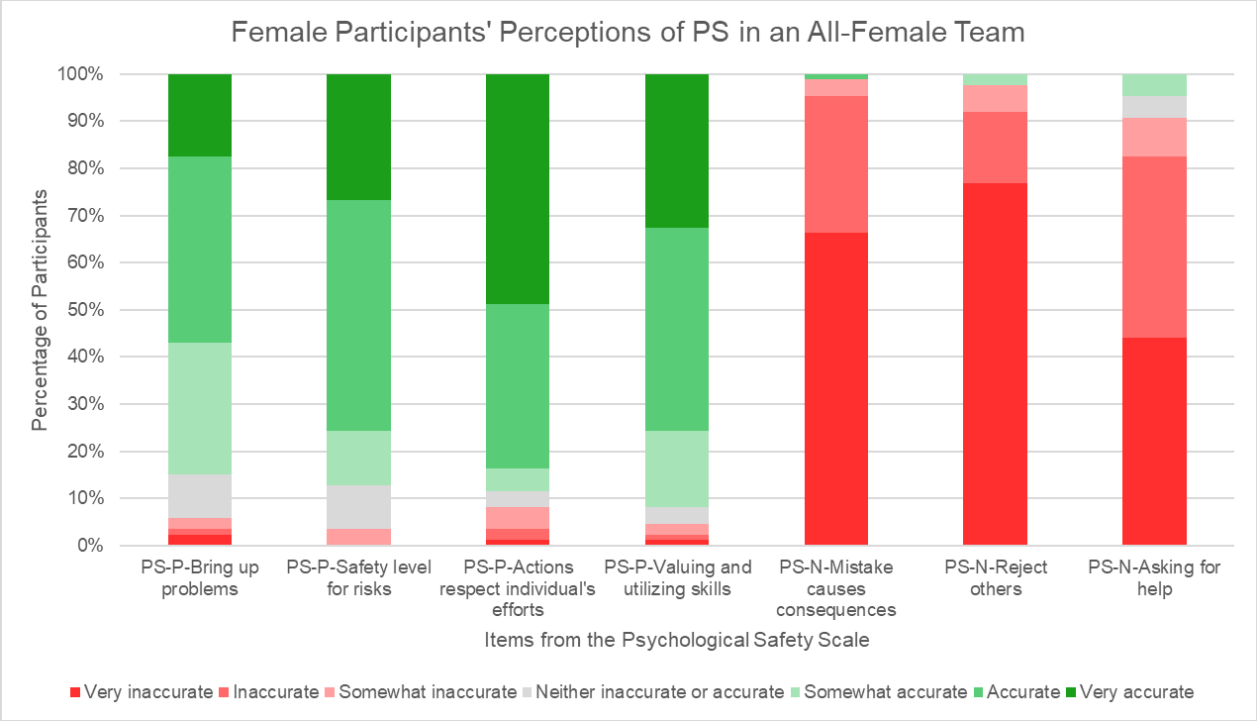


Figure 4 The Participants' Perceptions of Dimensions of Psychological Safety in an All-Female Team

Question 3 in Survey 1 had participants choose what best represents their agreement level on a 7 point Likert scale to 6 statements used to determine team cohesion. Figure 5 displays the distribution of responses to this question. To see this dataset displayed in another format, please refer to Appendix B

In Figure 5, it is evident that a vast majority (about 90%) of participants claimed they agreed to some degree to all of the items within the cohesion scale for this all-female team experience. One observation that was not expected for all-female teams that operate in-person, but was expected for those who operate fully virtual, was that about 10% of participants

somewhat disagreed to the statement that members on this all-female team feel close to each other. It was surprising to still see about 70% of participants working in a virtual team agree to this statement of team closeness. To view the box and whisker plot generated for this dataset, please refer to Appendix B.

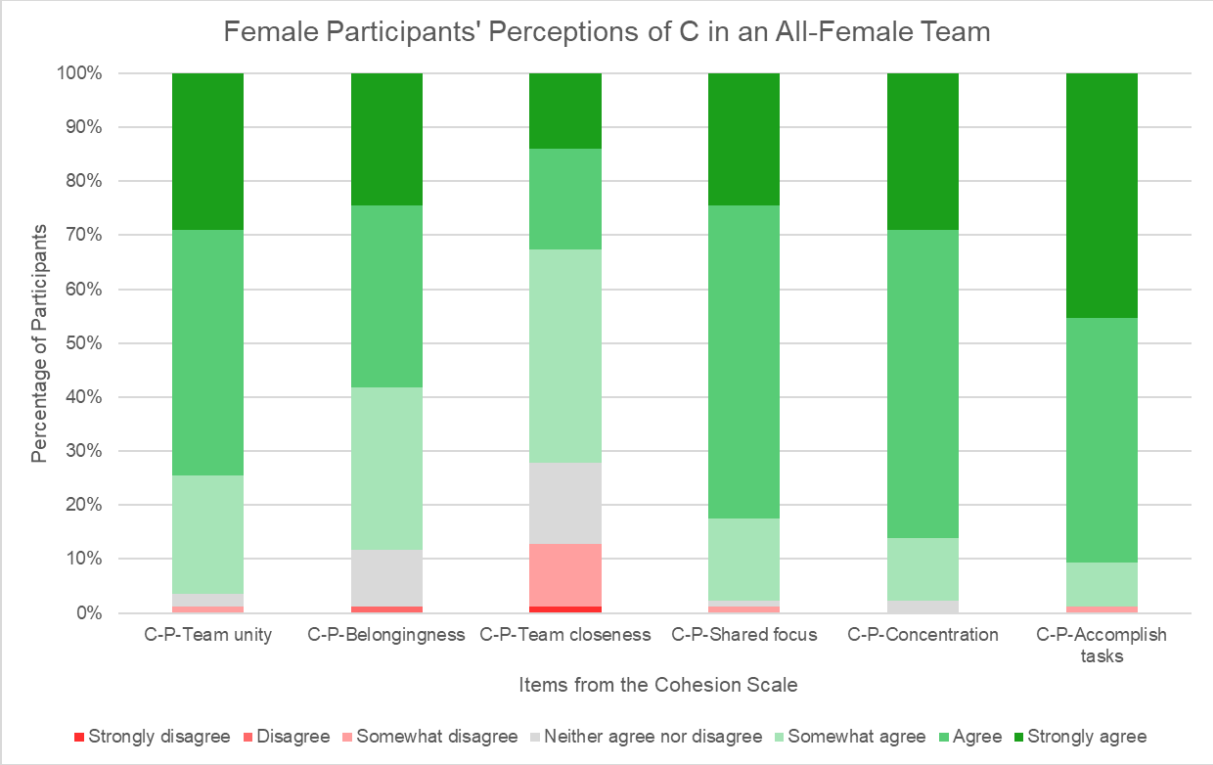


Figure 5 The Participants' Perceptions of Dimensions of Cohesion in an All-Female Team

Tables 15, 16 and 17 showcase the results of the Spearman's Rho Correlation tests run within each item scale. The same color coding system was used to interpret the correlation strengths (see Table 8). Within the psychological safety scale, there are positively and negatively worded items (italicized in tables) so they were pulled out and made into separate tables. Before running these tests, it was expected that when two positive item or two negative items were tested, it would produce a positive correlation due to them having the same type of connotation. When a positive item was tested against a negative item, they were expected to have a negative

correlation. This expectation held true for most of the correlation tests, with the exception of a few when comparing across two item scales.

Within the psychological safety scale, most of the positive correlated items were moderate in strength. There were two cases where there were weak positive correlations. These cases are when tests were performed on safety level for risks against their ability to bring up problems and the rejection of others against their mistake causing consequences.

Table 15 Survey 1 Outcomes of Correlations Tests Within Positively Worded Items of the Psychological Safety Scale

Spearman's Rho Correlation Tests Within Positively Worded Items of PS					
Item 1	**Item 2**	**N**	**Correlation**	**95% CI for ρ**	**P-Value**
PS-P-Safety level for risks	PS-P-Bring up problems	86	0.276	(0.064, 0.464)	0.01
PS-P-Actions respect individual's efforts	PS-P-Safety level for risks	86	0.419	(0.219, 0.586)	0
PS-P-Valuing and utilizing skills	PS-P-Safety level for risks	86	0.427	(0.227, 0.592)	0
PS-P-Valuing and utilizing skills	PS-P-Actions respect individual's efforts	86	0.445	(0.248, 0.607)	0

Table 16 Survey 1 Outcomes of Correlations Tests Within Negatively Worded Items of the Psychological Safety Scale

Spearman's Rho Correlation Tests Within Negatively Worded Items of PS					
Item 1	**Item 2**	**N**	**Correlation**	**95% CI for ρ**	**P-Value**
PS-P-Safety level for risks	*PS-N-Mistake causes consequences*	86	-0.339	(-0.518, -0.131)	0.001
PS-P-Actions respect individual's efforts	*PS-N-Mistake causes consequences*	86	-0.268	(-0.457, -0.055)	0.013
PS-P-Valuing and utilizing skills	*PS-N-Mistake causes consequences*	86	-0.22	(-0.415, -0.006)	0.042
PS-P-Actions respect individual's efforts	*PS-N-Reject others*	86	-0.421	(-0.588, -0.221)	0
PS-N-Asking for help	PS-P-Safety level for risks	86	-0.321	(-0.503, -0.112)	0.003
PS-P-Actions respect individual's efforts	*PS-N-Asking for help*	86	-0.452	(-0.613, -0.256)	0
PS-P-Valuing and utilizing skills	*PS-N-Asking for help*	86	-0.327	(-0.508, -0.118)	0.002
PS-N-Reject others	*PS-N-Mistake causes consequences*	86	0.345	(0.137, 0.523)	0.001
PS-N-Asking for help	*PS-N-Mistake causes consequences*	86	0.441	(0.243, 0.603)	0
PS-N-Asking for help	*PS-N-Reject others*	86	0.469	(0.275, 0.626)	0

Within the cohesion scale, most of the tests produced weak positively correlated results. There were two cases that produced moderate positive correlations and they were the sense of belongingness against the amount of team unity and their shared focus against the sense of

belongingness. There were three cases that have strong positive correlations and they were team closeness against team unity and concentration against team unity and concentration against team closeness.

Table 17 Survey 1 Outcomes of Correlations Tests Within Items of the Cohesion Scale

Spearman's Rho Correlation Tests Within C					
Item 1	**Item 2**	**N**	**Correlation**	**95% CI for ρ**	**P-Value**
C-P-Belongingness	C-P-Team unity	86	0.431	(0.232, 0.596)	0
C-P-Team closeness	C-P-Team unity	86	0.852	(0.767, 0.908)	0
C-P-Shared focus	C-P-Team unity	86	0.237	(0.023, 0.430)	0.028
C-P-Concentration	C-P-Team unity	86	0.752	(0.626, 0.840)	0
C-P-Team closeness	C-P-Belongingness	86	0.397	(0.194, 0.567)	0
C-P-Shared focus	C-P-Belongingness	86	0.436	(0.237, 0.599)	0
C-P-Concentration	C-P-Belongingness	86	0.219	(0.005, 0.414)	0.043
C-P-Accomplish tasks	C-P-Belongingness	86	0.374	(0.169, 0.548)	0
C-P-Shared focus	C-P-Team closeness	86	0.267	(0.054, 0.456)	0.013
C-P-Concentration	C-P-Team closeness	86	0.781	(0.665, 0.860)	0
C-P-Concentration	C-P-Shared focus	86	0.359	(0.152, 0.535)	0.001
C-P-Accomplish tasks	C-P-Shared focus	86	0.387	(0.183, 0.559)	0
C-P-Accomplish tasks	C-P-Concentration	86	0.243	(0.029, 0.435)	0.024

When items of psychological safety were tested across items of cohesion, there were two comparisons that produced a negative correlation when not expected. These two tests were the amount of team unity against members' actions respecting individual's efforts and team closeness against members' actions respecting individual's efforts. While this is important to observe and raises questions of why this is the case, the negative correlations are weak in strength. All other correlation tests between the two scales produced weak correlations.

Table 18 Survey 1 Outcomes of Correlations Tests Across Items of the Psychological Safety and Ability to Be Themselves Scale

Spearman's Rho Correlation Tests Across PS and AT					
Item 1	**Item 2**	**N**	**Correlation**	**95% CI for ρ**	**P-Value**
PS-P-Safety level for risks	AT-P	86	0.225	(0.012, 0.420)	0.037
PS-N-Asking for help	AT-P	86	-0.337	(-0.517, -0.129)	0.001
PS-P-Valuing and utilizing skills	AT-P	86	0.253	(0.041, 0.444)	0.019

Table 19 Survey 1 Outcomes of Correlations Tests Across Items of the Cohesion and Ability to Be Themselves Scale

Spearman's Rho Correlation Tests Across C and AT					
Item 1	**Item 2**	**N**	**Correlation**	**95% CI for ρ**	**P-Value**
C-P-Team closeness	AT-P	86	0.319	(0.110, 0.501)	0.003
C-P-Concentration	AT-P	86	0.274	(0.062, 0.462)	0.011

Table 20 Survey 1 Outcomes of Correlations Tests Across Items of the Cohesion and Psychological Safety Scale

Spearman's Rho Correlation Tests Across C and PS					
Item 1	**Item 2**	**N**	**Correlation**	**95% CI for ρ**	**P-Value**
C-P-Belongingness	PS-P-Bring up problems	86	0.382	(0.177, 0.554)	0
C-P-Shared focus	PS-P-Safety level for risks	86	0.345	(0.138, 0.524)	0.001
C-P-Accomplish tasks	*PS-N-Asking for help*	86	-0.246	(-0.438, -0.033)	0.022
C-P-Team unity	PS-P-Actions respect individual's efforts	86	-0.259	(-0.449, -0.046)	0.016
C-P-Team closeness	PS-P-Actions respect individual's efforts	86	-0.255	(-0.446, -0.042)	0.018

Chapter 6.3 Research Question 3 Findings

RQ3: Is there a difference in what women perceive as key factors for success when comparing all-female teams to mixed-gender teams?

Survey 2 responses were used to answer this research question. Participants were asked: what are two key factors for success in an all-female team (Question 3)? Then, they were also asked: what are two key factors for success in a mixed-gender team (Question 4)? These were both open-end questions. To refamiliarize yourself with the open-coding procedure used to code these responses, please refer back to Chapter 5.1 Open-Ended Questions.

Figure 8 illustrates how each category was discussed in the participants' responses to both questions. When participants were prompted to discuss the key factors that make an all-female team successful, the most frequent category discussed was sense of community. Many

participants believe the key factors to make an all-female successful come from factors within building a sense of community, whereas 16 less participants thought that this was a key factor for success in mixed-gender teams. When participants were prompted to discuss the key factors that make a mixed-gender team successful, the most frequent category discussed was the diversity of team members, while it was least discussed referring to all-female teams. This suggests that the participants were thinking about diversity in terms of gender and not the other types of diversity. Additionally, the participants indicated that the shared background of team members is only a key factor in all-female teams and not mixed-gender teams. Here, they may be associating shared backgrounds only to mean shared gender identities. A category that is discussed very frequently for key factors in both teams is communication and collaboration. To view graphs of each survey question individually and the most frequent categories discussed, please refer to Appendix B.

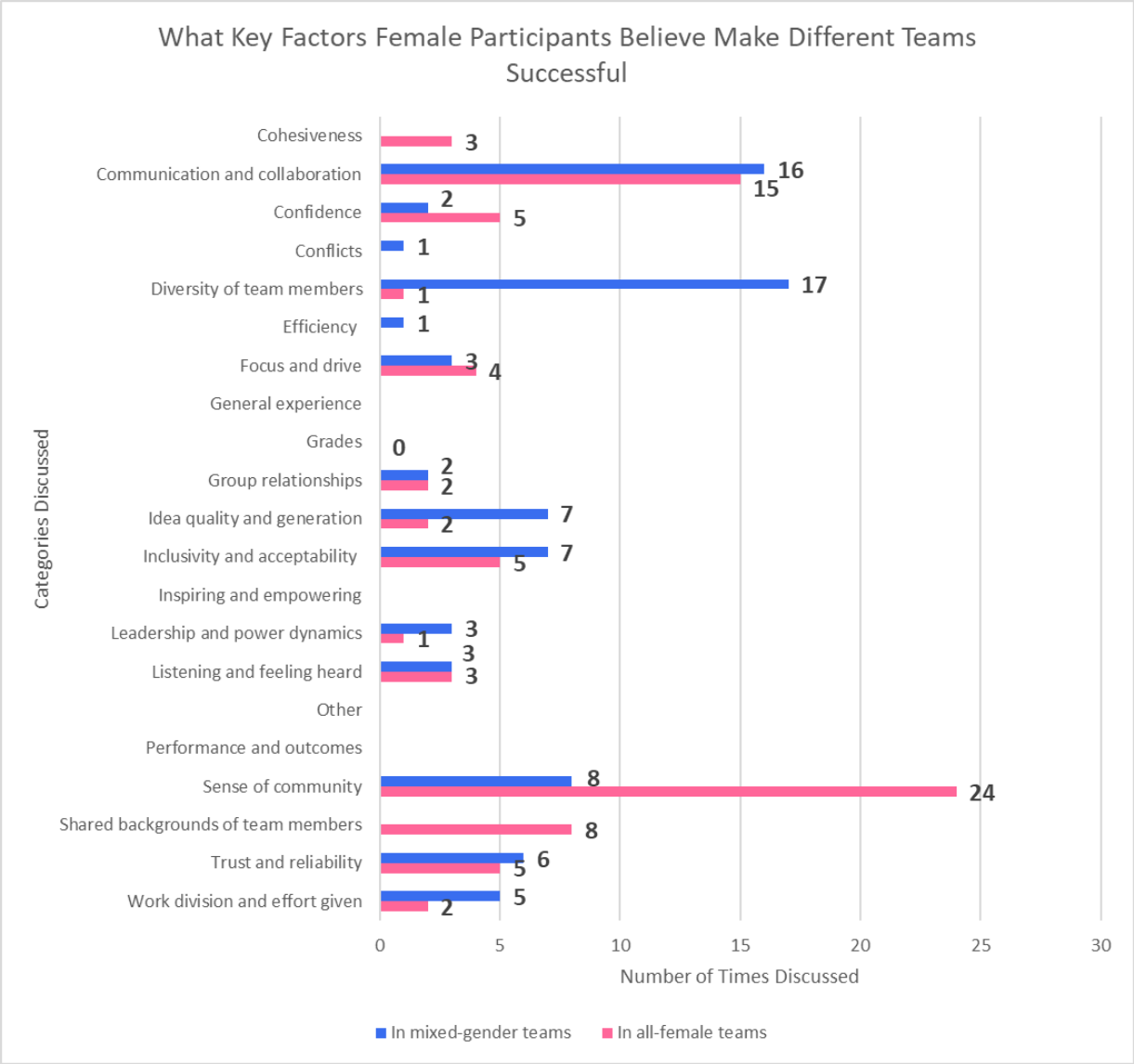


Figure 6 A Comparison of Key Factors Participants Perceive Make Two Types of Teams Successful

Chapter 6.4 Research Question 4 Findings

RQ4: How do women's perceptions of personal experience differ when comparing all-female teams to mixed-gender teams?

In Survey 2, Question 5 was an open-ended question where it asked participants to compare their personal experience when working in all-female engineering teams versus in mixed-gender engineering teams. Figure 9 displays how each category was discussed in response to this question.

When the participants were asked to compare their personal experience in all-female teams to their experience in mixed-gender teams, they expressed many different experiences. It can be noticed that very few participants discussed categories as being neutral and overall having no difference between the two types of teams. The most prominent responses were participants discussing their personal experience to be better in all-female teams. Across most categories discussed, participants spoke decisively about having positive experiences in all-female teams. Additionally, a large portion of participants also discussed that their experience in several categories were notably negative in mixed-gender teams. It is noted that only a small number of participants expressed their experience as being more negative in all-female teams and more positive in mixed-gender teams.

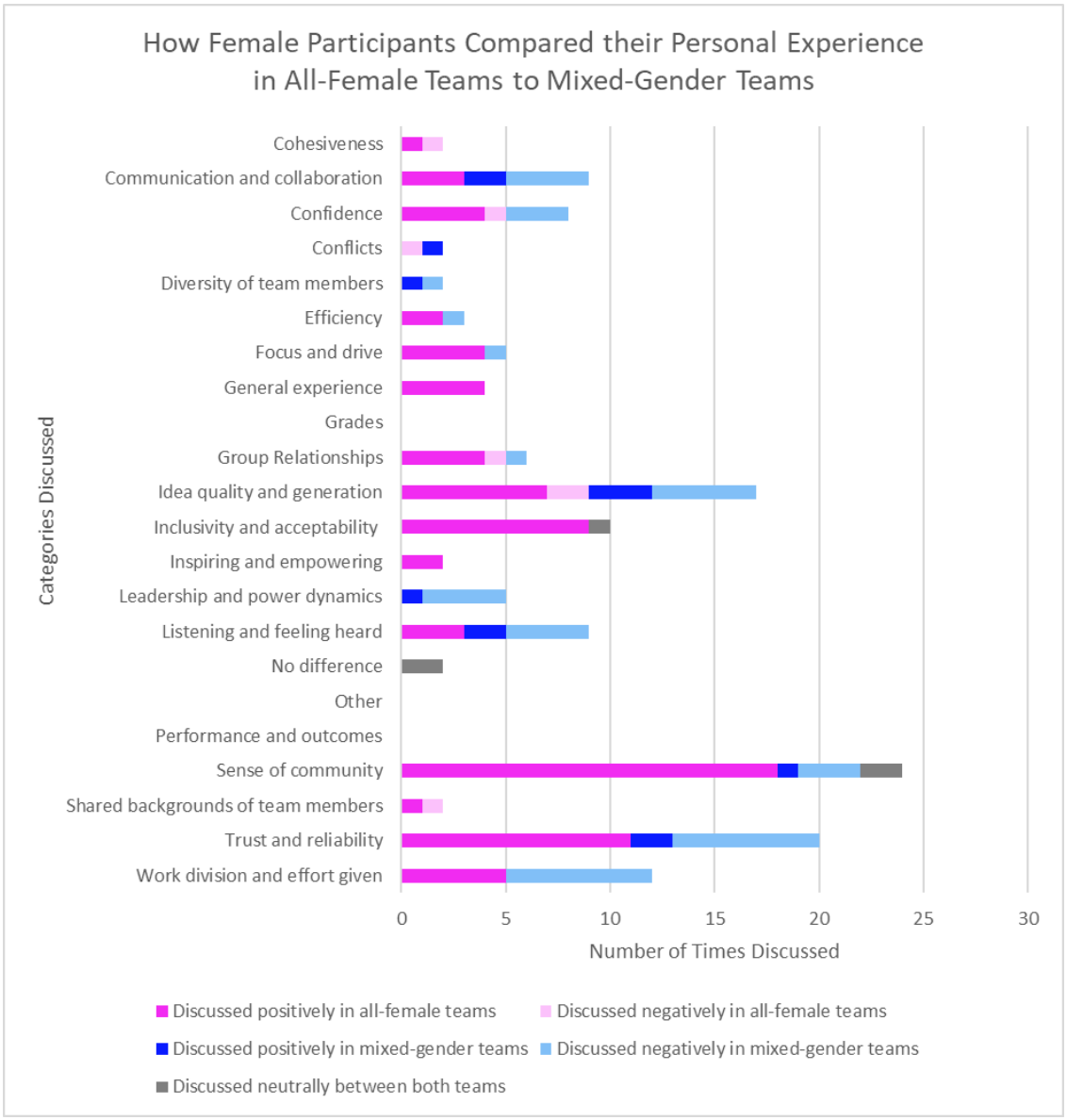
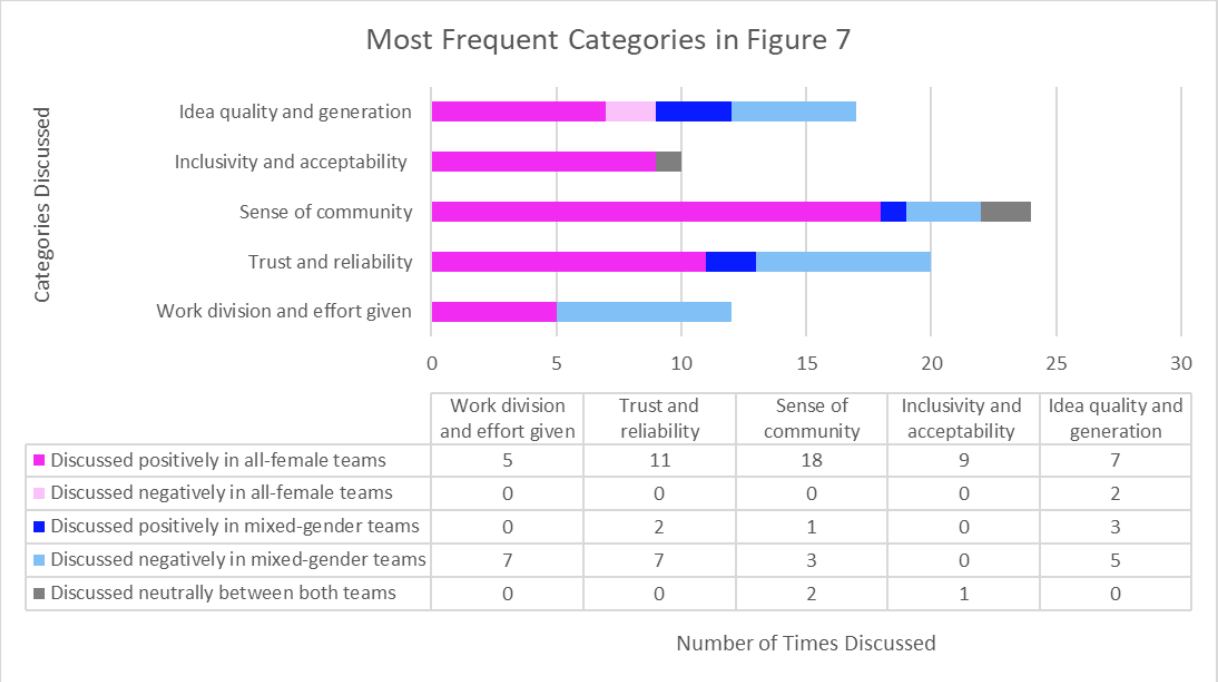


Figure 7 A Comparison of Personal Experiences Between Two Types of Teams

Figure 10 takes a closer look at the most frequent categories discussed. Sense of community was the most discussed category. Eighteen participants discussed the sense of community in all-female teams as being more positive than in mixed-gender teams. Trust and reliability were heavily discussed. The participants mostly felt that the trust and reliability was better within all-female teams and worse in mixed-gender teams. Idea quality and generation was another topic that was heavily discussed. Participants considered this topic in 4 different ways. A

large number of participants spoke about it being more positive in all-female teams. It was rare that participants discussed something as being more negative in an all-female team, but there were 5 participants who said the idea quality and generation process was worse in all-female teams. 7 participants specifically spoke about work division and effort in a negative way in mixed-gender teams, and 5 participants spoke about it being positive in all-female teams. 9 participants felt that all-female teams were more inclusive and accepting when compared to mixed-gender teams. Altogether, the common theme is that these women had more positive things to say about their personal experiences in all-female teams and more negative things to say in mixed-gender teams.



	Work division and effort given	Trust and reliability	Sense of community	Inclusivity and acceptability	Idea quality and generation
Discussed positively in all-female teams	5	11	18	9	7
Discussed negatively in all-female teams	0	0	0	0	2
Discussed positively in mixed-gender teams	0	2	1	0	3
Discussed negatively in mixed-gender teams	7	7	3	0	5
Discussed neutrally between both teams	0	0	2	1	0

Figure 8 The Most Frequent Categories Discussed in Figure 7

Chapter 6.5 Research Question 5 Findings

RQ5: How do women's perceptions of team performance differ when comparing all-female teams to mixed-gender teams?

Question 6 in Survey 2 was a similar open-ended question where this time it asked participants to compare their team performance when working in all-female engineering teams versus in mixed-gender engineering teams. Figure 9 displays how each category was discussed. Throughout the categories discussed, a large portion of participants discussed factors of their team performance to be very positive in all-female engineering teams. 5 participants claimed there was no difference in the team performance when comparing their experience in both all-female and mixed-gender teams.

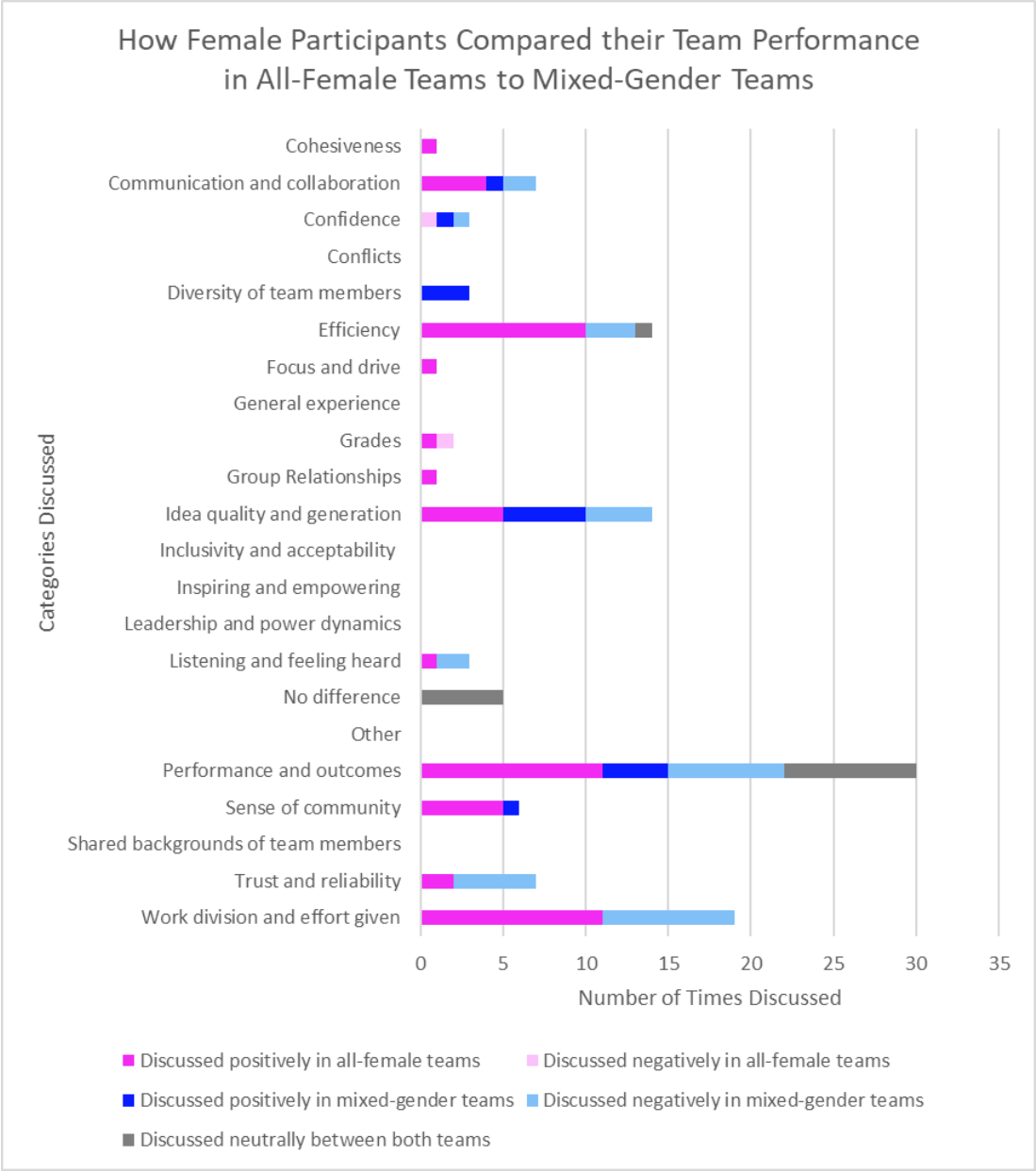
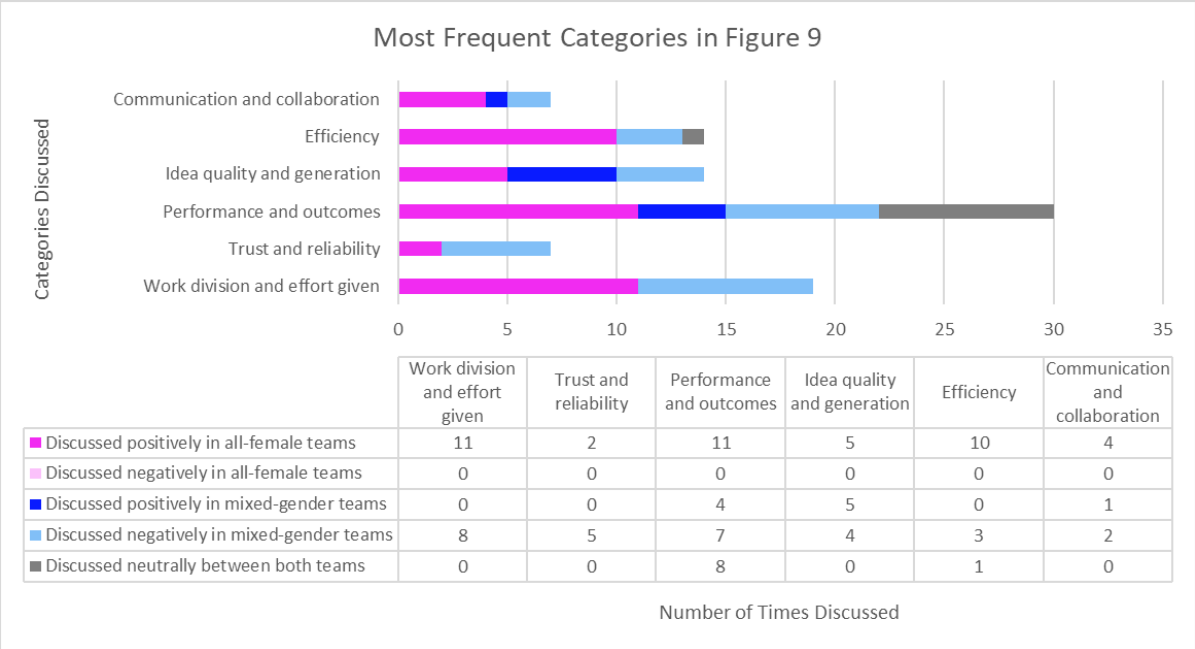


Figure 9 A Comparison of Team Performance Between Two Types of Teams

Figure 10 features the most frequent categories discussed in this question. The mode of this dataset is the performance and outcomes category. Within this category, 11 participants talked about their performance and outcomes in a more positive way on all-female teams, and 7 women spoke about it being more negative in mixed-gender teams. 8 participants said the performance and outcomes did not differ based on the gender composition of the team. Within

the work division and effort given category, 11 participants also spoke about it in a more positive way on an all-female team, while 8 women discussed it negatively on mixed-gender teams. Overall, when participants were asked about their team performance in the two different types of teams, these women still had more positive things to say when in all-female teams and more negative things to say in mixed-gender teams.



	Work division and effort given	Trust and reliability	Performance and outcomes	Idea quality and generation	Efficiency	Communication and collaboration
Discussed positively in all-female teams	11	2	11	5	10	4
Discussed negatively in all-female teams	0	0	0	0	0	0
Discussed positively in mixed-gender teams	0	0	4	5	0	1
Discussed negatively in mixed-gender teams	8	5	7	4	3	2
Discussed neutrally between both teams	0	0	8	0	1	0

Figure 10 The Most Frequent Categories Discussed in Figure 9

Chapter 6.6 Research Question 6 Findings

RQ6: How do women's emotions differ when comparing their experiences in all-female teams to mixed-gender teams?

In Question 2 on Survey 2, participants were asked how often they felt specific emotions on the two different types of teams. They were asked if they felt this emotion more often on an

all-female team, the same in an all-female team or mixed-gender team, or more often on a mixed-gender team. Figure 11 presents all of Survey 2 participants' responses.

It is clear to see that over 60% of participants felt all of the positive emotions more often in all-female teams. The findings show that 86% of participants specifically felt more supported in all-female teams. About one third of the participants felt that they were included, valued, and confident the same amount in both types of teams, whereas only 14% of participants felt supported the same amount in both types of teams. Only 2% of participants felt included and confident more often in mixed-gender teams. Overall, female participants felt an array of strong positive emotions more often in all-female teams.

When asked how often they felt particular negative emotions, participants were about split in half whether they felt overwhelmed, scared, and annoyed more often in mixed-gender teams or the same amount in both types of teams. Slightly more participants felt overwhelmed and scared the same amount in either team, while slightly more participants felt annoyed more often in a mixed-gender team. Only 5% or less of the participants felt these three negative emotions more often in all-female teams. Altogether, the female participants felt divided between having negative emotions more often in mixed-gender teams and having negative emotions the same amount in both types of teams.

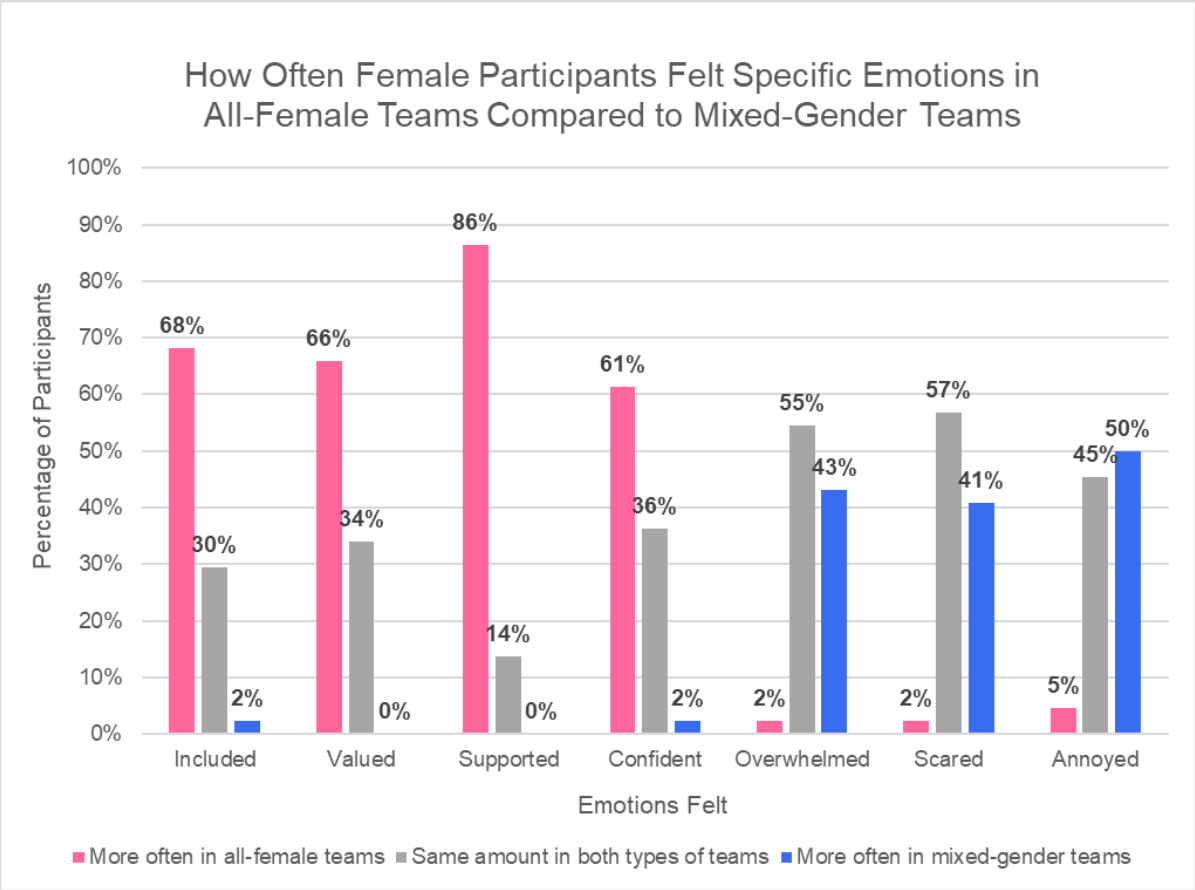


Figure 11 A Comparison of How Often Participants Felt Particular Emotions in Two Types of Teams

In Question 4 on Survey 1, participants were asked to represent which emotions they felt right after the engineering design workshop at WEPO, where they worked in all-female teams. Figure 12 displays all of Survey 1 participants' responses.

When participants reflected on their experience specifically in an all-female team, the vast majority of the participants felt positive emotions. Over 60% of the participants felt accomplished, confident, empowered, happy, included, inspired, proud, supported, and valued. The top three emotions felt on an all-female team were accomplished, supported, and included. The negative emotions felt included annoyed, excluded, overwhelmed, sad, and scared. Only 12% of participants felt overwhelmed in this team and 5% were annoyed. Only 1% of

participants felt excluded, sad, and scared on their team. The reasons that women experienced these emotions are not fully known, but it is clear that these women felt very positive emotions on this team, even with the team operating solely on a virtual platform. It is expected that these highly positive emotions led to the overall positive experiences they have in all-female teams.

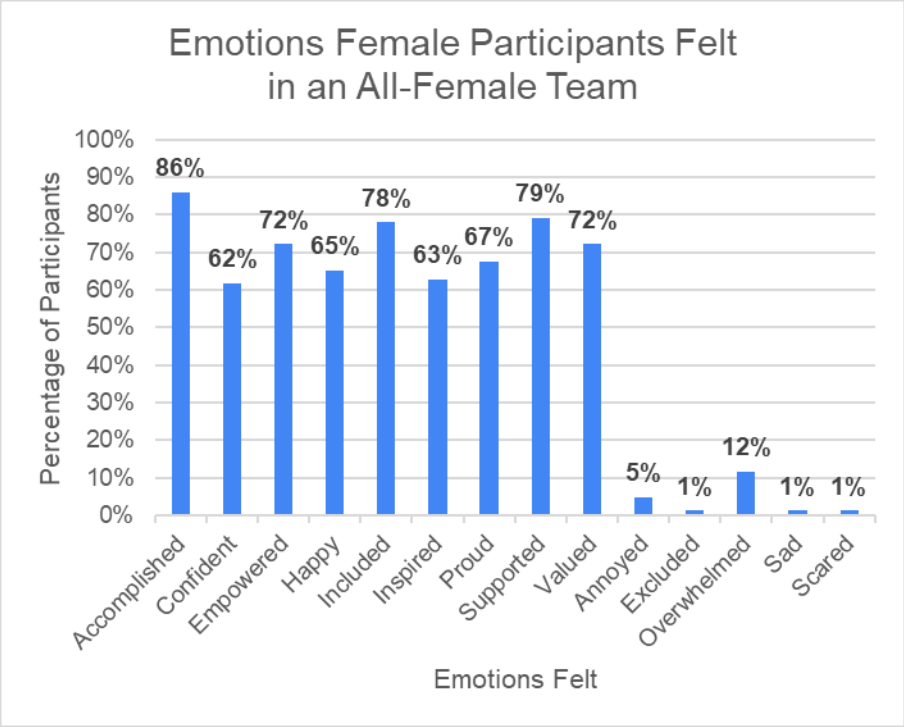


Figure 12 The Emotions Participants Felt in an All-Female Team

Chapter 7

Challenges and Limitations

Planning for this research study began early in 2020. After a few months of planning, a coronavirus pandemic started to put a halt on the world. In March 2020, all in-person collegiate activities and courses were moved to a virtual platform. Originally, the entire design of this study was to be conducted in person, collecting data from an in-person WEPO experience and two engineering classes where students worked in mixed-gender teams. In that case, these two surveys would have shares some of the same questions, which could be compared directly to each other. A significant amount of time and effort was dedicated to the initial study design. When the pandemic began, no one knew how long it would last. There was time lost redesigning this study due to not knowing whether WEPO and the engineering courses would be in-person in August of 2020. After Pennsylvania State University declared they would be operating mostly virtual for the fall 2020 semester, the study had to be completely redesigned.

There continued to be several challenges to overcome and delays that appeared to redesign many aspects of the study. WEPO had to be completely reorganized and coordinated to be conducted on a virtual platform. It took a lot of time for the WEPO leadership team to plan and redesign the workshops, specifically the engineering design workshop. Survey 1 participants would be reflecting on their experiences within this specific workshop, so Survey 1 was redeveloped to capture slightly different data when the workshop was in a new virtual environment.

Before the pandemic, Survey 2 was going to capture a completely different demographic of mixed-gender teams in two engineering courses' students. The survey planned to collect

different information having students compare their past experiences working in teams with different gender compositions. A large portion of time was spent developing the two surveys with all their questions on a virtual platform since they now had to be distributed and completed virtually. Additionally, it took time and additional communication with various people to coordinate a plan on how to distribute the two surveys to their intended audiences.

There were restrictions and limitations that became apparent when collecting both ordinal and nominal data. With these levels of measurements, the types of analysis and statistical tests that could be run were limited. These tests and analysis are said to be not as powerful as those available when using interval or ratio types of data. There was a learning curve in gaining knowledge of the types of analysis that could be performed with the responses to each question asked on the surveys. It took time to learn the assumptions and how to interpret the results of the various types of non-parametric statistical tests. Additionally, time was needed to learn how to input the data, run the statistical tests, and export the results in Minitab.

Chapter 8

Implications and Future Work

After completing this study, it was evident that these findings could be used in many applications both in academia and industry. Those with the knowledge of these findings could apply it in several ways to initiate better performance and experiences in engineering teams. This study only analyzed a specific set of research questions, while collecting a much larger amount of data that could be analyzed at a future time. There are many possibilities of how each dataset collected could be analyzed to draw conclusions of women's perceptions on different types of teams.

Chapter 8.1 Implications

In both academia and industry, engineering continues to slowly diversity in gender but remains heavily male-dominated. This thesis studied important factors that these female engineering students believe have enhanced team performance and their personal experiences when in engineering teams. These findings could possibly be applied to benefit other engineering teams. The findings help form a better understanding of what factors lead to these positive outcomes.

In academia, leaders in engineering colleges across the country are focusing on establishing gender equity within their programs, but there are consistently low retention rates within their female population of engineering students. Many engineering colleges have their students work in teams in a number of engineering courses. While it is intentional to have them practice and acknowledge that engineers often work in teams, it can deter women from continuing to study the major if their experience on the team is negative. If the team performs

poorly and the female student has an overall bad experience, she is likely to be discouraged from continuing on the path of engineering. In this thesis, it was observed that the female participants felt significantly positive performances and great overall experiences in all-female engineering teams. In those teams, women were supported and motivated by their peers to continue down the path of engineering. By understanding the factors that contributed to their successes, educators and students can apply this knowledge to make collegiate mixed-gender teams successful as well.

In industry, it is very important to have well performing teams with happy employees. To a company, higher performance and productivity of teams will directly increase their success and profit. Additionally, when employees have good experiences at work, they are happier and more likely to stay employed with the company, which also results in more company success. Executives, managers, and employees who understand these research findings can help foster favorable team dynamics and supportive environments for women in engineering teams which will result in better team performances and personal experiences.

Chapter 8.2 Future Work

While these two surveys were thoroughly analyzed and all of the research questions were addressed, there is still an abundance of data collected through the survey questions not studied directly in this thesis that could be further examined. The data from this study could be looked at in many other ways to answer additional research questions. Additional effort should be made to further study these factors discussed in engineering teams. This study could also be compared to previous mixed-gender engineering team research to draw more comparisons and conclusions.

The Do iT Lab will retain all of the data collected. This thesis will be distributed and electronically published.

Appendix A

Raw Data Tables

Survey 2 Raw Data Tables of Question 1		
In an all-female team, it was easier for me to completely be myself.		
	Number of Responses	Percentages
Strongly disagree	0	0%
Disagree	1	2%
Somewhat disagree	1	2%
Neither agree or disagree	1	2%
Somewhat agree	13	29%
Agree	15	34%
Strongly Agree	13	29%
In an all-female team, there is more of a feeling of unity and cohesion.		
	Number of Responses	Percentages
Strongly disagree	0	0%
Disagree	0	0%
Somewhat disagree	1	2%
Neither agree or disagree	2	5%
Somewhat agree	11	25%
Agree	17	39%
Strongly Agree	13	30%
In an all-female team, there is a more strong feeling of belongingness among my team members.		
	Number of Responses	Percentages
Strongly disagree	0	0%
Disagree	0	0%
Somewhat disagree	1	2%
Neither agree or disagree	3	7%
Somewhat agree	12	27%
Agree	12	27%
Strongly Agree	16	36%

In an all-female team, members feel closer to each other.		
	Number of Responses	Percentages
Strongly disagree	0	0%
Disagree	0	0%
Somewhat disagree	1	2%
Neither agree or disagree	2	5%
Somewhat agree	12	27%
Agree	18	41%
Strongly Agree	11	25%
In an all-female team, it is more safe to take a risk.		
	Number of Responses	Percentages
Strongly disagree	0	0%
Disagree	1	2%
Somewhat disagree	2	5%
Neither agree or disagree	7	16%
Somewhat agree	8	18%
Agree	15	34%
Strongly Agree	11	25%
In an all-female team, members are more able to bring up problems and tough issues.		
	Number of Responses	Percentages
Strongly disagree	0	0%
Disagree	0	0%
Somewhat disagree	2	5%
Neither agree or disagree	2	5%
Somewhat agree	7	16%
Agree	14	32%
Strongly Agree	19	43%
In an all-female team, it is easier to ask other members for help.		
	Number of Responses	Percentages
Strongly disagree	0	0%
Disagree	1	2%
Somewhat disagree	1	2%
Neither agree or disagree	1	2%
Somewhat agree	8	18%
Agree	12	27%
Strongly Agree	21	48%

Survey 1 Raw Data Tables of Question 1, 2, and 3		
Identify your general ability to "be yourself" in working with this team during the workshop.		
	Number of Responses	Percentages
1 I could not completely be myself	0	0%
2	2	2%
3	17	20%
4	55	64%
5 I could completely be myself	12	14%
If you make a mistake on this team, it is often held against you.		
	Number of Responses	Percentages
Very inaccurate	57	66%
Inaccurate	25	29%
Somewhat inaccurate	3	3%
Neither inaccurate or accurate	0	0%
Somewhat accurate	0	0%
Accurate	1	1%
Very accurate	0	0%
Members of this team are able to bring up problems and tough issues.		
	Number of Responses	Percentages
Very inaccurate	2	2%
Inaccurate	1	1%
Somewhat inaccurate	2	2%
Neither inaccurate or accurate	8	9%
Somewhat accurate	24	28%
Accurate	34	40%
Very accurate	15	17%
People on this team sometimes reject others for being different.		
	Number of Responses	Percentages
Very inaccurate	66	77%
Inaccurate	13	15%
Somewhat inaccurate	5	6%
Neither inaccurate or accurate	0	0%
Somewhat accurate	2	2%
Accurate	0	0%
Very accurate	0	0%

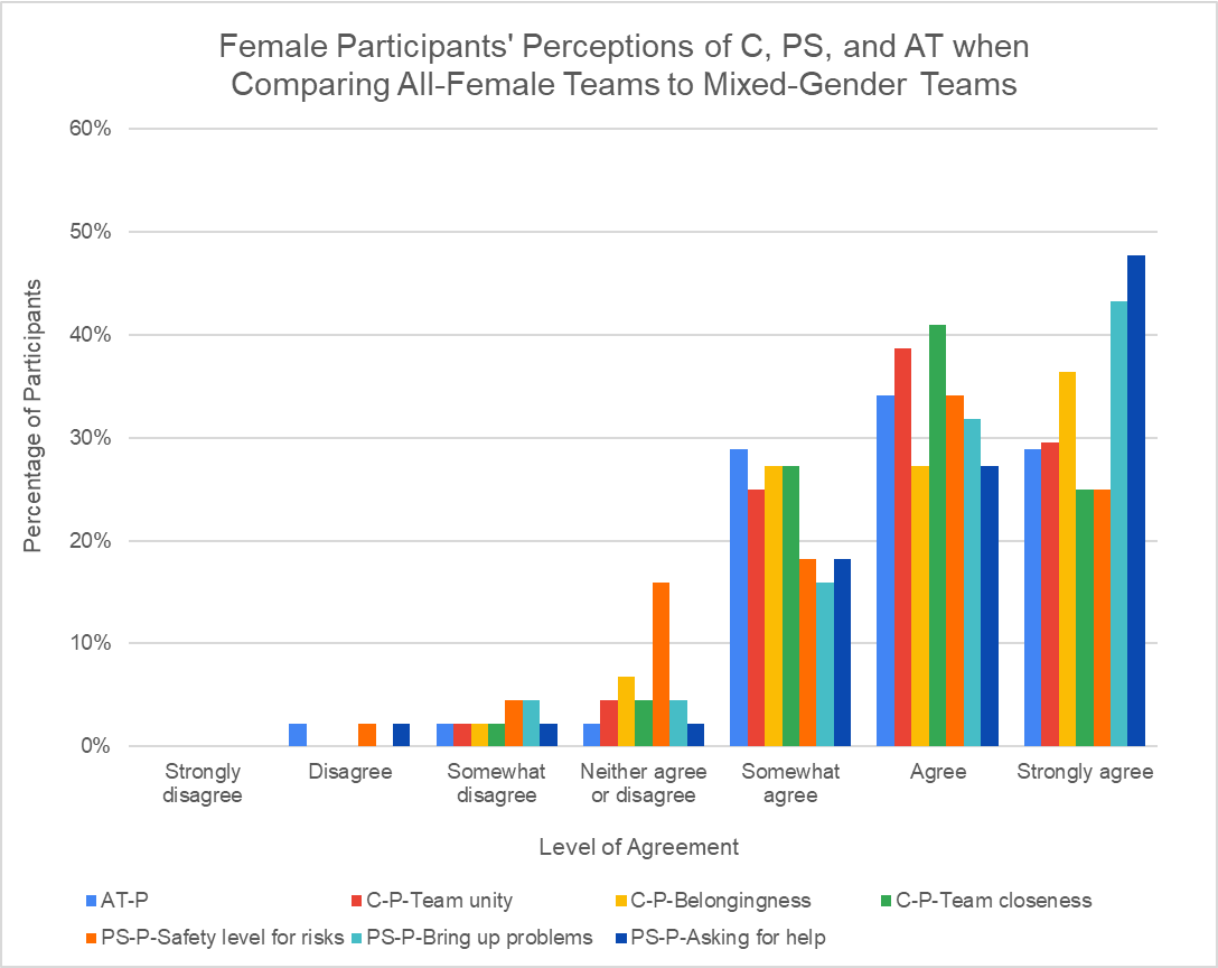
It is safe to take a risk on this team.		
	Number of Responses	Percentages
Very inaccurate	0	0%
Inaccurate	0	0%
Somewhat inaccurate	3	3%
Neither inaccurate or accurate	8	9%
Somewhat accurate	10	12%
Accurate	42	49%
Very accurate	23	27%
It is difficult to ask other members of this team for help.		
	Number of Responses	Percentages
Very inaccurate	38	44%
Inaccurate	33	38%
Somewhat inaccurate	7	8%
Neither inaccurate or accurate	4	5%
Somewhat accurate	4	5%
Accurate	0	0%
Very accurate	0	0%
No one on this team would deliberately act in a way that undermines my efforts.		
	Number of Responses	Percentages
Very inaccurate	1	1%
Inaccurate	2	2%
Somewhat inaccurate	4	5%
Neither inaccurate or accurate	3	3%
Somewhat accurate	4	5%
Accurate	30	35%
Very accurate	42	49%
Working with members of this team, my unique skills and talents are valued and utilized.		
	Number of Responses	Percentages
Very inaccurate	1	1%
Inaccurate	1	1%
Somewhat inaccurate	2	2%
Neither inaccurate or accurate	3	3%
Somewhat accurate	14	16%
Accurate	37	43%
Very accurate	28	33%

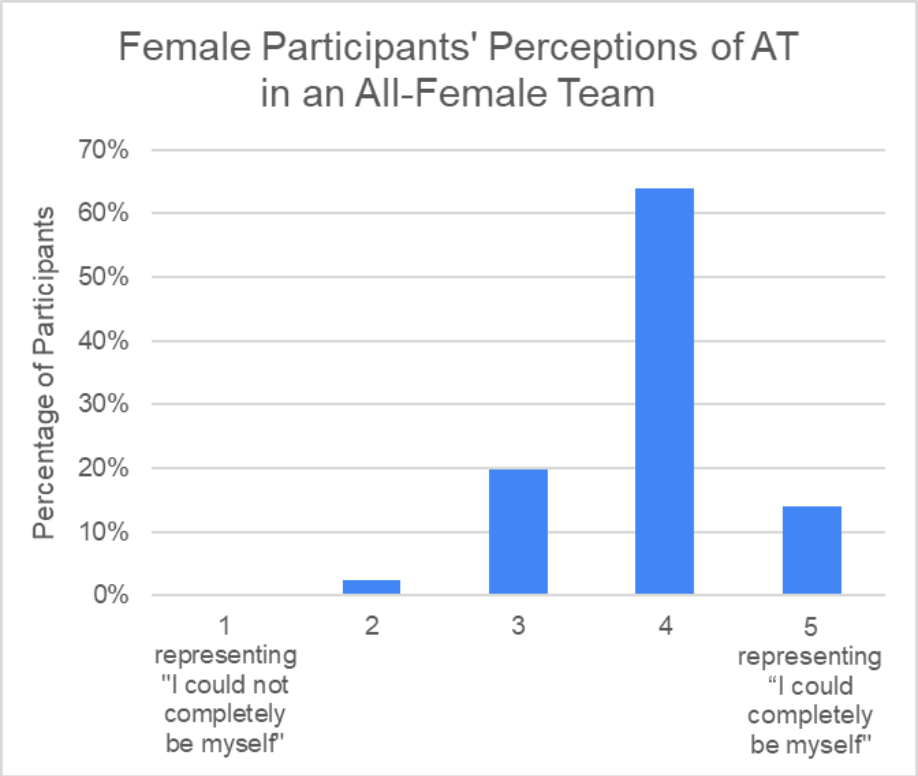
There is a feeling of unity and cohesion in my team.		
	Number of Responses	Percentages
Strongly disagree	0	0%
Disagree	0	0%
Somewhat disagree	1	1%
Neither agree or disagree	2	2%
Somewhat agree	19	22%
Agree	39	45%
Strongly agree	25	29%
There is a strong feeling of belongingness among my team members.		
	Number of Responses	Percentages
Strongly disagree	0	0%
Disagree	1	1%
Somewhat disagree	0	0%
Neither agree or disagree	9	10%
Somewhat agree	26	30%
Agree	29	34%
Strongly agree	21	24%
Members of my team feel close to each other.		
	Number of Responses	Percentages
Strongly disagree	1	1%
Disagree	0	0%
Somewhat disagree	10	12%
Neither agree or disagree	13	15%
Somewhat agree	34	40%
Agree	16	19%
Strongly agree	12	14%
Members of my team share a focus on our work.		
	Number of Responses	Percentages
Strongly disagree	0	0%
Disagree	0	0%
Somewhat disagree	1	1%
Neither agree or disagree	1	1%
Somewhat agree	13	15%
Agree	50	58%
Strongly agree	21	24%

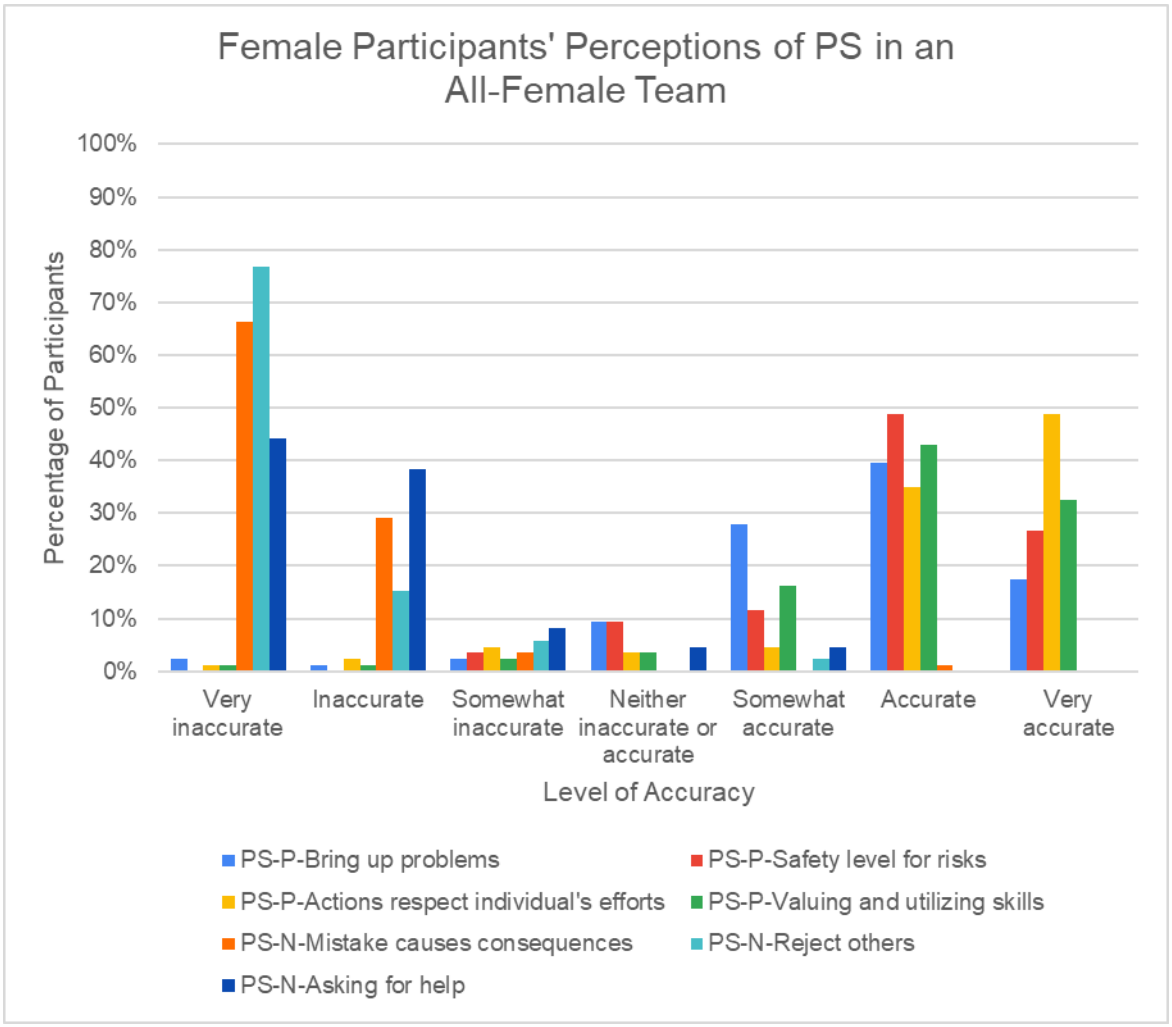
My team concentrates on getting things done.		
	Number of Responses	Percentages
Strongly disagree	0	0%
Disagree	0	0%
Somewhat disagree	0	0%
Neither agree or disagree	2	2%
Somewhat agree	10	12%
Agree	49	57%
Strongly agree	25	29%
My team members pull together to accomplish work.		
	Number of Responses	Percentages
Strongly disagree	0	0%
Disagree	0	0%
Somewhat disagree	1	1%
Neither agree or disagree	0	0%
Somewhat agree	7	8%
Agree	39	45%
Strongly agree	39	45%

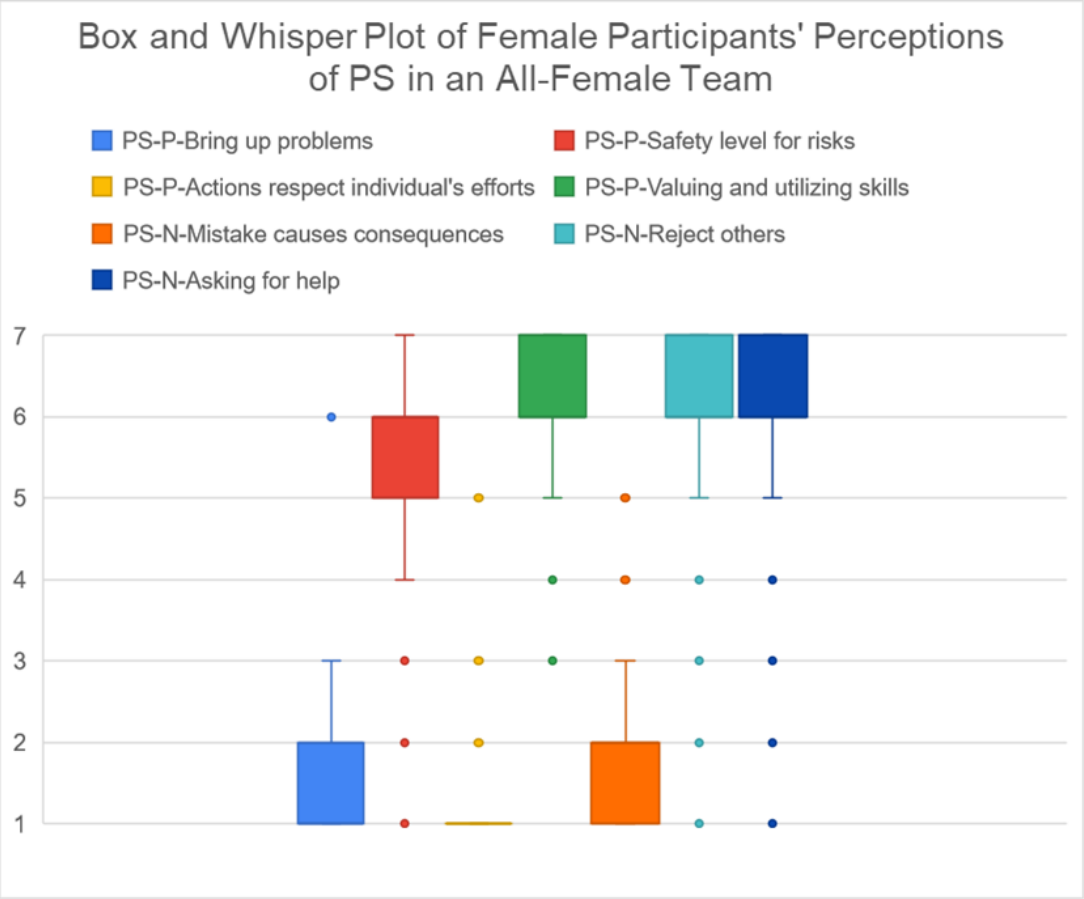
Appendix B

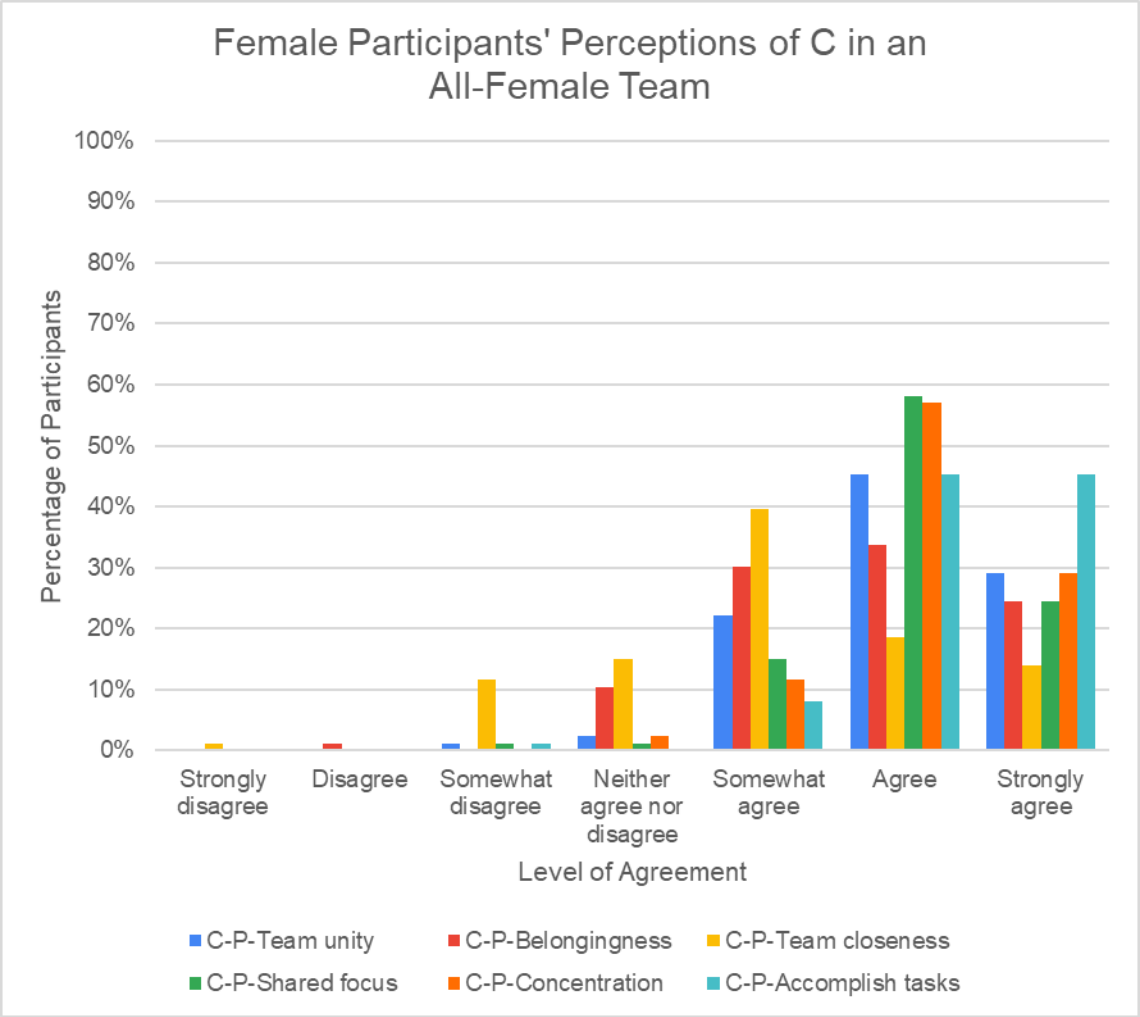
Additional Figures

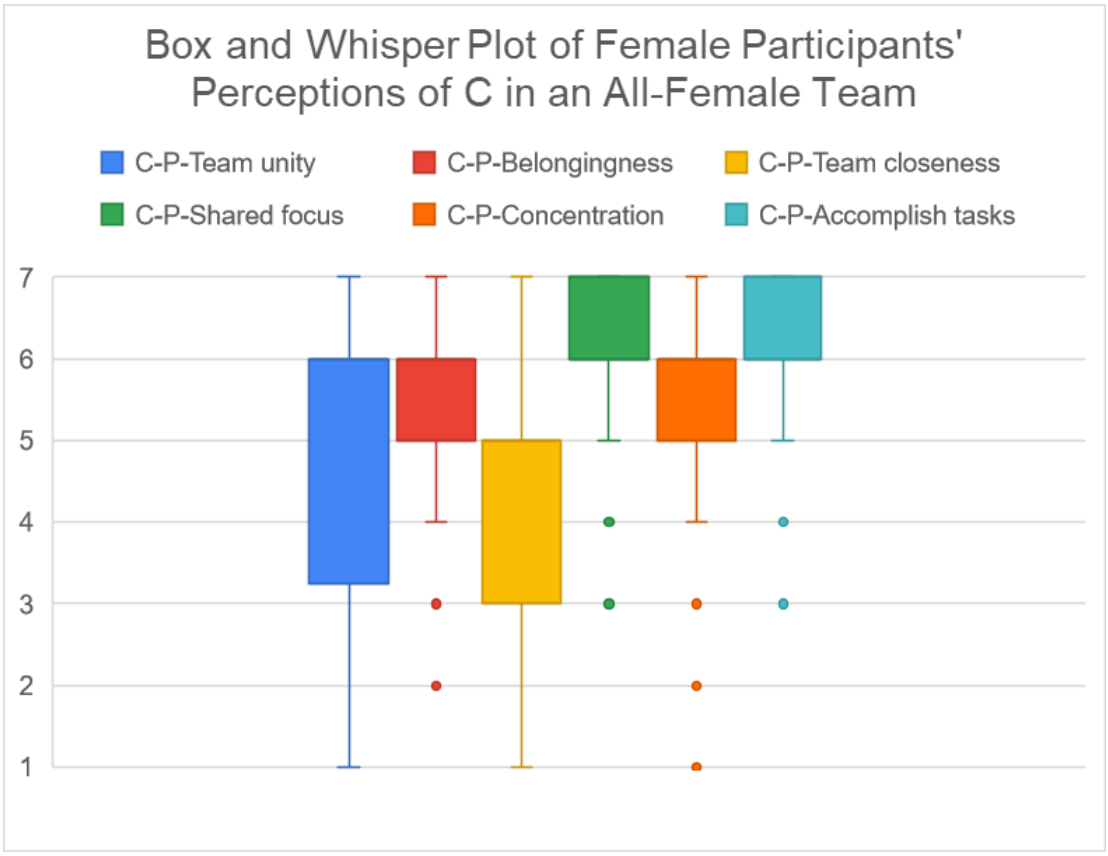


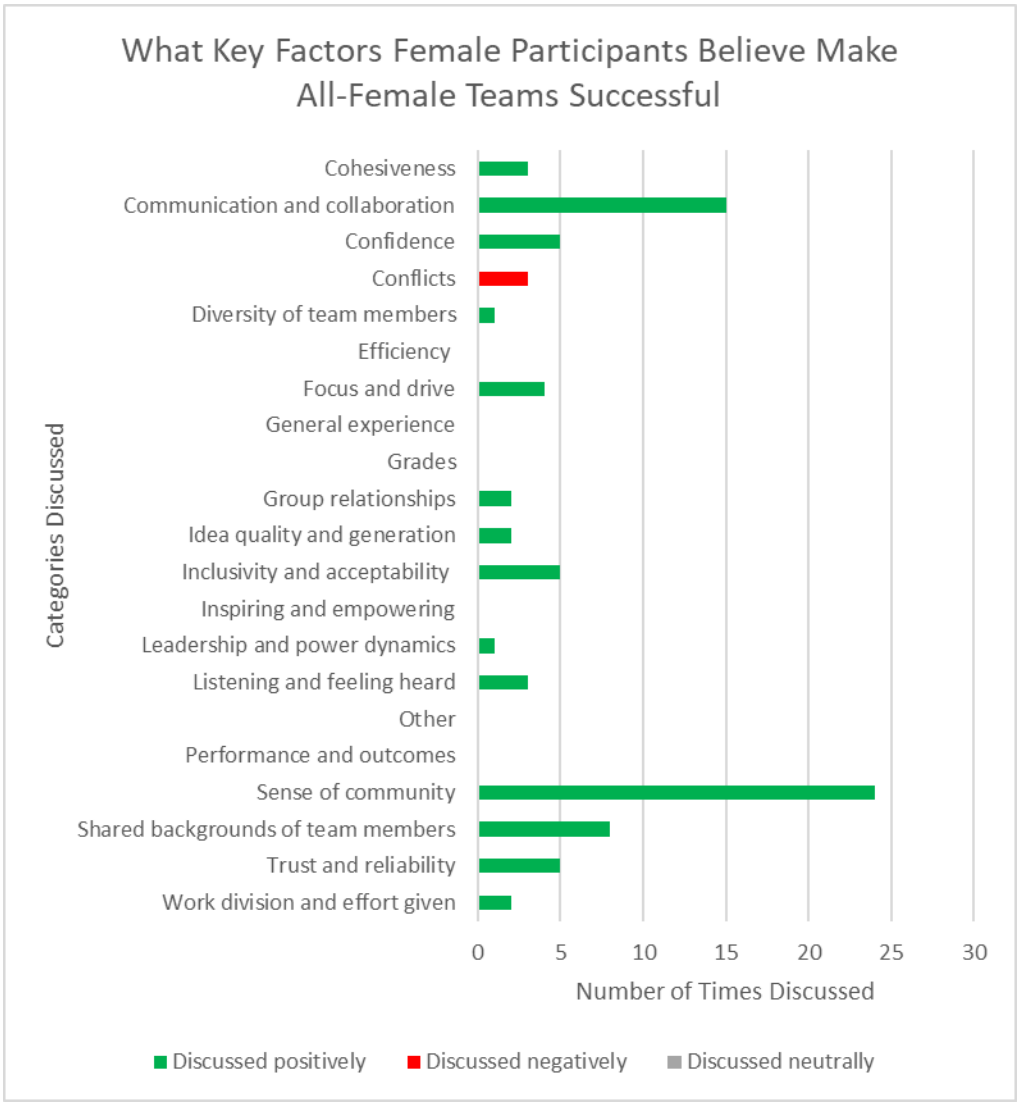

Female Participants' Perceptions of AT in an All-Female Team
Percentage of Participants
70%
60%
50%
40%
30%
20%
10%
0%
1 representing "I could not completely be myself"
2
3
4
5 representing "I could completely be myself"

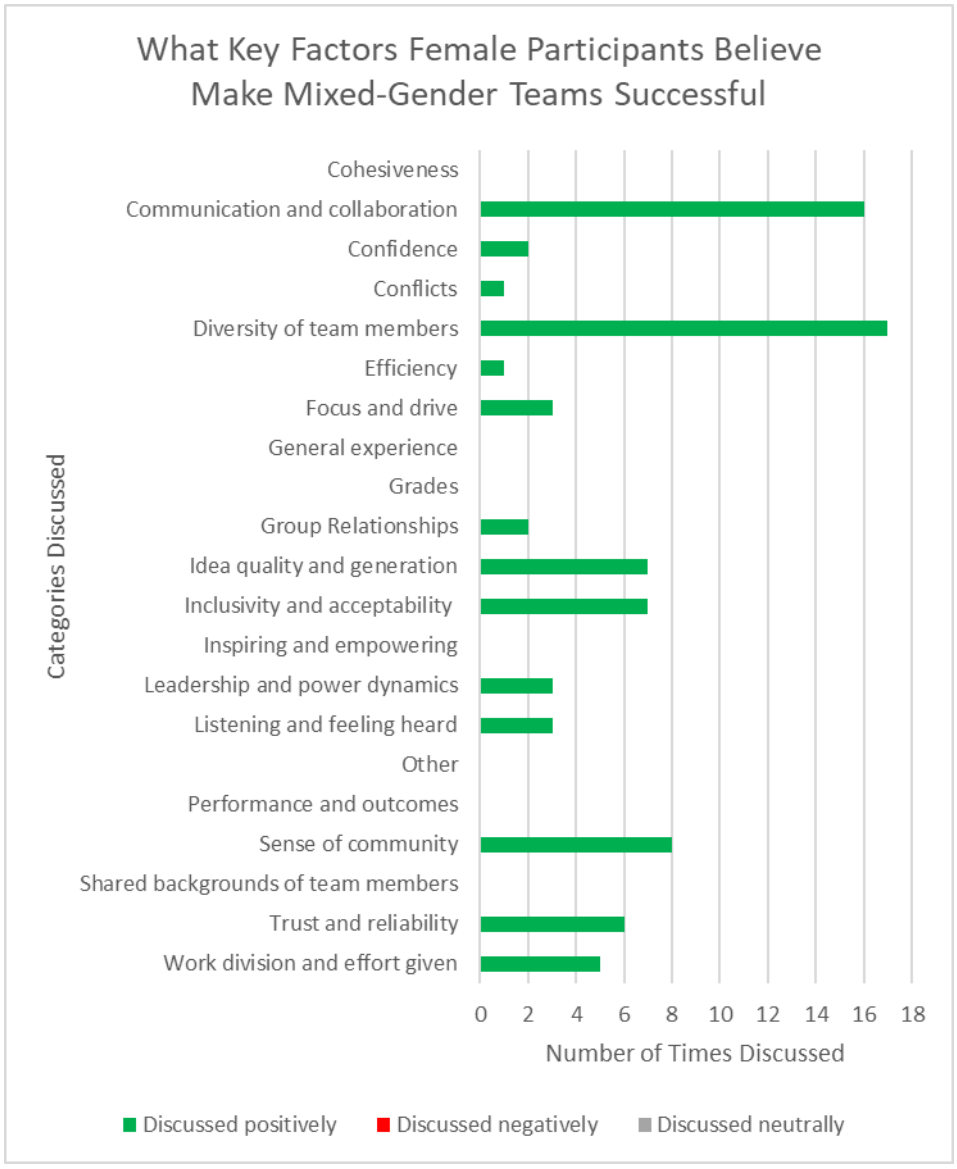

Female Participants' Perceptions of PS in an All-Female Team
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage of Participants
Very inaccurate
Inaccurate
Somewhat inaccurate
Neither inaccurate or accurate
Somewhat accurate
Accurate
Very accurate
Level of Accuracy
PS-P-Bring up problems
PS-P-Safety level for risks
PS-P-Actions respect individual's efforts
PS-P-Valuing and utilizing skills
PS-N-Mistake causes consequences
PS-N-Reject others
PS-N-Asking for help


Box and Whisper Plot of Female Participants' Perceptions of PS in an All-Female Team
PS-P-Bring up problems
PS-P-Safety level for risks
PS-P-Actions respect individual's efforts
PS-P-Valuing and utilizing skills
PS-N-Mistake causes consequences
PS-N-Reject others
PS-N-Asking for help
7
6
5
4
3
2
1


Female Participants' Perceptions of C in an All-Female Team
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage of Participants
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree
Level of Agreement
C-P-Team unity
C-P-Belongingness
C-P-Team closeness
C-P-Shared focus
C-P-Concentration
C-P-Accomplish tasks


Box and Whisper Plot of Female Participants' Perceptions of C in an All-Female Team
C-P-Team unity
C-P-Belongingness
C-P-Team closeness
C-P-Shared focus
C-P-Concentration
C-P-Accomplish tasks
7
6
5
4
3
2
1


What Key Factors Female Participants Believe Make All-Female Teams Successful
Cohesiveness
Communication and collaboration
Confidence
Conflicts
Diversity of team members
Efficiency
Focus and drive
General experience
Grades
Group relationships
Idea quality and generation
Inclusivity and acceptability
Inspiring and empowering
Leadership and power dynamics
Listening and feeling heard
Other
Performance and outcomes
Sense of community
Shared backgrounds of team members
Trust and reliability
Work division and effort given
Categories Discussed
0
5
10
15
20
25
30
Number of Times Discussed
Discussed positively
Discussed negatively
Discussed neutrally


What Key Factors Female Participants Believe Make Mixed-Gender Teams Successful
Categories Discussed
Cohesiveness
Communication and collaboration
Confidence
Conflicts
Diversity of team members
Efficiency
Focus and drive
General experience
Grades
Group Relationships
Idea quality and generation
Inclusivity and acceptability
Inspiring and empowering
Leadership and power dynamics
Listening and feeling heard
Other
Performance and outcomes
Sense of community
Shared backgrounds of team members
Trust and reliability
Work division and effort given
0 2 4 6 8 10 12 14 16 18
Number of Times Discussed
Discussed positively
Discussed negatively
Discussed neutrally

Appendix C

Survey 1 Structure

Reflection Survey on WEPO Engineering Design Workshop

Thank you for your interest in participating in this research study! You must be 18 years old or older to participate. This research is conducted by Devyn Kirban and will be used for her senior thesis, which will study key factors that make engineering teams successful.

All you have to do is submit this survey. All questions are specific to the team you worked in during the WEPO Engineering Design Workshop.

Please email any questions or concerns to Devyn Kirban at dbk5264@psu.edu

* Required

Are you 18 years old or older? (You must be at least 18 to participate) *

◯ Yes

Please review the consent form:
https://docs.google.com/document/d/1PpSQObWmledop-Gs0U1MzuJp1nFcy0U8wpVftzOyNwk/edit?usp=sharing

To sign the consent form, type your full legal name. *

Your answer

Provide the date of your signature. *

Date

mm/dd/yyyy

1. What is your PSU email? *

Your answer

2. What WEPO team were you in? *

Choose

3. What is your gender? *

- ○ Female
- ○ Male
- ○ Non-binary
- ○ Prefer not to disclose

4. Which actions did you notice yourself doing during the workshop? (Check all that apply) *

- ☐ Offering new ideas
- ☐ Asking clarifying questions
- ☐ Letting everyone speak
- ☐ Adding comic relief
- ☐ Persistent about your ideas when challenged
- ☐ Physically/virtually sketching or building the model
- ☐ Verbally disagreeing with others
- ☐ Verbally supporting others
- ☐ Cutting others off
- ☐ Embracing extended pauses
- ☐ Acknowledging concerns and suggesting alternatives
- ☐ Nodding your head up and down
- ☐ Building on others' ideas
- ☐ Perceiving members' input but choosing not to respond
- ☐ Keeping the team on track
- ☐ Agreeing with others' ideas
- ☐ Adding depth to others' suggested ideas
- ☐ Asking rhetorical questions

5. Using the scale, identify your general ability to "be yourself" in working with this team during the workshop. *

	1	2	3	4	5	
I could not completely be myself	○	○	○	○	○	I could completely be myself

6. Please choose what best represents the accuracy of each of the following statements. *

	Very inaccurate	Inaccurate	Somewhat inaccurate	Neither inaccurate or accurate	Somewhat accurate	Accurate	Very accura
1. If you make a mistake on this team, it is often held against you.	○	○	○	○	○	○	○
2. Members of this team are able to bring up problems and tough issues.	○	○	○	○	○	○	○
3. People on this team sometimes reject others for being different.	○	○	○	○	○	○	○
4. It is safe to take a risk on this team.	○	○	○	○	○	○	○

5. It is difficult to ask other members of this team for help.	○	○	○	○	○	○	○
6. No one on this team would deliberately act in a way that undermines my efforts.	○	○	○	○	○	○	○
7. Working with members of this team, my unique skills and talents are valued and utilized.	○	○	○	○	○	○	○

7. Please choose what best represents your agreement to each of the following statements. *

	Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
1. There is a feeling of unity and cohesion in my team.	○	○	○	○	○	○	○
2. There is a strong feeling of belongingness among my team members.	○	○	○	○	○	○	○
3. Members of my team feel close to each other.	○	○	○	○	○	○	○

4. Members of my team share a focus on our work.	○	○	○	○	○	○	○
5. My team concentrates on getting things done.	○	○	○	○	○	○	○
6. My team members pull together to accomplish work.	○	○	○	○	○	○	○

8. Check all the boxes that represent how you felt right after the workshop. *

- [ ] Included
- [ ] Valued
- [ ] Happy
- [ ] Empowered
- [ ] Supported
- [ ] Proud
- [ ] Accomplished
- [ ] Inspired
- [ ] Confident
- [ ] Annoyed
- [ ] Sad
- [ ] Excluded
- [ ] Scared
- [ ] Overwhelmed
- [ ] Other:

9. Please write at least 2 sentences explaining your general positive or negative feelings/impressions of your experience working in this team. *

Your answer

10. Please write at least 1 sentence on how working virtually affected your overall experience. *

Your answer

11. Please write at least 2 sentences on how the experience working in this team compared to previous experiences in MIXED gender teams. If you do not have previous experience, please write N/A. *

Your answer

Appendix D

Survey 2 Structure

Reflection Survey on Engineering Team Experiences

Thank you for your interest in participating in this research study! You must be 18 years old or older to participate. This research is conducted by Devyn Kirban and will be used for her senior thesis, which will study key factors that make engineering teams successful.

All you have to do is submit this survey. To answer these questions, please reflect on any previous experience you have working in all female engineering teams and mixed gender engineering teams.

Please email any questions or concerns to Devyn Kirban at dbk5264@psu.edu

* Required

Are you 18 years old or older? (You must be at least 18 to participate) *

◯ Yes

Please review the consent form:
https://docs.google.com/document/d/1PpSQObWmledop-Gs0U1MzuJp1nFcy0U8wpVftzOyNwk/edit?usp=sharing

To sign the consent form, type your full legal name. *

Your answer

Provide the date of your signature. *

Date

mm/dd/yyyy

1. What is your email? *

Your answer

2. What WEPO Leadership Team(s) were you on? *

- [ ] 2018 WEPO Leadership Team
- [ ] 2019 WEPO Leadership Team
- [ ] 2020 WEPO Leadership Team

3. What is your expected or actual (if graduated) graduation year? *

Your answer

4. What is your gender? *

- ◯ Female
- ◯ Male
- ◯ Non-binary
- ◯ Prefer not to disclose

5. Please choose what best represents your agreement to each of the following statements comparing your experience in all female teams versus mixed gender teams. *

	Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
1. In an all female team, it was easier for me to completely be myself.	◯	◯	◯	◯	◯	◯	◯
2. In an all female team, there is more of a feeling of unity and cohesion.	◯	◯	◯	◯	◯	◯	◯

3. In an all female team, there is a more strong feeling of belongingness among my team members.	○	○	○	○	○	○	○
4. In an all female team, members feel closer to each other.	○	○	○	○	○	○	○
5. In an all female team, it is more safe to take a risk.	○	○	○	○	○	○	○
6. In an all female team, members are more able to bring up problems and tough issues.	○	○	○	○	○	○	○
7. In an all female team, it is easier to ask other members for help.	○	○	○	○	○	○	○

6. Please represent how often you felt the following emotions in certain teams. *

	More often on an all female team	Same in an all female team or mixed gender team	More often on an a mixed gender team
Included	○	○	○
Valued	○	○	○
Supported	○	○	○
Confident	○	○	○
Overwhelmed	○	○	○
Scared	○	○	○
Annoyed	○	○	○

7. Please represent how often you felt yourself doing the following actions in certain teams. *

	More often on an all female team	Same in an all female team or mixed gender team	More often on an a mixed gender team
Offering new ideas	○	○	○
Persistent about your ideas when challenged	○	○	○
Verbally supporting others	○	○	○
Acknowledging concerns and suggesting alternatives	○	○	○

8. What are 2 key factors that make an all female team successful? *

Your answer

9. What are 2 key factors that make a mixed gender team successful? *

Your answer

10. Please write at least 2 sentences comparing your PERSONAL EXPERIENCE when working in all female engineering teams versus in mixed gender engineering teams. *

Your answer

11. Please write at least 2 sentences comparing TEAM PERFORMANCE when working in all female engineering teams versus in mixed gender engineering teams. *

Your answer

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ACADEMIC VITA

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EDUCATION

Bachelor of Science in Engineering Science *with Honors*
Schreyer Honors College
The Pennsylvania State University, *University Park, PA*
Anticipated Graduation: May 2021

GLOBAL EXPERIENCE

Introduction to Design Engineering May 2018
École Centrale de Nantes, *Nantes, France*

TECHNICAL EXPERIENCE

Interior Architecture Engineering Intern June – Aug 2020
Ford Motor Company, *Dearborn, MI - Remotely*

- Examined over 70 vehicles 2nd and 3rd row seat structure weights, comfort ratings, and loadfloor angles to form conclusions on how competitors prioritize comfort versus utility
- Analyzed 2 passenger 2nd row offerings to determine the allocation of width split between seating surfaces, arm rests, and gaps

Product Engineering Intern Nov 2019 – Jan 2020
Kirban Performance Products, *Kintnersville, PA*

- Engineered the Kirban Auto Easel, an invention of a hood latch car show display stand
- Collaborated with several companies to assemble prototypes and manufacture

Project Quality Engineering Intern May - Aug 2019
Mack Trucks, *Macungie, PA*

- Investigated current production concerns to avoid installation issues in design phase of future projects
- Performed vehicle analysis on over 150 campaign trucks to ensure proper clearances and mechanical performance
- Developed training documents on quality tools: Part Handling Review, Critical and Significant Characteristics Management, and Process Failure Mode Effects Analysis

Systems Engineering Intern May - Aug 2018
Lockheed Martin, *Moorestown, NJ*

- Performed statistical comparisons on simulations of the Aegis combat missile system
- Operated hardware to replicate environmental factors and radar systems
- Designed, simulated, and built a model rocket that intercepted an airborne target launched by a vehicle within an Agile team

RESEARCH EXPERIENCE

Engineering Teams Research Lead Nov 2019 – April 2021
Penn State Do iT Lab, *Malvern, PA - Remotely*

- Led a project studying gender, cohesion, psychological safety, and other key factors in engineering teams
- Designed and distributed two research surveys evaluating what optimizes team performance and personal experience
- Analyzed and drew conclusions from data collected from 130 participants

LEADERSHIP & INVOLVEMENT

President, Penn State Society of Engineering Science 2017-20
Mentor, Penn State Women in Engineering Program Orientation (WEPO) 2017-20
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