

FEMALE FACTOR AND TEAM PROJECTS: A SOCIAL SENSITIVITY
PERSPECTIVE

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Female Factor and Team Projects: A Social Sensitivity Perspective

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ABSTRACT

Software Development is a complex, time-consuming task wherein a team must collaborate effectively over a long period of time. Achieving maximum productivity and quality requires commitment. A recent MIT study concluded that teams with greater Social Sensitivity perform better on collaborative tasks, with Social Sensitivity defined as a measurable empathic ability to grasp others' feelings and perspectives. However, this study was based on generic tasks (solving visual puzzles, agreeing on moral judgments, and negotiating over limited resources) that were completed in a matter of hours. In contrast, software development projects require teams to work on more complex tasks of longer duration. Our goal is to determine whether previous research, not focused on students or professionals in scientific or technical fields, is relevant for computing disciplines. This paper reports results from empirical studies investigating the impact of females on team Social Sensitivity, performance and satisfaction.

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ਲਖ ਖੁਸ਼ੀਆ ਪਾਤਿਸਾਹੀਆ ਜੇ ਸਤਿਗੁਰੁ ਨਦਰਿ ਕਰੇਇ ॥

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O my mind, place your faith in the Lord.

Wherever I go, my Lord and Master is there with me.

The Lord saves the honor of His humble servants and slaves.

-Sri Guru Granth Sahib Ji

DEDICATION

This thesis is dedicated to my parents.
For their endless love, support and encouragement.

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1. INTRODUCTION

Software development is a complex activity that requires a group of individuals to work effectively as a team [1]. Since the success rate of software development projects is low, with just 32% of all projects succeeding, it is important to understand the team factors that can significantly influence performance [29]. In the domain of Software Development, projects are complex and teamwork is a central factor, as these projects cannot be completed by an individual. Software development projects are difficult not only because of the complex technologies involved, but the complexity of the social interactions that take place between project team members.

Team projects are central to the education of engineers. The objective of any good curriculum is to prepare the graduates for their professional careers by providing them with relevant information and experiences [27]. In software engineering, software developers develop and maintain software of such complexity that the tasks cannot be handled at the individual level [27]. Since the tasks are so great, it becomes crucial to work as a team or group; moreover, the tasks require experts from several fields need to join together in order to understand and analyze the problem domain and design a system solution [27]. Various researchers assert that the mastery of the soft skills needed to navigate interpersonal relationships and to negotiate social interaction is crucial to team success [30, 31]. With the typical current academic syllabus and course of study, many students graduate with the necessary hard technical skills (i.e., the ability to perform a specific task or activity) but lack essential soft skills (e.g., interpersonal abilities for effective interaction with team members and customers). An employer survey conducted by the staffing company Adecco found similar results. The company stated that "...44% of respondents cited soft skills, such as communication, critical thinking, creativity and collaboration, as the area with the biggest gap" [3].

A recent survey conducted by the Workforce Solutions Group at St. Louis Community College found that more than 60 percent of employers found applicants lacking in “communication and interpersonal skills” [28]. Recent studies indicate that employers consistently rate these skills as deficient in incoming hires, namely skills like communication, teamwork, leadership and adaptability. The National Association of Colleges and Employers surveyed more than 200 employers about their top 10 priorities for new hires. Overwhelmingly, they wanted candidates who are team players, problem solvers and who can plan, organize and prioritize their work. Technical and computer-related knowledge placed much further down the list [28]. Research conducted by Begel et al. found that recently hired software developers often struggle to adequately communicate when they needed assistance or were struggling with a problem [15]. Scott et al. concluded that the ability to work as part of a cross-disciplinary team was necessary in industry [16].

A recent systematic literature review by Radermacher et al. identified several areas in which graduate students were found to fall short of employers’ expectations, including personal skills and professional ethics, such as communication, teamwork, ethics, and more [17]. Begel also presented results emphasizing the importance of communication and collaboration techniques that were lacking in recent graduates [18]. The study presented five areas that recent graduates find particularly difficult: communication, collaboration, technical, cognition, and orientation.

Clearly, there is a need for the measurement and evaluation of the impact of soft skills in order to ensure that teams are performing optimally. Researchers like Anita Williams Woolley of Carnegie Mellon and Thomas Malone of MIT have been successful thus far in specifying the three main factors that most strongly impact team collaboration and collective intelligence [5].

The study measured Social Sensitivity factor using the “Reading the Mind in the Eyes” test, created and validated by Baron-Cohen et al. [11]. This test gauges the

individuals' accuracy in judging someone's emotional state by looking at their eyes. Figure 1, below, shows a sample of how the test is conducted.

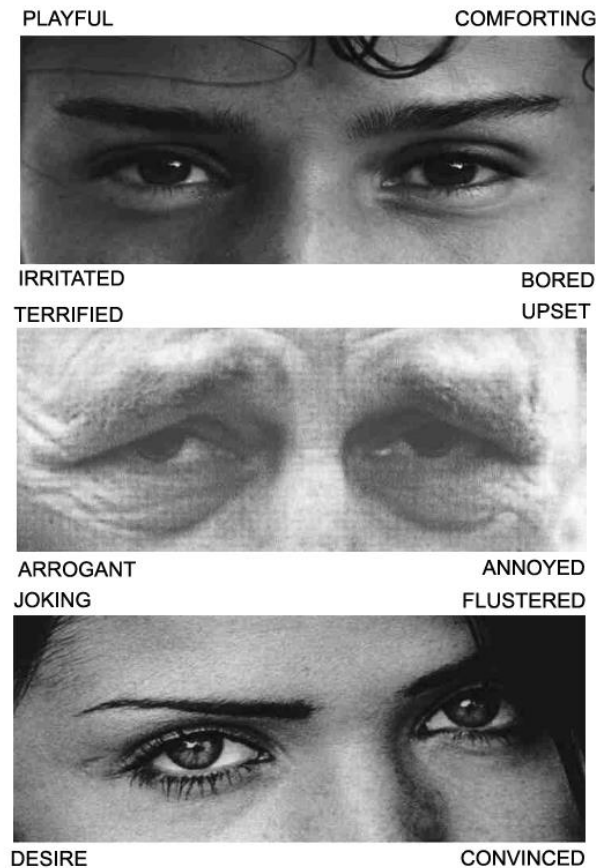


Figure 1. Reading the mind in the eyes test

A subject is presented with a series of 36 photographs of the eye areas of actors. For each photograph, the subjects are asked to choose which of four adjectives best describes how the person in the photograph feels.

The study established three factors that have the greatest effect on team performance and collective intelligence, viz. 1) *Social Sensitivity*, the ability to correctly understand feelings, 2) *turn-taking behavior*, or giving everyone the chance to speak during a conversation, and 3) *proportion of females* in the group, which is simply the number of females in a given group [5]. The results show that the teams whose members had higher

levels of Social Sensitivity score were more collectively intelligent. The study also found that groups with a higher proportion of females tended to perform better than groups of men.

The above study was conducted using generic tasks, such as solving visual puzzles, brainstorming, making collective moral judgments, and negotiating over limited resources. Our study is aimed at finding how group behavior and team performance are affected by Social Sensitivity, and particularly, the presence of female team members. Bender et al. previously evaluated the impact of Social Sensitivity (SS) in the context of student teams enrolled at North Dakota State University (NDSU) who worked on a semester-long technical project [9]. Their results showed a positive and significant correlation between average SS and team performance. That is, the higher the average SS of team (calculated by averaging the individual SS scores of team members), the better the team performed. Additionally,, individual SS scores were correlated with the individual performance of the subjects. Thus, there is compelling and strong evidence that the SS of individuals and team members impacts team performance.

Our research also draws on the original study findings by Woolley et al., which showed that "*proportion of females*" can have a significant impact on the team performance [5]. In addition, a study by Snodgrass [4] showed that females are known to be more socially sensitive than males. However, neither of these studies were conducted with software professionals or in the context of software engineering. Therefore, the current study attempts to determine whether including more females in a group would significantly impact the performance of software engineering teams comprised of students enrolled in computer science classes at NDSU.

Similar to the research aim of validating SS findings in the context of software engineering team projects [9], this research investigates the hypothesized impact of the proportion of females on a team on the team's performance, in the context of SS studies at NDSU. To perform this analysis, this research utilizes SS data from a substantial sample of Computer Science (CS), Software Engineering (SE), and Management of Information

Science (MIS) students enrolled in the computer science department at NDSU. The student teams worked on semester-long projects and their respective performance was recorded. This paper evaluates the impact of the proportion of females on a team on the team's average SS values and the team's performance by varying the number of females from 0 to 4 (i.e., no female to all females within a team of 4 individuals). For all team sizes (with 0 to 4 females), virtual teams were formed and SS values and team performance were compared. A qualitative evaluation based on peer reviews was also performed to help the researchers better understand the results.

The remainder of the paper is structured as follows: Section 2 presents related background work and motivations for undertaking a Social Sensitivity perspective in understanding Team Dynamics. A description of the study is provided in Section 3. This section also discusses research questions and related hypotheses, as well as the experimental procedures used. Section 4 provides a detailed explanation of the data collection and the techniques employed. Section 5 provides an analysis of the quantitative and qualitative data, and a brief discussion of the obtained results. Section 6 explains the results in greater detail and discusses the fundamental findings of this study. Section 7 discusses threats to validity, and Section 8 provides the conclusion, which briefly describes the import of the discoveries of this study.

2. BACKGROUND AND RELATED WORK

This section outlines the purpose of evaluating the impact of SS and proportion of females on the performance of software development teams. This section also cites relevant background to provide context for the research that will be presented in the remainder of the document.

2.1. Motivation

Teamwork is defined as "*a joint action by a group of people, in which each person subordinates his or her individual interests and opinions to the unity and efficiency of the group*" [21]. It is also defined by Scarnati (2001, p. 5) as "*a cooperative process that allows ordinary people to achieve extraordinary results.*" Harris & Harris (1996) state that a team has a common goal or purpose where team members can develop effective, mutual relationships to achieve team goals [24].

Successful teamwork relies on synergism between all team members, creating an environment where each member is willing to contribute in order to nurture a positive and effective team environment. Team members must be flexible enough to adapt to a cooperative working environment wherein goals are achieved through collaboration and social interdependence, as opposed to the process of achieving individualized, competitive goals (Luca & Tarricone, 2001). Cohen and Ledford, examining more than 80 self-managing teams at an American telecommunications company, found that self-managed teams had significantly better performance and higher job satisfaction than traditional working groups or departments [19].

Therefore, it is clearly important to understand the factors that impact team performance. It is obvious that "*Together, everyone accomplishes more*" (Michael Lombach, 2005). When it comes to teamwork, most people think in terms of baseball, basketball, or football teams. In contrast, a team is "*really just a group of people who use their skills, experience, and knowledge to work toward a common goal*" (Bachel, 2007) [20]. Sacrificing

individuality for the advancement of a team's interest or goals is difficult for some, but teamwork is "*truly greater than the sum of its parts*" (Levy, 2005) [20]. Working as a group and thinking as a team can have advantages [20]. For example, as a team "*you see different points of view and learn new ways of solving problems*" (Bachel, 2007) [20].

Researchers have identified two main measures of team effectiveness: task performance and team member effectiveness (e.g. satisfaction, participation, and willingness to work together) [22, 23]. Much research has been presented on the subjects of team composition and factors effecting team effectiveness, but no single attribute has stood out as the key to better performance. A recent study raised intriguing questions when it found that team success had less to do with the intelligence of individual team members than with team dynamics, such as how well the team communicated and collaborated [5]. The study found that Social Sensitivity, or an empathic ability to correctly understand another's feelings and thoughts [9], was the largest contributing factor to a team's collective intelligence and the central predictor of team effectiveness and performance [5].

2.2. Related work on role of social sensitivity in teamwork

Success for a team project is directly dependent on Team Performance. Team performance is, in turn, directly correlated with the average Social Sensitivity (SS) of its group members, equality in conversational turn-taking, and the proportion of females in the group, as suggested by a recent MIT study [5]. The research showed that simply having "smart" people does not actually guarantee the group's success on a given task or project. Instead, team performance depends on how well the group members get along and how high the group members' Social Sensitivity scores are [5, 6]. This study states that the proportion of females in a group is linked to its effectiveness in solving difficult problems with the main reason attributed to Social Sensitivity, as females tend be more socially sensitive than males [5].

Social Sensitivity (SS) is the ability to correctly understand the feelings and viewpoints of people [25]. It is often referred to, in layman's terms, as "social" or "soft" skills. Social Sensitivity also includes a knowledge of social norms, roles and scripts. Possessing emotional and social skills is also associated with higher quality social relationships and more supportive social support systems [26]. The key social skills that comprise social intelligence include: the ability to express oneself in social interactions, the ability to "read" and understand different social situations, knowledge of social roles, norms, and scripts, interpersonal problem-solving skills, and social role-playing skills [26].

Our research is motivated by two studies: *viz.* Woolley et al. [5], a study on Social Sensitivity that established a correlation between Social Sensitivity and effective teamwork; and a recent empirical study by Bender et al. [9] on the role of Social Sensitivity in classroom team projects. The following paragraphs discuss the major findings from these two studies (Woolley et al., at MIT and Bender et al., at NDSU) and how they inspired the research presented in this paper.

Woolley et al. [5] established a correlation between SS and effective teamwork. In this study, the researchers first randomly divided 699 people into groups of two to five. They employed the team-task taxonomy developed by social psychologist Joseph E. McGrath to measure the groups' performance on a series of exercises (brainstorming, physical coordination, and moral reasoning). Woolley et al. found that neither the intelligence level of the smartest member nor the average intelligence of the group as a whole played much of a role in team performance. The researchers measured SS score using the "Reading the mind in the eyes" test devised by Baron-Cohen et al. On this test, the subject is presented with a series of 36 photographs of actors' eye areas and asked to choose which of four adjectives best describes how the person in each photograph is feeling. This study presented three interesting findings that relate directly to team performance and dynamics: 1) *Social Sensitivity* 2) *Turn-taking* 3) *proportion of females*. Each of these three factors were directly correlated with an increase in team performance. Woolley et al.'s study was based on

generic tasks such as the aforementioned visual puzzle solving, brainstorming, making collective moral judgments, and negotiating over limited resources. Each of these tasks took place over a relatively brief timespan, from a few hours to a few days. Therefore, it was important to evaluate whether the SS results would hold true in the context of longer projects with software professionals. Hence, Bender et al. [9] performed a study on 76 students enrolled at NDSU. The study established a correlation between SS and team performance and member satisfaction, even on a semester-long project.

Our study sought to determine the relationship between having more females on a team and team performance, as well as satisfaction gained over the course of the project. Though the study by Woolley et al. at MIT did analyze the effect of having greater proportion of females in a group, but as those tasks were of brief duration, we would like to find out if female presence has an impact during long-term software development projects. The main inspiration for the current study came from the study conducted by Woolley et al., at MIT, which stated that increasing the proportion of females makes a team smarter [5]. We wanted to analyze the validity of this claim when applied to the computing discipline. To visualize and understand team dynamics in the software industry, we used data gathered during previous [9] empirical studies that were conducted on semester-long classroom projects.

3. DESCRIPTION OF EXPERIMENT TO EVALUATE RESEARCH GOALS

This section describes the process used in analyzing the role of the “*female factor*” in group dynamics and on team SS score. This includes a brief description of the research question, hypothesis, and experimental procedure.

This study was designed to analyze the relationship between the Social Sensitivity of student teams and the quality of work in computer science team projects in the context of the team’s proportion of female members. The study entailed an analysis of SS and team performance data that was collected during previous studies. This would allow us to evaluate and validate the impact of SS on the quality of student projects. To understand the impact of the proportion of females, we created each possible female-male ratio combinations for teams of four people. The number of females on each team ranged from 0 (i.e., a team of all males) to 4 (i.e., a team of all females).

The study was performed on 157 subjects (76 in one study {Males: 59, Females: 17} and 81 in a replication of the study in a different year {Males: 76, Females: 5}), all of whom were enrolled in a Social Implications of Computing course at North Dakota State University. These studies used a randomized experimental design in which participants were tested to determine their Social Sensitivity scores and randomly assigned to virtual teams of four participants each. We call these virtual groups because we combined their SS scores to compute their average SS scores. The members did not actually work together. Instead, we combined their individual performance scores and individual SS data for the purpose of evaluation.

Students worked within their assigned virtual teams to complete a semester-long project that dealt with an ethical topic in information technology. The students produced a series of deliverables over the course of the semester and their performance on each deliverable was recorded. An overall score on the group project was computed based on these deliverable scores.

In order to evaluate the impact of the ratio of females within a team of 4 individuals (varying from no female to all females), we created five virtual team groups, *viz.* MMMM, MMMF, MMFF, MFFF, FFFF. For each of these five virtual groups, all possible combinations were created.

A post-study survey was completed by the students and evaluated by the research to enable a qualitative analysis of student satisfaction and feedback. Evaluation was primarily constructed on the level of satisfaction achieved by gender, and how male and female members respectively evaluated their teammates.

3.1. Research questions/hypotheses

RQ 1: *How is the proportion of females correlated with the performance of student teams on semester-long projects?*

Related hypothesis: *Adding more women significantly improves team performance.*

Recent studies have shown that factors like group satisfaction, group cohesion, and group motivation are not predictive of project success or team performance [5]. Furthermore, recent studies suggest that adding more women to a team can make the team collectively smarter, as women are generally found to be better than men at reading and responding to other people's emotions [5]. However, these studies were conducted using generic tasks and for very short periods of time. Therefore, it cannot really be said, based on these studies, that adding women would increase team performance in the software industry. It is our goal to determine the effect of the presence of females on teams; and if an effect exists, how great the implication.

RQ 2: *Do females report greater job satisfaction than males in the same work environment?*

Related hypothesis: *Female attitude toward a job is more positive than male attitude.*

There have been various studies representing the notion that females report equal or greater job satisfaction than men [32]. Again, however, these studies were not performed

in the context of software development. Our hope is that the answer to this question will improve our understanding of team composition in the software industry and the computer science classroom.

3.2. Independent and dependent variables

The experiment manipulated the following independent variable:

- a) *Social Sensitivity Score*: Each participant completed the *Reading the Mind in the Eyes* [11] test in order to determine their individual Social Sensitivity score.

The following dependent variable was measured:

- a) *Average Team Social Sensitivity*: Team performance is influenced by the Social Sensitivity of the team, and the Team Average Social Sensitivity was measured by forming Virtual Teams and averaging the individual SS scores of the members that make up each team.

3.3. Experimental procedure

This study used a randomized experimental design in which participants were tested to determine their Social Sensitivity scores and were then randomly assigned to a team. Figure 2, below, illustrates the study design overview. After conducting the Social Sensitivity test, team projects began. Upon completion of the study, a post-study satisfaction survey was conducted.

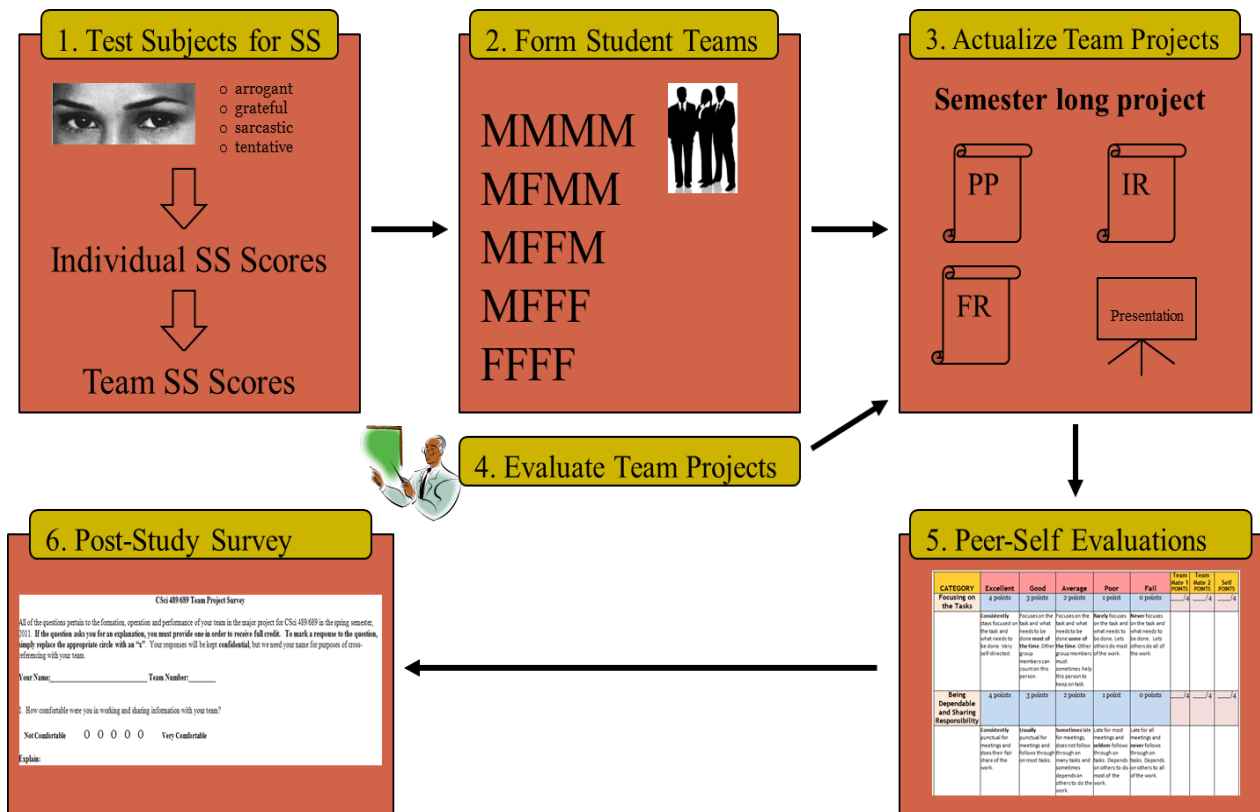


Figure 2. Study design overview

3.3.1. Step 1: Pre-study social sensitivity test

An SS (Social Sensitivity) survey was conducted using *Reading the Mind in the Eyes* [11] test, so that SS scores could be obtained and utilized. A glossary that contained each adjective's definition and a sample sentence using that adjective were provided to make sure subjects had a clear understanding of the adjectives used in the test. The students were advised to read the glossary thoroughly and refer to it if needed during the survey.

3.3.2. Step 2: Team formation

Virtual Teams were formed, with each group comprised of four subjects. An automated script was used to form the Virtual Teams from the set of enrolled subjects. The teams were formed into groups, viz. MMMM, MMMF, MMFF, MFFF, FFFF.

- MMMM: All four team members are male.

- MMMF: One team members is female and the other three are male.
- MMFF: Half of the members are male and the other half female.
- MFFF: One of the members is male, and the other three are females.
- FFFF: All four team members are female.

While forming Virtual Teams, extra efforts were made to maintain consistency so no individual would be counted twice for the same team formation. For example, Person A cannot be in one generation of the formation (MMMM) and also in another generation of the same formation (MMMM). However, the same person could be in different formations, e.g. Person A could be in (MMMM) and (MMFF) to better evaluate the effect of his or her presence in various formations.

The rationale for the virtual group formation was to understand and evaluate the effect of having female team members in a group, and how the presence of female participants affect the Average Team Social Sensitivity score, which would ultimately affect the Team Performance, based on the findings of several previous studies [9] [4].

3.3.3. Step 3: Project actualization

With the advent of the semester, projects were distributed and the project phase began. The project included producing a project proposal, an interim report, a final report, and a final presentation.

The proposal required students to articulate the ethical questions they planned to investigate, justify the question's importance, identify major stakeholders and ethical values, specify their research methods, and plan the project. Halfway through the semester, each team submitted an interim progress report that described the project goal, objectives, and scope, employed research methods, presented evidence to support their ethical viewpoints, and evaluated potential stakeholder actions. Near the semester's end, each team orally presented their project and submitted a final written report.

3.3.4. Step 4: Team performance evaluation

As the Team Performance directly relates to the Average Team Social Sensitivity [4] [9], the team's performance was evaluated based on the Team Average Social Sensitivity. This research aimed to evaluate the Average Team Social Sensitivity and the impact of female representation on the team.

3.3.5. Step 5: Peer and self-evaluation

After each deliverable, subjects completed an evaluation of each of their team members as well as themselves. The following ten candidate characteristics of an effective team member were included: *focusing on the tasks, being dependable, responsibility sharing, listening, questioning, discussing, research and information sharing, individual performance, brainstorming, and group teamwork*. Subjects rated each of the ten attributes on a 5-point Likert scale and were allowed to submit comments. These results were captured to help researchers better understand the results.

3.3.6. Step 6: Post-study survey

A nineteen-question survey was administered to the students at the end of the semester. This post-study survey collected data about the self-perceived effectiveness of each team, including: whether members felt valued; if the team cooperated, communicated, and interacted well; if effective feedback occurred among team members; if conflict existed and how it was resolved; and what the overall quality was of the team work environment.

3. DATA COLLECTION

From the Pre-Study Social Sensitivity test, Social Sensitivity scores would be collected via Reading the Mind in the Eyes [11], which would then be used to understand the Social Sensitivity factor as per female participation.

Teams were divided into 5 formations based on the number of females. As mentioned previously, to maintain consistency we ensured that no individual was counted twice for the same team formation. This resulted in each team group being allocated a different number of teams. Table 1 shows the number of possible combinations (virtual teams) for each group. For example, there were 56 teams made of all males, with no male part of two of these teams. Similarly, 68 virtual teams included at least one female, and so on.

Table 1. Team groups and number of virtual teams for each group

Team Group	Number of teams
MMMM	56
MMMF	68
MMFF	32
MFFF	21
FFFF	16

Team average Social Sensitivity scores for each of the 193 teams formed are shown in Figure 3. The Social Sensitivity (SS) scores range from a minimum of 9 to a maximum of 32, with most teams scoring in the range of 19 to 25. It can be seen in Figure 2 that the Social Sensitivity score of teams is centered around the value (mean = 22.07), a normal

distribution. The horizontal axis signifies the average score for each team and the vertical axis signifies the frequency of SS scores for each team.

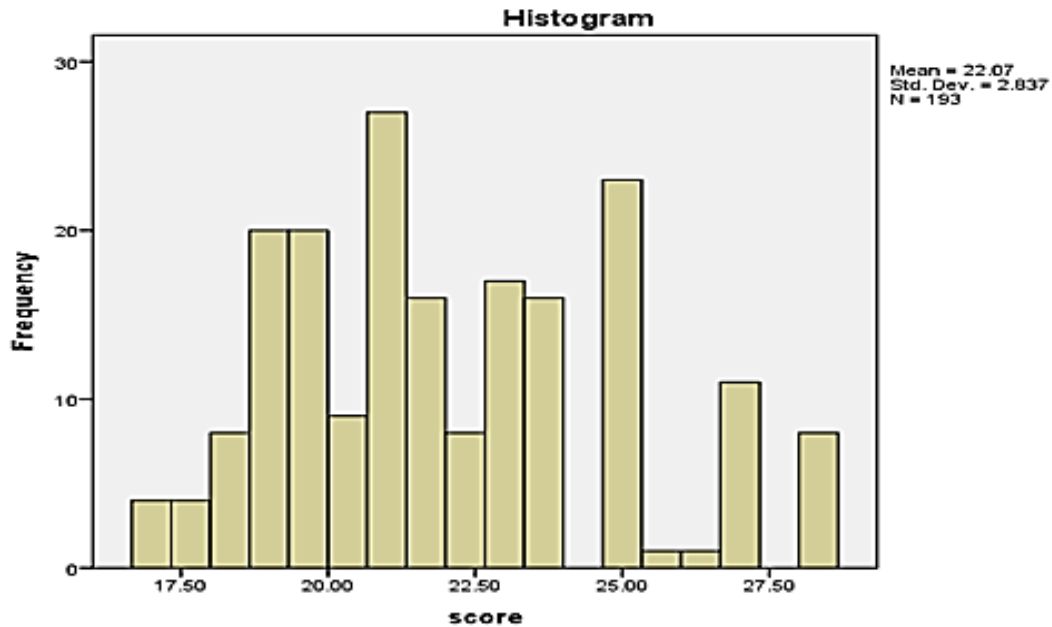


Figure 3. Team social sensitivity scores

A Box and Whisker plot for the 193 teams provides a visual representation of the distribution and variance in the teams’ average Social Sensitivity scores. The plot depicts the distribution of N=193, and the median value of 22. The summary table and Box plot are shown in Table 2 and Figure 4, respectively.

Table 2. Summary table

Team Group	Average Team SS Score	Variance(σ^2)	Range
MMMM	23.17	11.28	9.7 (28.5-18.7)
MMMF	22.70	5.41	8.2 (27-18.7)
MMFF	20.81	5.55	7.2 (24-16.7)
MFFF	20.31	1.79	4.9 (23.6-18.7)
FFFF	20.31	4.29	4.5 (22.5-18.5)

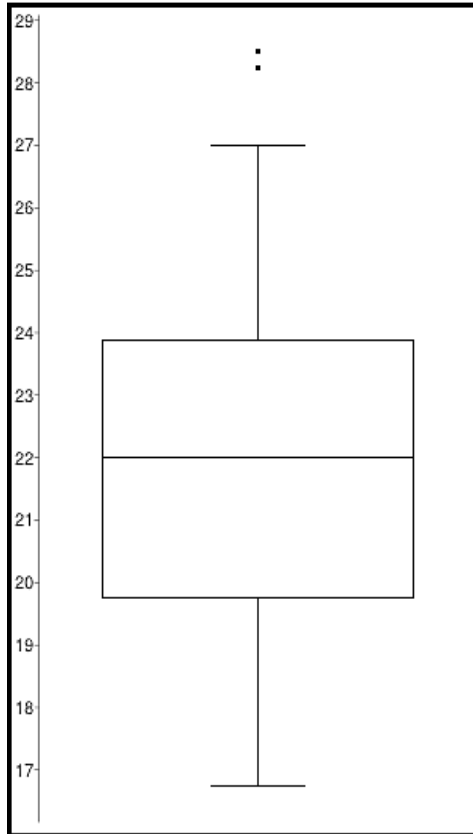


Figure 4. Box and whisker plot for students associated with different team groups

The variance for the SS score of the 193 teams is 8.006, which shows that the data points are quite broadly spread out from the mean and from each other.

As mentioned earlier, we also investigated the peer evaluation data to determine whether there is any relation between SS score and satisfaction achieved, as well as the dynamics of the female factor in the different team groups. In other words, we wanted to understand whether there is any change in satisfaction achieved based on the varying proportion of females in the group. As there are many different kinds of team activities, which can impact the performance and dynamics of the group, we carefully analyzed the 10-question survey to understand the effects of the presence of females and of subjects with high Social Sensitivity scores. The survey questions focused mainly on the tasks of

brainstorming, sharing responsibility, and other team activities. They are briefly described below:

- 1) **Focusing on the Tasks:** How well does the team member stay focused on the task and do what needs to be done?
- 2) **Being Dependable:** How punctual is the team member for meetings?
- 3) **Sharing Responsibility:** How good is the team member at doing their fair share of the work?
- 4) **Listening:** How good is the team member at listening respectfully to all members of the team during discussions, and considering others' opinions?
- 5) **Questioning:** How well does the team member respectfully pose questions to all team members?
- 6) **Discussing:** How well does the team member respectfully interact and discuss issues with all team members?
- 7) **Research and Information-sharing:** How well does the team member gather research, share useful ideas and defend/rethink ideas relating to the group's project goals?
- 8) **Individual Performance:** What is the quality of the team member's work?
- 9) **Brainstorming:** How often does the team member originate, seek and develop ideas and solutions collaboratively with others?
- 10) **Group Teamwork:** How good is the team member at consistently collaborating, cooperating and compromising as needed to achieve goals?

This Peer Evaluation Questionnaire Survey provided data regarding Team Satisfaction and Team Cohesion, which will be discussed in later sections of this document.

4. DATA ANALYSIS AND RESULTS

This section provides an analysis of the quantitative and qualitative data, which includes average team Social Sensitivity scores and feedback (peer evaluation survey), respectively.

Because each virtual team consisted of four subjects and the SS score was individually based, individual SS scores were averaged into a team score based on the Team Formation strategy.

Figure 5, below, shows the average Social Sensitivity of virtual teams in each group formation.

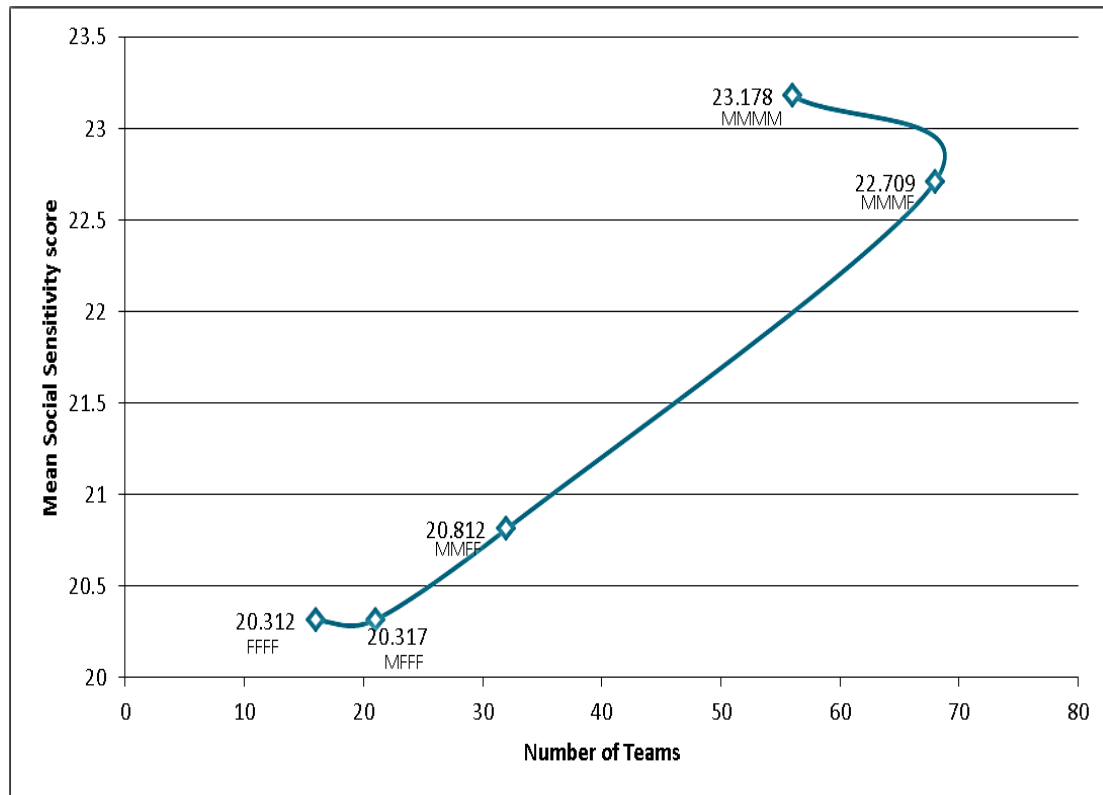


Figure 5. Team mean SS scores based on different types of teams

These results (Figure 5.) showed that our hypothesis was false and the teams with a higher proportion of females did not have much higher SS score as stated by Woolley et al. study.

To further test our hypothesis and research question, a one-way ANOVA test was performed to see whether the mean of the SS score differs among the five team types. In Figure 5, the horizontal axis depicts the quantity of teams of each of the five different formations, viz. MMMM, MMMF, MMFF, MFFF, FFFF. The vertical axis shows the Average Social Sensitivity score for each of the team types. Via an unpaired *t test*, we also analyzed the statistical significance of the difference between Team group’s Social Sensitivity scores (Table 3, below).

Table 3. Statistical significance between each team group’s average social sensitivity

Team Groups	Statistical Significance
MMMM – MMMF	p-value = 0.3617(Not statistically significant)
MMMM – MMFF	p-value = 0.0007(Extremely statistically significant)
MMMM – MFFF	p-value = 0.0007(Extremely statistically significant)
MMMM – FFFF	p-value = 0.0019(Very statistically significant)
MMMF – MMFF	p-value = 0.0003(Extremely statistically significant)
MMMF – MFFF	p-value = 0.0001(Extremely statistically significant)
MMMF – FFFF	p-value = 0.0003(Extremely statistically significant)
MMFF – MFFF	p-value = 0.3867(Not statistically significant)
MMFF – FFFF	p-value = 0.4751(Not statistically significant)
MFFF – FFFF	p-value = 0.9935(Not statistically significant)

Based on the results shown in Table 3, it is evident that adding a female to an all-male group did not significantly improve the SS or social intelligence of the group (MMMM

vs. MMMF had a non-significant value of $p = 0.36$). On the contrary, a team of all males (MMMM) was significantly more socially sensitive on average compared to teams with 2 females (MMFF), three females (MFFF), or all females (FFFF). The p -values were less than 0.05 for each of these three comparisons.

For the next part of the study, we analyzed the 10-question peer evaluation survey conducted upon completion of the project to understand relation of team activities to high SS score members and the presence of females. We analyzed whether team cohesion and reviews of performance and peer evaluation were dependent on gender.

The 10 questions on the peer evaluation survey were based on the team process activities that highly impacted team effectiveness: Brainstorming, Dependability, Discussing Nature, Task Focusness, Listening, Performance, Questioning, Information Sharing, Responsibility, and Teamwork. The survey questionnaire was given to every student in the class, who were asked to evaluate his or her team members. Responses were based on a 5-point Likert scale (0-4). The average scores by gender are shown in the table below (Figure 6). The scores below are based on 28 surveys completed by females and 88 surveys completed by males. The average female scores for all project process activities were not statistically different from the average male scores. Although this does not directly align with the findings of Woolley et al. at MIT [5] that women are much more collaborative and increase a team's collective intelligence, it is highly possible that Woolley's findings are not valid for women in computing disciplines.

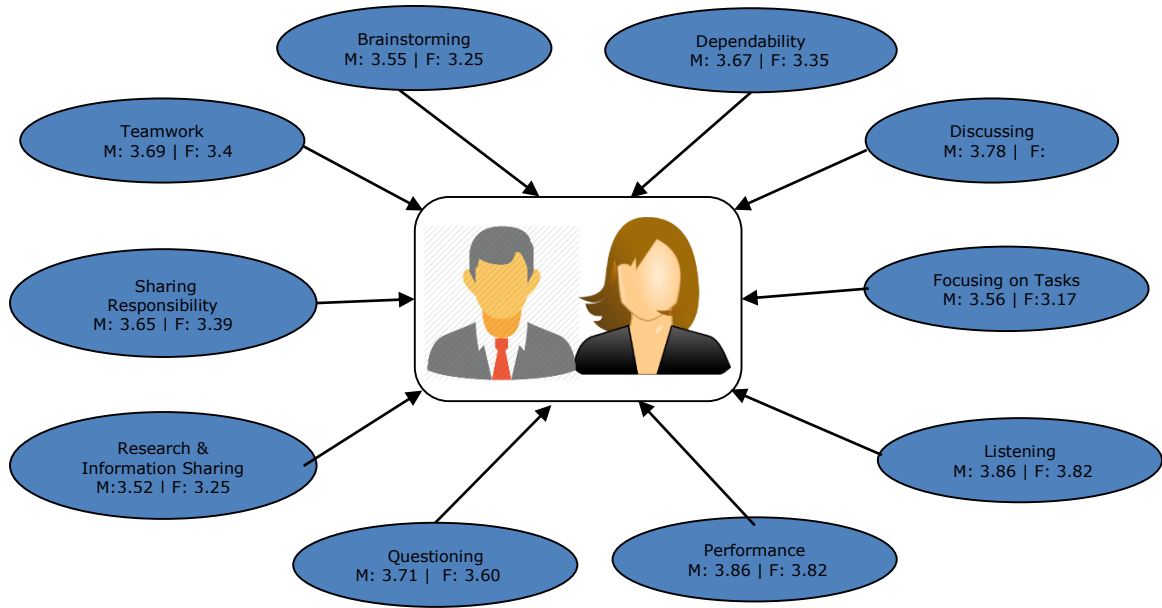


Figure 6. Post-study peer evaluation survey results

In evaluating the notion that females are more satisfied at work than males, we mainly focused on a list of 'buzzwords' that indicate extreme emotions, such as 'exceptional,' 'distracted,' or 'intense.' and used these to evaluate the satisfaction level achieved by each gender. The results showed various instances in which male subjects seemed dissatisfied with their team members. For example, they endorsed comments like "Person X doesn't actively participate in group discussions" or "Person X's research for the first few assignments wasn't very thorough." In contrast, female subjects were generally extremely satisfied with their team members' performance and efforts.

5. DISCUSSION OF RESULTS

Our fundamental finding was that the proportion of females was not highly correlated with the performance of student teams on large semester-long projects. Average Social Sensitivity scores of teams with a high proportion of female members was highly statistically significant (p -value = 0.0019) in comparison to teams with a low proportion of female members. Hence, our initial hypothesis that "Adding more women can significantly increase the Social Sensitivity of the team" did not hold true. Previous research studies showed that groups with a higher proportion of females tended to have higher SS scores than groups with less or no females. However, we believe this claim to be true only for tasks carried out over a brief period of time, like solving visual puzzles, brainstorming, making collective moral judgments, or negotiating over limited resources. These tasks required mere hours to complete. Additionally, we believe that it does not hold true for cases in which participants are interacting in a classroom environment for lengthy (e.g., semester-long) projects.

Furthermore, the presence of females did not have any substantial effect on team performance activities, such as Brainstorming, Research and Information Sharing, and Teamwork, to name a few. We averaged scores for each performance activity based on gender and found that females, on average, had a similar score to males on all team performance activities.

One other important finding in our study is that it supports the recent study by PayScale, Inc. which showed that women tend to be more satisfied with their jobs than men [12][13]. In analyzing the post-study and peer evaluation survey's open-ended questions, we realized that females tended to be more satisfied with team performance and team dynamics than males. This finding supports our hypothesis that "Female attitude towards jobs are more favorable than males" holds true even in the field of Computing. Our key finding also supports new global research [33] from Accenture, which has found that a greater number of women (40%) are satisfied with their current job and are not looking for

new job opportunities as compared to men (28%). Although we found that females received similar average scores on team performance activities as males, it is worth noting that females expressed greater satisfaction than males. Research conducted in several European countries also indicates that females show a significantly higher level of job satisfaction [34] than males.

6. THREATS TO VALIDITY

As the Social Implication class includes international students, there may be a slight possibility that they would get along less well than others due to the fact that English was not their native language. Although International students are required to pass the English proficiency exams, such as TOEFL and IELTS, they may lack proficiency in understanding cultural and ethnological nuances. It is also highly possible that it may have resulted in a lower Average female Social Sensitivity than would a general female population [25] score, as most of the female respondents on this survey were international students.

An additional factor that might be relevant is the question of which factors of “femaleness” contribute to Social Sensitivity levels in the general female population, and whether females who are attracted to computing disciplines inherently have or express those characteristics in similar ways to the overall female population.

Another threat relates to peer evaluations and perceived pressure for conformance. Although peer evaluations were performed online and outside of the classroom environment in an effort to reduce peer pressure from the presence of other students, it is highly likely that some students may have felt some sense of allegiance and given more favorable ratings to their fellow students.

7. CONCLUSION

Our initial belief that the effect of including female members would have a significant and broad-ranging impact, not only in terms of achieving higher team performance but also greater team satisfaction and constructive growth, with less interpersonal challenges, proved to be a negative hypothesis in terms of increased average Social Sensitivity. The results also showed that female presence on a team did not contribute via team process activities that would be essential for project success. However, a qualitative analysis of post-study data suggested that females tend to have a more favorable attitude towards their jobs and report more satisfaction than males even when they are in the same work environment.

A research study published by Accenture [33] has also found that a greater percentage of women (40%) are satisfied with their current jobs and are not looking for new job opportunities, compared to men (28%). Some authors, such as Randy Hodson from Indiana University at Bloomington, have also suggested that women's attitudes toward their jobs are often more favorable than men's attitudes [32].

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