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What is the Perception of Female and Male Software Professionals on Performance, Team Dynamics and Job Satisfaction? Insights from the Trenches

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***Abstract*—Research has shown that gender diversity correlates positively with innovation and productivity in many professional engineering and technology domains. Yet, software development teams are dominated by males. In this paper, we aim at understanding whether female software professionals, compared to male, have different perceptions on a) team performance and dynamics, b) their own personal performance, c) their immediate supervisors, and d) accomplishment, recognition, and opportunities. Understanding perceptions of different genders can help software professionals, their supervisors and those responsible for staff create and foster environments in which both females and males are comfortable and perform best. To achieve this aim, we conducted a survey targeted at individual software professionals in technical roles. We collected and analyzed data from 55 female and 69 male respondents. Our results show basic differences in demographics (e.g., males tend to be older, have more senior roles, and have longer tenure with their employer). While we did find some differences around perceptions of spirit of team work, productivity, sense of satisfaction and fairness of reviews from supervisors, in general, females and males do not seem to differ significantly in their perceptions. Based on the results from our survey and insights from the current literature, we discuss commonalities and differences between females and males, and explore potential implications for performance reviews, recognition, and career progression.**

***Index Terms*—diversity; female and male software professionals; perceptions; software development teams; descriptive survey**

I. Introduction

Recent research has shown that diversity (i.e., differences amongst members of a group) tends to contribute to better work outcomes in creative, innovative, knowledge-driven and technology-focused disciplines [1]. This goes against early publications in social psychology that indicated that diversity can have negative impacts on group functioning [2] and team outcomes [3]. It is now believed that diverse teams offer better opportunities for innovation [4]. There are multiple types of diversity: "surface level diversity" (e.g., gender, age) [2], functional diversity (e.g, role, expertise, tenure) [5], and "deep-level" diversity (e.g., attitudes, beliefs) [2].

Despite the proven benefits diversity brings, there is a severe lack of gender diversity in computing and software engineering. Women make up 57% of the professional workforce in the US, but they comprise only a quarter of the computing workforce [6]. In 1998, Bill Wulf, who was then serving as the president of the National Academy of Engineering in the US, stated that the lack of diversity results in opportunity costs, "a cost in products not built, in designs not considered, in constraints not understood, in processes not invented." Wulf explained, "Every time we approach an engineering problem with a pale, male design team, we may not find the best solution." This is because gender diversity leads to a balance between the traits and skills of feminine and masculine roles [7]. For example, Razavian and Lago identified "flavors of feminine expertise" (e.g., communication, intuition, embracing ambiguities), how these could complement male expertise, and how these contribute to more successful projects [8].

Personality and gender have been explored in social sciences, but problems of teamwork in organizations and gender are still not well understood in software development [9]. A recent systematic literature review on software engineers' personality traits found that only two studies consider gender and gender diversity when studying team climate and performance [10]. Literature that does explicitly investigate gender diversity in software engineering (e.g., [11]–[13]) offers an "external view" on the impact of gender diversity (i.e., how diversity contributes to productivity or innovation). It has been found that gender and tenure diverse software development teams are more productive than homogeneous teams [12] and software organizations experience benefits with increased gender diversity [13]. Also, even though there are surveys on diversity for the entire ICT sector, these envelop far more than just software development roles, and do not provide a definite view on software professionals with technical backgrounds.

To help individual software professionals, their supervisors and those in charge of staff create environments in which both

females and males are comfortable and can perform best, we must also understand individual perceptions. This is particularly relevant when thinking of retention and job satisfaction in the software industry. Fifty-six percent of technical women leave mid-career – twice the rate of men [14]. Eighty percent of these women stay in the workforce but take non-technical jobs or start their own companies. Therefore, this study aims to offer an "internal view" on gender diversity to complement the "external view". We define the goal of this paper as follows:

> **Goal:** Improve understanding of perceptions of female and male software professionals in technical roles on various aspects of performance, team dynamics and job satisfaction.

We operationalize this goal into four research questions:

RQ1: What is the perception of female and male software professions on team performance and team dynamics? RQ1 provides insights from individuals into how they perceive the performance and interactions with other members in their team and how this differs with gender. RQ1 aims at perceptions on the distribution of work in teams, peer pressure, the performance of teams, the support for and involvement in making decisions related to their own work, and team spirit.

RQ2: What is the perception of female and male software professionals on their own personal performance? RQ2 provides insights about the individual's own perception of themselves (with regards to productive time spent on tasks, overall productivity and going beyond expectations when contributing to projects) compared to their colleagues and how it differs depending the individual's gender.

RQ3: What is the perception of female and male software professionals of their immediate supervisor? Supervisors impact the success of individuals, but also influence job satisfaction, happiness of teams and team members, etc. Therefore, it is important to understand how individuals feel about their supervisor and how this differs with gender.

RQ4: What is the perception of female and male software professionals on accomplishment, recognition, and opportunities? Differences in how females and males feel about accomplishments, recognition, and opportunities may help understand how to increase job satisfaction and improve staff recruitment and retention.

This paper is meant to stimulate software engineering practitioners and researchers (and potentially software engineering and technology educators) to reflect on gender diversity in the industry. In detail, we provide the following **contributions:**

- We present quantitative evidence for the differences and commonalities in perceptions of female and male software professionals in technical roles on various aspects of performance, team dynamics and job satisfaction.
- We discuss commonalities and differences between females and males, and present implications for software engineering practice, in particular with regards to performance reviews, recognition, and career progression, including a comparison with the literature.

The rest of the paper is organized as follows: In Section II, we discuss the research method and study design to answer our research questions. Results of our study are discussed in Section III. We elaborate on potential implications in Section IV. We conclude the paper in Section V.

II. Research Method

We conducted a *descriptive* survey to understand *how* software professionals in technical roles of different genders perceive performance, team dynamics and job satisfaction (rather than investigating *why* things are perceived in a certain way). The survey collected information to provide a snapshot of the current status [15] and to describe attitudes and perceptions [16]. The study itself followed the process proposed by Ciolkowski et al. [17] and used activities of the survey process defined by Pfleeger and Kitchenham [18], including survey definition (i.e., definition of goal and objective), survey design (definition of data collection and analysis procedures), survey implementation through an online infrastructure, and survey execution and analysis.

A. Population and Sampling

Population: Our target population was software professionals in technical roles in industry that work in teams and have immediate supervisors. We did not restrict the target population with regards to business domain, location, company size or number of years of practical experience.

Sampling: We used purposive sampling [19]. This was because respondents needed to hold a technical role (e.g., developer, software architect, test engineer) and have practical experience with working in teams. Furthermore, we aimed at a balance between female and male respondents. In addition to purposive sampling, we branched out into chain referral sampling [20] to get as many data points as possible for more accurate findings [21]. Other sampling techniques, e.g., random sampling, may have resulted in many invalid responses or responses from individuals in non-technical roles. To recruit participants, we advertised the survey in our personal local and global networks, through industry contacts and by postings in online communities (e.g., LinkedIn, Facebook). The sample size was restricted with regard to the responses that we could obtain and there is no simple way to define the size of the sample in a study like ours [16]. Consequently, we were not able to calculate a response rate.

B. Data Preparation and Collection

We used a self-administered online questionnaire (Qualtrics survey software) for data collection [22], shown in Table I. The online questionnaire was active from December 2015 to February 2016. While interviews would have allowed more in-depth discussions and targeted questions, we chose an online questionnaire because a) it allowed us to obtain data from a larger number of respondents since participants could fill in the questionnaire independent from researchers, b) it allowed

us to collect data from participants independent from their location and without time synchronization, and c) it reduced errors in data that could occur when manually entering data from paper-based questionnaires.

When answering the questions, we asked participants to refer to one particular team. If participants were part of more than one team, we asked them to refer to the team that they were involved in most. This allowed us to capture more accurate information about the context. Also, referring to one particular team made it easier for participants to answer questions and reduced the probability of "it depends" answers.

The survey instrument was reviewed by an expert in questionnaire design from outside the software engineering domain as well by practitioners. The survey instrument was also evaluated through a series of pilots with representatives from the target population and revised accordingly.

C. Data Analysis and Visualization of Results

We used descriptive statistics and quantitative data analysis. In particular, we used frequency analysis and cross-tabbed the answers to the different questions on the questionnaire. We performed statistical tests and regression modeling to identify differences between genders as well as correlations between the answers. We only report findings from these statistical analyses if they led to relevant insights. We show the results for the Likert-type scale questions as net stacked distributions. Similar to Singer et al., we do not report neutral/undecided or "I don't know" answers [23] but results are centered on neutral to show if groups lean to one side or another. Also, since the number of responses from females and males differ, we visualize the percentages of responses for each gender in stacked bar charts rather than absolute numbers. This allows a more convenient comparison of "trends" in answers from females and males. The two gray bars in each direction in the stacked distributions represent 50% and 100%, respectively.

III. Results

A. Demographics

We received 124 complete responses out of which 55 (44%) were from female respondents and 69 (56%) from male respondents. Seventy-nine responses were incomplete and discarded. In this section, we provide a demographic characterization of our sample. The sample is rather representative.

- **Technical roles (Q1):** The majority of respondents held the role of a software developer (61%), see Figure 1. Around 60% of both females and males held this role.
- **Seniority (Q2):** Almost 50% of participants were at senior level, including team leads, supervisors and principals. Junior roles, including interns and new graduates accounted for 28% while the remaining participants classified themselves in intermediate roles. A Mann-Whitney test of difference in distribution shows that there is a statistically significant higher number of male respondents in senior roles ($U = 2542$, $p < 0.001$).

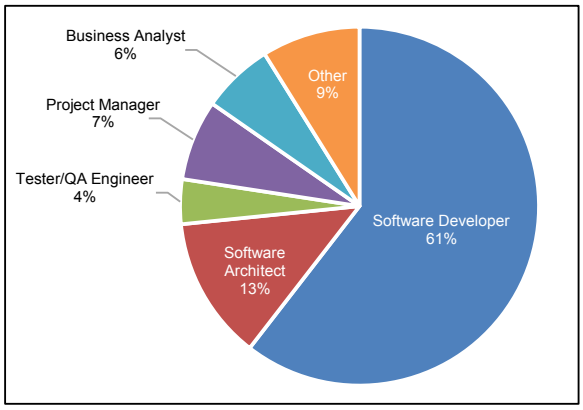

Fig. 1. Technical roles of respondents.

- **Domestic/international company (Q3) and size (Q4):** Twenty-one respondents (17%) worked at domestic companies while the majority of respondents (83%) worked at international companies and 108 respondents (87%) worked at companies with more than 50 employees.
- **Domains (Q5) and software categories (Q6):** Respondents were from different software domains (e.g., health care, manufacturing, transportation, telecommunications) and software development categories (e.g., embedded, web, mobile) with no one dominating domain or category.
- **Team size (Q8):** The average size of teams in which respondents worked was quite large (eleven team members). On average, teams had nine male team members and two female team members.
- **Time at company (Q9) and industry experience (Q10):** More than half of respondents (54%) have six or more years of industry experience, but most respondents (85%) have been working five years or less at their current company. Males tend to have longer tenure at their current company (Mann-Whitney: $U = 2519$, $p < 0.001$).
- **Annual salary (Q11):** More than 60% of respondents have an annual salary of more than $70,000 (all converted to NZD). More than 70% of male respondents earn more than 70,000 per year, compared to around 50% of female respondents. This difference is not statistically significant.
- **Highest level of education (Q12):** Most respondents (71% of females, 68% of males) have a Bachelor's degree (three years) or a Bachelor's with Honors (four years). There is no statistically significant difference in the education between females and males.
- **Age (Q13)**: The majority of respondents was younger than 40 years old with 23% older than 40 years. Males tend to be older (Mann-Whitney: $U = 2552$, $p < 0.001$).

B. RQ1: Team Performance and Dynamics

We visually summarize the findings for RQ1 in Figure 2.

Distribution of work assignments (Q15): Overall, 50 respondents (40%) agree that work is fairly distributed and only seven respondents (6%) indicated that they disagree that

TABLE I
QUESTIONNAIRE

#	Question	Purpose	Response options
Q1	In which technical category would you consider your position?	Demographics	business analyst; project manager; software architect; software developer; other
Q2	Please indicate the seniority of the position you hold.	Demographics	junior; intermediate; senior
Q3	Is your company an international or domestic company?	Demographics	international; domestic
Q4	What is the size of your organization (number of employees)?	Demographics	<10; 20-49; 50-99; 100-499; 500-999; 1,000-4,999; 5,000-9,999; 10,000+
Q5	In what software domain would your company fall under?	Demographics	applications; systems; embedded; web; mobile; scientific; other
Q6	What is the software development category of your company?	Demographics	agriculture; art, entertainment, recreation; construction; education; finance/banking/insurance; government/public administration; healthcare; hotels and food services; information technology; manufacturing; mining; professional, scientific, and technical services; publishing; real estate and rental-leasing; transportation and warehousing; utilities; wholesale/retail; telecommunications; defense/military; other
Q7	What is the gender of your direct supervisor?	Demographics	female; male
Q8	What is the size of your development team?	Demographics	number of female and male team members
Q9	How long have you been working for your company?	Demographics	<1 year; 1-2 years; 3-5 years; 6-10 years; 10+ years
Q10	How many years of experience do you have in the tech industry?	Demographics	<1 year; 1-2 years; 3-5 years; 6-10 years; 11-15 years; 16-20 years; 20+ years
Q11	What is your annual salary (in NZD)?	Demographics	0-25,000; 25,001-40,000; 40,001-50,000; 50,001-40,000; 60,001-70,000;70,001-80,000; 80,001-90,000; 90,001-100,000; 100,001-110,000; 110,001-120,000; 120,001-130,000; 130,001-140,000; 140,001-150,000; 150,000+
Q12	What is the highest level of education you have completed?	Demographics	highschool; some college; bachelor; bachelor w/Honors; masters; doctorate; professional degree
Q13	What is your age?	Demographics	20-24; 25-29; 30-34; 35-39; 40-44; 45-49; 50-54; 55-59; 60-64; 65-69
Q14	What is your gender?	Demographics	female; male
Q15	Work assignments are distribute fairly.	RQ1	strongly disagree; disagree; neutral/undecided; agree; strongly agree
Q16	What is your level of satisfaction with regards to: Peer pressure.	RQ1	very dissatisfied; dissatisfied; neutral/undecided; satisfied; very satisfied
Q17	My team consistently performs up to expectations.	RQ1	strongly disagree; disagree; neutral/undecided; agree; strongly agree
Q18	I have the support and authority to make the decisions I need to make.	RQ1	very dissatisfied; dissatisfied; neutral/undecided; satisfied; very satisfied
Q19	I have enough involvement in decisions that affect my work.	RQ1	very dissatisfied; dissatisfied; neutral/undecided; satisfied; very satisfied
Q20	Overall, how satisfied are you with the spirit of teamwork within your company?	RQ1	very dissatisfied; dissatisfied; neutral/undecided; satisfied; very satisfied
Q21	Compared to the "average" employee: Productive time spent working on the tasks assigned to me.	RQ2	upper 5%; upper 10%; upper 20%; upper 30%; middle 50%; lower 30%; bottom 20%
Q22	Compared to the "average" employee: Overall productivity in getting the job done.	RQ2	upper 5%; upper 10%; upper 20%; upper 30%; middle 50%; lower 30%; bottom 20%
Q23	Compared to the "average" employee: Going beyond what is expected of me to contribute to the project.	RQ2	upper 5%; upper 10%; upper 20%; upper 30%; middle 50%; lower 30%; bottom 20%
Q24	My supervisor takes time to listen to me.	RQ3	strongly disagree; disagree; neutral/undecided; agree; strongly agree
Q25	My supervisor gives me fair reviews.	RQ3	strongly disagree; disagree; neutral/undecided; agree; strongly agree
Q26	My supervisor is willing to promote me.	RQ3	strongly disagree; disagree; neutral/undecided; agree; strongly agree
Q27	I feel comfortable communicating with my supervisor.	RQ3	strongly disagree; disagree; neutral/undecided; agree; strongly agree
Q28	I feel valued as a team member.	RQ4	very dissatisfied; dissatisfied; neutral/undecided; satisfied; very satisfied
Q29	This is the type of job in which I can feel a sense of accomplishment.	RQ4	very dissatisfied; dissatisfied; neutral/undecided; satisfied; very satisfied
Q30	What is your level of satisfaction with regards to: Personal sense of accomplishment.	RQ4	very dissatisfied; dissatisfied; neutral/undecided; satisfied; very satisfied
Q31	What is your level of satisfaction with regards to: Peer recognition.	RQ4	very dissatisfied; dissatisfied; neutral/undecided; satisfied; very satisfied
Q32	What is your level of satisfaction with regards to: Base compensation.	RQ4	very dissatisfied, dissatisfied; neutral/undecided; satisfied; very satisfied
Q33	Overall, how satisfied are you with the recognition you receive for doing a good job?	RQ4	very dissatisfied; dissatisfied; neutral/undecided; satisfied; very satisfied
Q34	Are there real opportunities for career development in the company?	RQ4	very dissatisfied; dissatisfied; neutral/undecided; satisfied; very satisfied

the work is fairly distributed. The remaining respondents were undecided about the distribution of work assignments and no respondent indicated either strong agreement or disagreement about the fair distribution of work within teams. There is no statistically significant difference between females and males.

Peer pressure (Q16): Most respondents do not feel peer pressure in their team. However, around 40% of respondents were either undecided or perceived some peer pressure. A Mann-Whitney test did not indicate a statistically significant difference in the distribution of responses between males and females. However, 5% of female respondents are very dissatisfied with the peer pressure they perceive in their team, but no male respondents expressed this level of dissatisfaction.

Performance of teams (Q17): The perception of consistent performance could indicate whether female and male participants have similar judgments about how well their team does. Most respondents were undecided about the consistent performance of their team (42%). On the other hand, 37% of respondents agree that their team performs consistently. No strong disagreement or agreement was reported. We did not find a statistically significant difference in the responses from female and male participants and most female or male respondents are either not sure if their team performance is consistent or agree that it is consistent.

Authority to make (Q18) *and* involvement in decisions (Q19): An important aspect of how team members work with each other is to what degree they have the authority to make decisions in order to get their job done and the involvement they have in decisions that affect their work. Most respondents are satisfied with both aspects (61% of females and 81% of males feel that they have support and authority to make decisions; 76% of females and 78% of males feel that they are involved in decisions). There is no statistically significant difference in the responses from female and male participants.

Spirit of team work in organization (Q20): The overall perception of the spirit of team work differs between males and females: Females tend to be less satisfied with the spirit of teamwork (Mann-Whitney: $U = 2250.5$, $p = 0.02$).

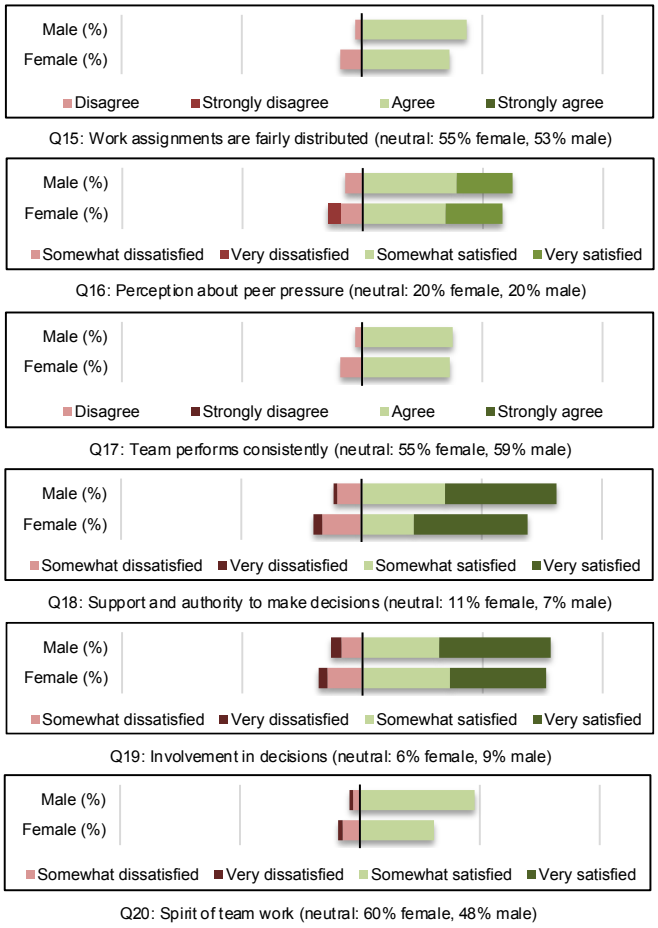

Fig. 2. Answers to questions related to RQ1.

Key insight(s)

Differences between genders:

- Some female participants (5%) expressed extreme dissatisfaction with peer pressure in their team.
- Females are less happy with the spirit of team work in their company.

Similarities across genders:

- Many respondents agree that work is fairly distributed in their teams, but almost half of respondents are not sure whether the distribution of work is fair.
- Many respondents could not judge how consistently their team performs (55-59%). Those who did provide a non-neutral answer, were more likely to be satisfied with team performance.
- Respondents are mostly satisfied with their involvement in decision making processes.

C. RQ2: Perception of Own Personal Performance

Respondents compared themselves to an "average" colleague, see Figures 3, 4, and 5, respectively. Again, we show the percentages of responses, e.g., in Figure 3, around 5% of females consider themselves among the upper 5%. We also show the "expected" distribution of responses based on the statistically expected allocation of individuals to the upper 5%, 10%, etc. Respondents could select only one answer, so, for example, the expected number of individuals in the upper 10% is only 5% since we exclude individuals in the upper 5%. The figures show that respondents over-estimate their abilities.

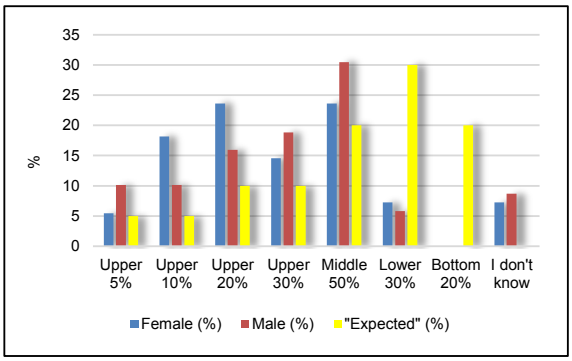

Fig. 3. Comparison with colleagues: productive time (Q21).

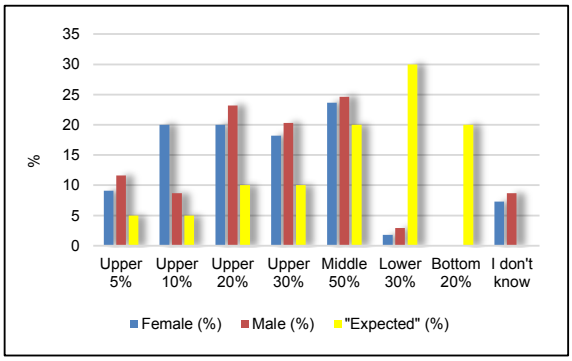

Fig. 4. Comparison with colleagues: overall productivity (Q22).

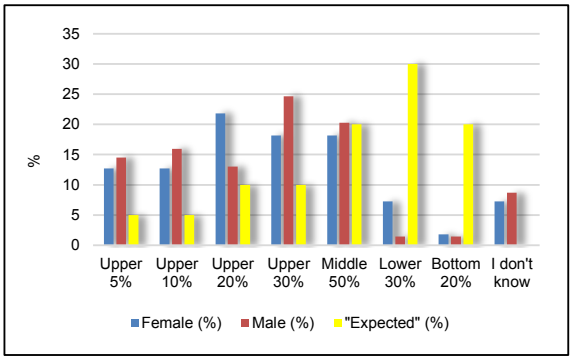

Fig. 5. Comparison with colleagues: going beyond expectations (Q23).

We performed several linear regression analyses to assess the effect of the demographic measures on the perceptions of

one's own performance compared to their colleagues. Each of the demographic measures was checked for collinearity issues, and experience was excluded from the models because it was highly correlated with four other demographic measures. Table II shows the results of the regression models. Seniority was the most significant factor that affected the three perceptions. The estimated coefficients for seniority have positive values, which are associated with more favourable perceptions, meaning more senior respondents rated themselves more favourably. This affect is most significant for the perceptions around "overall productivity in getting the job done". As the values for gender are categorical and non-numeric, we used dummy coding to enable inclusion of gender in the model [24]; males were coded as 0 and females as 1. The positive coefficient, therefore, indicates that females perceived themselves more favourably for each of the three measures. This affect is slightly significant for perceptions around "overall productivity in getting the job done". Of course, as would be expected, the demographic measures are not useful by themselves to explain these perceptions, as can be seen by the low Adjusted R-squared values. This means that there are likely many additional factors beyond demographics that affect one's perception of their performance.

TABLE II
EFFECTS ON PERCEPTIONS OF OWN PERFORMANCE

	Productive time (Q21)	**Overall productivity (Q22)**	**Going beyond expectations (Q23)**
(*Intercept*)	1.92	2.31*	2.22*
Gender	1.62	2.02*	1.01
Age	0.17	-1.05	0.17
Education	0.67	-0.13	0.07
Employment	-0.02	0.51	0.45
Seniority	2.83**	4.02***	2.94**
Adjusted R-squared	0.07	0.12	0.06

(*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$)

Key insight(s)

Differences between genders:

- Females perceived themselves more favorably with a slight statistical significance for overall productivity.

Similarities across genders:

- Both males and females are likely to believe their performance is better than their colleagues.
- Seniority is a better predictor of perception of performance than gender.

D. RQ3: Perception of Immediate Supervisor

Results are displayed in Figure 6. The gender of the immediate supervisors of respondents is shown in Table III. The number of female supervisors in our sample is quite small.

Time to listen (Q24): Most respondents agree that their supervisor takes time to listen. Only 11% of respondents provided a neutral answer or disagreed with this statement.

TABLE III
GENDER OF IMMEDIATE SUPERVISORS

	Female respondents	**Male respondents**
Female supervisor	12 (22% of female respondents)	12 (17% of male respondents)
Male supervisor	43 (78% of female respondents)	57 (83% of male respondents)

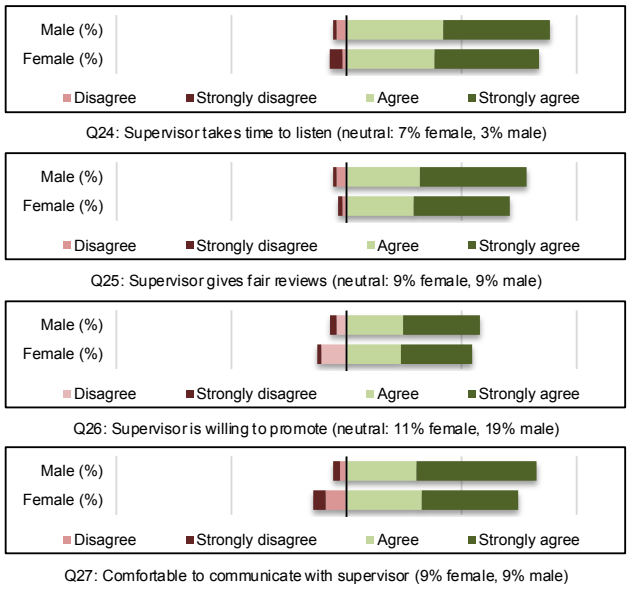

Fig. 6. Answers to questions related to RQ3.

This could imply that both females and males perceive their supervisors as approachable.

Fair reviews (Q25): Even though most respondents agree or strongly agree that their supervisor provides fair reviews, around 18% of female respondents could not tell (i.e., answered "I don't know") whether the review of the supervisor is fair (compared to 7% of males).

Willingness to promote (Q26): Most respondents agree that their supervisor is willing to support promotions. However, a significant number (34% of all respondents) provided a neutral response or do not know.

Communication with supervisor (Q27): Most respondents are comfortable communicating with their supervisor.

We did not find a statistically significant difference between female and male respondents on any of the above points.

Key insight(s)

Differences between genders:

- Females find it more difficult to judge whether they receive fair reviews from their supervisors.

Similarities across genders:

- Both female and male respondents are overall satisfied with how they work with their supervisor.
- Most respondents agree or strongly agree that their supervisor is willing to promote them, but compared to other criteria (e.g., time to listen, fair reviews) the level of agreement for this aspect is lower.

E. RQ4: Accomplishment, Recognition, and Opportunities

We investigated perceptions of the sense of accomplishment, recognition, and opportunities based on several aspects (responses illustrated in Figure 7).

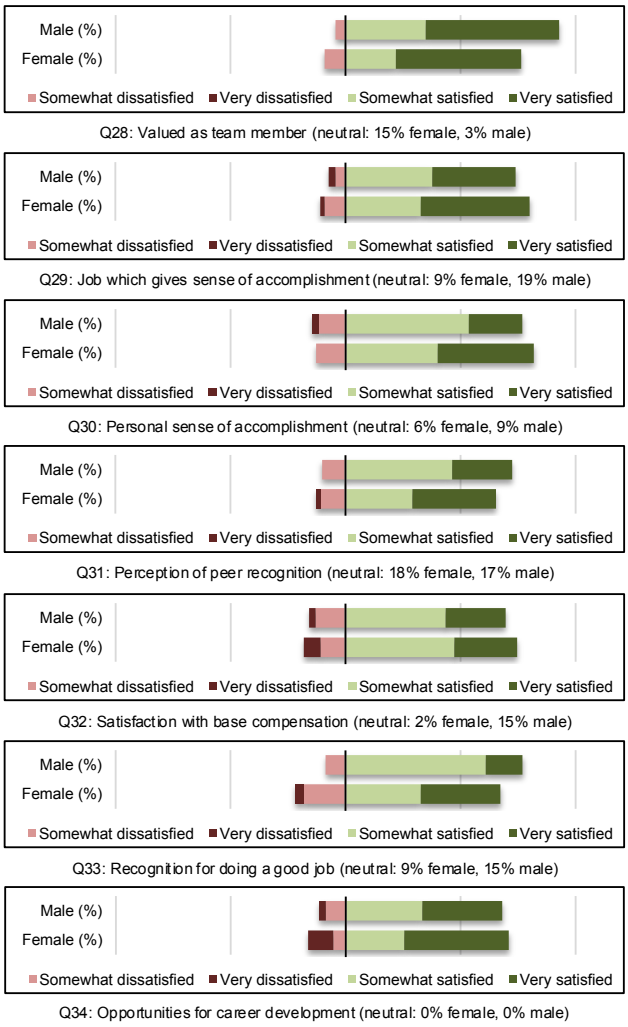

Fig. 7. Answers to questions related to RQ4.

Valued team member (Q28): Females and males feel valued in their team. There is no significant difference between females and males in how satisfied they are.

Type of job which gives sense of accomplishment (Q29): Both, female and male respondents consider their job as the type of work from which they gain a sense of accomplishment.

Sense of personal accomplishment (Q30): Even though the majority of females and males feel a sense of personal accomplishment, the Mann-Whitney test shows that females are somewhat more satisfied with their personal sense of accomplishment ($U = 1552$, $p = 0.03$).

Peer recognition (Q31): Females and males are satisfied with the recognition they receive from their peers.

Satisfaction with base compensation (Q32): While more female respondents indicated less satisfaction with their base salary, this is not statistically significantly different to male respondents.

Overall recognition for doing a good job (Q33): Overall, from Figure 7 it appears as if females are less satisfied than males with regards to the recognition they receive for doing a good job. This difference is not shown in statistical tests.

Career opportunities (Q34): There does not appear to be a significant difference between female and male respondents regarding satisfaction with career opportunities. However, when segregating responses by tenure, females become increasingly more pessimistic about career opportunities the longer they are employed, while the opposite is true for male respondents (see Figure 8; to calculate the average, we mapped satisfaction levels to numerical values, e.g, "Very dissatisfied" was mapped to 1, "Somewhat dissatisfied" was mapped to 2, etc.). This difference is not statistically significant, likely due to the small number of responses for each grouping.

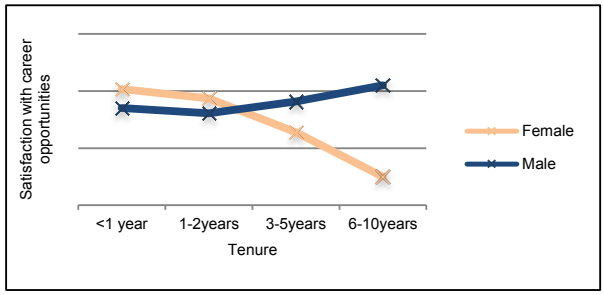

Fig. 8. Average satisfaction level around career opportunities for males and females segregated by tenure.

Key insight(s)

Differences between genders:

- Female respondents are more satisfied with their personal sense of accomplishment.
- Female respondents become increasingly pessimistic about career opportunities as their tenure increases.

Similarities across genders:

- Most respondents feel valued, feel their job provides a sense of accomplishment and are satisfied with the recognition they receive.

IV. Discussion

Some of our results presented in Section III may not be surprising or controversial. However, our survey takes a picture of reality, and as argued by Torchiano and Ricca, reality is rarely surprising or controversial [25]. Our study attempts to offer empirical evidence that validates anecdotal evidence.

At the most basic demographic level, we found that males tend to be older, hold more senior roles, and have longer tenure with their current employer. Bryson et al. [26] argues that these differences are related and occur because of the "gendered" and male-dominated nature of the software engineering

industry. Overall, these demographics indicate that there may be barriers to women's advancement in the software industry, from the types of positions they are in and how these positions and roles are valued. We found no statistically significant difference in the salary and education level of female and male respondents in our sample.

A. Explaining Our Results

1) Similarities in Females and Males: For many of the questions investigated in this study, there is no statistically significant difference between female and male respondents. How could we potentially explain these similarities? As argued by Harrison et al., when group members interact, "dissimilarity in the typically studied surface-level dimensions such as sex and age becomes less important than deep-level attitudinal dissimilarity in, for instance, job satisfaction" [2]. This is also what we observed: Differences occurred mostly for RQ4, which investigated the perception of accomplishments, recognition and opportunities. Another reason for the similarities in female and male respondents could be that perceptions depend on personalities of developers, and, as Smith et al. found, there are only few significant differences in the personality traits of developers regardless of gender [27]. Similarly, Bryson et al. found that women and men do not differ significantly in terms of organizational commitment [26]. Many questions in our study, with the exception of questions related to RQ2, are in one way or another related to organizational commitment.

2) Differences between Females and Males: We did find some statistically significant differences in responses between male and female. One possible explanation for these differences could be that men in our sample are more senior, have longer tenure with their company and may be at a more privileged level for organizational communication [26]. However, our study (and regression modeling) did not find evidence that these factors would cause significant differences in the perception of female and male software professionals. The only exception is overall productivity. Still, overall there appears to be a slight shift of female responses towards negativity (even though not statistically significant).

B. Implications for Practitioners

1) Fair Performance Reviews: Many females (18% of respondents, compared to only 7% of males) are unsure if they receive fair feedback from their supervisor. This could imply that changes are needed around the practices of providing feedback. Since most respondents are satisfied with the recognition they receive from their peers in their team (RQ4), it could be argued that peer performance reviews are a better and more transparent way of making sure that as a whole reviews are perceived as "fair" (in contrast to usual reviews that are done by managers who do not always have first hand contact with the details that go into a task but only see the end result). While peer reviews have been investigated in education to increase fairness in assessing individuals (e.g., Anson and Goodman [28]) and organizational psychology (e.g., Ohland et al. [29]), there are no empirical insights about the efficiency and effectiveness of peer-based reviews in software engineering practice. In particular, research on peer reviews in education has found that there is little or no gender bias (e.g, Tucker, [30], Main and Sanchez [31]), which could be another argument for complementing performance reviews in software organizations by evaluations from peers.

2) Recognition: Responses to Q33 indicate that more than 20% of females are somewhat or very dissatisfied with the recognition they receive. For males, we saw only 8% were dissatisfied and none were very dissatisfied for this same question. Other studies have also found that women, compared with men, report experiencing less recognition [26]. Receiving regular feedback and recognition at the time things happen is important. As found in other contexts, low-quality performance appraisals negatively impact job satisfaction and organization commitment [32]. Organizations should ensure that staff receive regular recognition of their efforts both formally and informally.

Furthermore, others have reported that women hold lower expectations of their jobs and therefore tend to report higher levels of job satisfaction [18]. The same study found that women tend to report more favorably on intrinsic measures, while extrinsic measures held more appeal for men. This reinforces the importance of the nature of the work that keeps people satisfied and engaged.

3) Career Progression: One difference we saw between men and women was their level satisfaction on opportunities for career development over time. Females who were employed by their company for longer were less satisfied, yet we do not see this same trend with male respondents (as illustrated in Figure 8). This negative perception might likely be further exacerbated by the fact that males currently dominate the more senior positions. Previous research found that 56% of technical women leave mid-career [14]. Software organizations, therefore, should take care to ensure women at all stages of their career are satisfied with their opportunities for career development to prevent the loss of female talent.

C. Future Work

The presented study can be considered an exploratory exercise that is used as a pre-study to a more thorough investigation [17]. Thus, many additional research questions have emerged.

1) Influence of Software Practices: Is there a correlation between the type of software practices respondents use in their business (e.g., Scrum, Kanban, "waterfall", XP, etc.) to job satisfaction, the engineers' perceived value and level of peer recognition? This is particularly interesting as females reported less satisfaction with the spirit of team work within their organization – something that should, in theory, be a key part of a good agile team. Previous research has linked agile software development practices as a way to encourage females into the software engineering industry (and, in turn, retain them in the industry) [33]. This is even more relevant considering that the strongest predictor of organizational commitment for both females and males is good communication across all sectors of the organization [26]. Agile software development practices

are collaborative, open and social frameworks that lead to more peer feedback and review on a daily basis. Thus, it would be interesting to learn if perceptions of employees differ on agile teams compared to more traditional teams.

2) Technical Roles: Are there differences in perceptions based on a respondent's technical role? Unfortunately, as many of our responses came from software developers, our findings do not allow any conclusions about the technical roles of respondents and their responses. It would be interesting to investigate further how perceptions around performance, job satisfaction, recognition and accomplishment vary across roles.

3) Gender of Supervisor: Does the gender of the immediate supervisor have any impact on the perceptions of female and male engineers? We were unable to find any statistically significant differences based on the gender of the immediate supervisor. This could be due to the sample size and that only 24 respondents (i.e., 20%) had a female supervisor. One of the few studies that looked at the gender of the supervisor and its impact on how software developers work is Gilal et al. who found that when it comes to successful or failing projects, there is no difference based on the gender of the team lead [13]. However, further investigation is needed in this area.

4) Personal Sense of Accomplishment: Why are females more satisfied with their personal sense of accomplishment? We found that females were more satisfied with their personal sense of accomplishment than male respondents. One potential reason could be that females make a more conscious decision when entering the software industry (compared to males for which entering the software industry is not going against the norm). Follow-up interviews could investigate this further.

5) Drivers for Lower Tenure for Females: Why do many women leave their employers mid-career? While many would speculate that this is due to the stronger push for women to combine family and profession, only 20% of these women leave to take time out of the workforce. In fact, 49% of women who leave mid-career stay in the technology domain (22% self-employed and 10% at start ups). They may leave because females, compared to males, are less satisfied with the team spirit within their companies (Q20), are less optimistic around career opportunities (Q34), are generally dissatisfied when it comes to support and authority making decisions (Q18), and are negative towards recognition they receive (Q33). Being self-employed or working at a start-up could provide a more positive environment. Future research should further investigate the drivers for women leaving at mid-career.

6) Peer pressure: What type of peer pressure do women in software experience? Five percent of females in our study are very dissatisfied with the peer pressure they perceive in the team. Future work could investigate the "type" of peer pressure experienced. For example, peer pressure could be professional (e.g., pressure to contribute more) or personal (e.g., social pressure to "fit in").

D. Threats to Validity

Threats to *construct validity* are about the relationship between the theory and the observations and the appropriateness of the measures used in the study. Survey questions were based on issues relevant to team work and work satisfaction. Respondents might have interpreted questions differently than intended. This could have led to misleading findings. Although we reviewed and piloted the survey instrument to make sure that questions were clear and not confusing, it is possible that our selection of questions either excluded important topics or could have been misunderstood by respondents. However, we do not have evidence of these problems.

Threats to *internal validity* are about confounding factors that could have impacted our results and causal relationships and the appropriateness of the conclusions drawn from the study. It is possible that we were biased in the interpretation of the answers. We avoided this threat as much as possible by having several researchers evaluate the data (note that the author team included two females and two males). Also by giving options to respondents, we did not need to determine what respondents might have meant in their answer. A related issue is sampling bias. Perhaps one of the biggest problems with our survey is self-selection bias, i.e., females might have been more interested in participating in a study that tries to identify different perceptions based on gender. Also, respondents self-reported their perception. However, since software engineering activities depend on human activities, these perceptions matter. Finally, one could imagine that in a world in which people have negative feelings about gender diversity would be less likely to respond to such a study, thus skewing the results.

External validity is about the generalizability our findings. Our sample contained 124 respondents. Since we advertised the survey through mailing lists, etc. we cannot compute the response rate. However, we cannot claim that those who participated in the survey are representative of the entire software engineering industry. This is particularly true since respondents worked at international companies with a potentially large spectrum of national or cultural gender equality.

V. Conclusion

We compared the perceptions of female and male software developers on various aspects of performance, team dynamics and job satisfaction. The data reveals that while there is some difference, many factors do not differ significantly between females and males. We found differences in the following:

- Compared to females, males tend to hold more senior software engineering roles, are older and have longer tenure with their current organization.
- Compared to males, females are less satisfied with the spirit of team work in their company.
- Compared to males, females perceive themselves more favorably with a small statistical significance for overall productivity.
- Compared to males, females tend to be more satisfied with their personal sense of accomplishment.

The contribution of this paper is twofold. The first contribution is quantitative evidence for the differences and commonalities in the perception of female and male software professionals of performance, team dynamics and job satisfaction. As pointed

out earlier, very few studies have addressed this issue. We contribute an "internal" view that shows that there are many similarities between females and males. The second contribution is a discussion of the commonalities and differences in females and males and a set of implications of how software professionals perceive how they work with others for performance reviews, recognition and career progression, including a comparison with the current literature.

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