



Perceptions of contribution in software teams

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Abstract

In this paper, we report results of a survey of graduate students who worked in teams on software projects. The survey revealed that there is a statistically significant gap between how team members perceived their own contribution towards the goals of the project, and how that contribution was perceived by their teammates. The paper discusses this gap and its implication for the functioning of the teams. © 2000 Elsevier Science Inc. All rights reserved.

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1. Introduction

In this paper we look at the classroom software teams from the perspective of an individual member. Our aim is to determine how team members perceive their own contribution to the over-all effort, and how that contribution is viewed by other teammates. It is assumed that a perception gap may be a source of friction in the team, and may contain the seed for interpersonal problems. These interpersonal problems may, in turn, interfere with the objectives of the team.

We measured the perceptions in a survey of graduate students in the first graduate Software Engineering course. The course deals with the fundamentals of software engineering. A part of the course is a semester-long project. For the project, the class is divided into teams. All team members are assigned the same grade for the project, and team members select both the structure of the team and the internal division of the work within the team.

At the end of the semester, the team members received an anonymous questionnaire that asked them to rate their own contribution and the contribution of the others towards the project. The analysis of the results showed that most of the students considered their individual project contribution to be significantly higher than that of their colleagues, or to put it differently: they rated

themselves significantly higher than they were rated by their colleagues. This finding and the consequences are discussed in the conclusions of the paper. The data collected are described in Section 2, the results are described in Section 3, related work is summarized in Section 4, and conclusions and future work are in Section 5. Appendix A contains the questionnaire used in the survey.

2. The data collected

For the semester projects, the class was divided into several teams. Each team received a brief description of a program to be developed in C++. Team size varied from two to four members. The task for the team consisted of completing the requirements, developing a program using a specified methodology (Rajlich, 1994), and documenting the final program in a specified format (Rajlich and Varadarajan, 1999). There were two deliverables: A prototype of the project in the middle of the semester, and final project at the end. The size of the final code ranged between 500 and 2000 lines of code. Each member's role in the project was left to the decision of team members.

Respondents completed the survey before they received their project grade. The results of the survey did not affect the individual's grade in the project, and the responses were collected anonymously. Two different sets of data were collected in two different classes and semesters, the first one with 33 students and second one with 44 students.

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There were two different scales for assessing the contribution: One was assessing percentage of total effort by the individuals on the team, with the possible range of the answers from 0% to 100%. The expectation was that for each questionnaire, the total sum of the effort of all team members is 100%. The other question assessed the importance of the contribution. That is, it presented an individual grade for each team member on a scale from 1 to 5, with value “5” being the highest¹. The survey was easy to conduct, and can be easily replicated in other settings.

3. Results

In the evaluation of the results, we analyzed the difference between the way team members perceive themselves and the way they are perceived by other group members. Our null hypothesis was that there is no difference in the perception by themselves and by the others. An ANOVA (i.e., analysis of variance with repeated measures²) was used to evaluate both perceived effort and grade. The score for the other members on both effort and grade was the mean responses of all other members. All 77 out of 77 cases were accepted as correct data. Table 1 contains the summary of means for ratings of Self and Others.

Following the guidelines of American Psychological Association Manual, the results of the survey are summarized in the following way:³ A repeated measures analysis of variance (Tashman and Lamborn, 1979) found support for the hypothesis that team members ($M = 42.42\%$) perceive their contributions to the project to be greater than that of the typical other members ($M = 30.15\%$) of their team, $F(1, 76) = 18.84$, $p < 0.01$. Similarly, a second repeated measures analysis of variance found that team members ($M = 4.16$) reported that they should receive a higher grade than the typical other members ($M = 3.78$) of their team, $F(1, 76) = 8.26$, $p < 0.01$.

¹ Although the “grade” measure is a Likert scale, and therefore an ordinal variable, most researchers tend to treat Likert scales as continuous variables (Kerlinger, 1992).

² A repeated measures ANOVA is used when the same subjects are used in each level of the independent variable (Keppel, 1991).

³ M refers to group mean. Two numbers within parentheses (e.g., (1,76)), refer to degree of freedom and sample size, respectively. The degree of freedom, or the ability of scores to vary within a variable, is important in establishing significance values. The F score is the ratio of variance due to the independent variable (e.g., percent of effort) to the variance due to the extraneous error. Finally, the p score indicates significance of the degree of difference between oneself and the other members of the team in perceptions. A $p < 0.01$ means that the effect is very significant.

Table 1
Mean values from the survey

	Self	Others
Percentage of effort	42.42	30.15
Grade for effort	4.16	3.78

4. Related work

An interesting question is whether a similar gap in perceptions exists in other teams in other settings. In the literature it was reported that a team leader who provides incentives, gets members to see their contribution as indispensable, and makes sure that the cost of contributions does not exceed the benefits, significantly reduces loss of productivity in the team. That is, the team leader improves the morale of the team (Sheppard, 1995). In another study, specific task assignments were seen as a source of unfairness (Miles and Klein, 1998). These factors may be related to the perception gap we reported in this study.

The perception gap is closely related to self-serving biases that are pervasive in interpersonal situations, which are more likely to occur when the need to self-enhance is great (Campbell and Sedikides, 1999). Furthermore, the self-serving biases are more likely to occur when situations are ambiguous or uncertainty is high, as is often the case in software programming teams. The team’s goal is to implement a software project, and software is essentially invisible (Brooks, 1987). Because of the invisibility, many aspects of software are difficult to measure or assess, and the subjective evaluations can be widely different. Team members know the complexities and difficulties they themselves faced, while the difficulties of the others are not as obvious to them. According to Campbell and Sedikides (1999), self-serving bias is modified by a number of factors such as self-esteem, and the pervasive self-serving bias results from a variety of threats to one’s self-perception.

5. Conclusions and future work

The survey revealed that there is a statistically significant gap between the way team members perceived their own contribution towards the goals of the project, and the way their contribution was perceived by other group members. This difference in perception has a potential of creating tension within the team and disrupting the cooperation, because there is a possibility that every single team member may feel to be undervalued by others and not receive his or her due.

The perception gap can be a threat to the team and its goals. Facing the gap requires interpersonal skills on the part of the team management and team members. In the literature, it was documented that excellent software

professionals have high social skills (Sonntag, 1995), and we speculate that some of those skills may be used to bridge the perception gap. On the other hand, it was asserted (Demarco and Lister, 1987) that many project failures are caused not by the lack of technical capabilities, but by a failure of interpersonal skills in the team. We believe that team members and managers should be aware of the existence of the perception gap, and the awareness will help them to deal with one possible source of the team problems. If both the managers and team members deal competently with the gap, they will improve the interpersonal relationships in the teams, and they will help the teams to achieve their objectives.

Future studies may look at factors that have been found to moderate self-serving biases resulting from the need to self-enhance. Some of the factors include task importance, outcome expectancies, self-esteem, achievement motivation, task choice, self-focussed attention, perceived task difficulty, interpersonal orientation, status, emotion, locus of control, task type, and the role within the team (Campbell and Sedikides, 1999).

The industrial software teams differ in many aspects from the classroom teams we surveyed. Typically, they have a strong managerial structure, they work together for longer time, they are staffed with experienced professionals, and team members are evaluated individually by the managers. All these differences may influence the perception gap. Future studies should conduct surveys in industry, and find whether the gap can also be found there. However, we speculate that the more the industrial teams resemble our classroom teams, the more likely we are to find perception gap. We expect that the teams with a weak managerial structure, short history, lack of individual evaluation of the team members, or less professional maturity of the team members, will display a similar perception gap as we found.

Appendix A. The questionnaire of the survey

How many people participated in your project?

How many percent of the work was done by:

Yourself _____

Colleague #1 _____

Colleague #2 _____

Colleague #3 _____

Total 100%

How important is the contribution of individual team members?

Grade their work on scale 1–5, where 5 is the highest, 1 is the lowest:

Yourself _____

Colleague #1 _____

Colleague #2 _____

Colleague #3 _____

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