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Collective Identity in Software Development

A study on how software developers' collective self-esteem affects team effectiveness

Master's thesis in Software Engineering and Technology

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Abstract

Background Software development has progressed towards an agile approach over the last decade, which increases demand for delivering high-quality software with a short time to market. Such an environment requires good communication and teamwork within teams as well as with outside stakeholders in order to attain a state of high performance to be able to reach objectives. Therefore, social interaction is central for a software development team to be successful. Such social interactions form social identities and social structures in both teams and organizations.

Objective This thesis investigates possible effects that the collective self-esteem of individuals may have on the effectiveness of software development.

Method Interviews were conducted with seven individuals to gain insight and find factors that could be used to explain correlations and causalities between collective self-esteem and software development effectiveness. The qualitative data from interviews were analyzed and summarized using summative content analysis. Furthermore, the seven individuals answered a questionnaire multiple times throughout the timespan of one month. The questionnaire was based on previous research on the topic of collective self-esteem and served as a means to explain the qualitative data. The quantitative data gathered from the questionnaire was tested and analyzed with statistical tests.

Results An individual's collective self-esteem is affected by the context of their groups and perceived effectiveness also varies based on the group context. In this case, it was found that communication played an important role as a mediating effect between collective self-esteem and effectiveness. However, the quantitative results show that there were no direct correlations between the aspects of collective self-esteem and effectiveness.

Conclusions We show that many social interactions interplay and affect both individuals' collective self-esteem and group effectiveness. Specifically, communication stood out as a central factor in the qualitative data which we were not able to find in the quantitative data, as our methods focused on collective self-esteem and effectiveness. Communication should be broken down into several factors to explore the topic further as a mediating effect.

Keywords: software, engineering, software engineering, project, thesis, social identity, collective self-esteem, effectiveness, communication.

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Andreas Bäckevik, Gothenburg, May 2018
Erik Tholén, Gothenburg, May 2018

Contents

1
Introduction

In most fields, including Software Engineering, projects are commonly carried out in teams, mainly due to the belief that teams empower individuals to be more productive [11]. Cambridge Dictionary [5] defines a team as "a set of people who work towards a common goal". Furthermore, Cambridge Dictionary [6] defines a project as "a piece of planned work or an activity that is finished over a period of time and intended to achieve a particular purpose". Within Software Engineering, projects are commonly taken on with an agile approach, such as SCRUM [26].

Most agile approaches have originated from the agile manifesto. One value that is central in the agile manifesto [3] states "Individuals and interactions over processes and tools", which in combination with Cambridge dictionary's definition of a team, reinforces the importance of interaction within teams.

In an agile team, group maturity affects different aspects of team agility [15]. There are connections between maturity and agility within groups, where a mature group is also a more agile group. The agiler a group is, the greater the chances of it being a high performing group [15]. According to Wheelan [36], groups need on average six months to become high performing. Therefore, teams that dissolve before a six month period are likely not able to reach a state of high performance. Gren [14] suggests applying social identity theory to find more complex correlations between group maturity and group development in agile projects.

Three terms will be used throughout this thesis when discussing identity theory that are based on the terminology used by Cheek et al. [8]. The first term, personal identity, refers to how people view themselves as individuals, just as in European terminology [19]. The second term, social identity, refers to how people view themselves in relation to others, based on factors such as popularity or attractiveness. The third term, collective identity, refers to how people view the social groups to which they belong and one's self-concept with regards to e.g. gender, race, religion, nationality, ethnicity and socioeconomic class or feelings of belonging in such groups.

Collective identity theory describes how individuals relate to and reflect on social groups they belong to. For example, Tajfel and Turner [33] describe an extreme where interactions between multiple individuals can be solely based on social groups they belong to and not interpersonal relations. This is often prominent in team sports where players compete not necessarily because of interpersonal relations with their opponents but because they want their team to win. To be able to describe and

quantify an individual's collective identity within groups, Luhtanen and Crocker [19] created a scale to measure collective self-esteem which is divided into four aspects. By using this scale while also measuring group performance, potential relationships between one's collective self-esteem and group performance can be explored.

A group's performance can be defined very differently based on the context of its surroundings. For instance, a customer service company may define a team's performance based on customer ratings and not speed. Furthermore, many industries have adapted to Lean Management after its success at Toyota [34]. One of the core principles in Lean is to eliminate waste which means avoiding activities that do not deliver customer value [29]. In comparison with Cambridge Dictionary's [7] definition of effectiveness "the ability to be successful and produce the intended results", it is evident that there is an overlap between the two. Therefore, this thesis looks closer into the effectiveness of social groups within software development due to effectiveness being more tangible than group performance. With help of the Input-process-outcome framework, developed by McGrath and described by Mathieu et al. [20], we describe group effectiveness as estimated effort divided by spent effort.

1.1 Thesis Objective

The objective of this thesis was to investigate the potential impact of collective identity on effectiveness within teams in the field of software development. It aimed to explain how collective self-esteem affect software development effectiveness. Semi-structured interviews were held to explain individuals' collective self-esteem and group effectiveness. To explain the qualitative data, collective self-esteem was measured through a Collective Self Esteem Scale Questionnaire [19]. The questionnaire was extended to ask for the respondents' effectiveness to bundle it with their collective self-esteem measure. The structure of this thesis was based on the following research question:

How does collective self-esteem correlate to software development effectiveness?

1.2 Scope and Limitations

The software development groups within the organization under investigation were split into two subgroups: support and development. The purpose of a support group was for one software developer to aid with technical support to a non-developer project team. Support groups were often short-lived (a couple of hours up to one week) and could include technical tasks such as debugging or developing small applications with a very specific purpose. Development groups consisted of only software developers. The goal of development groups was to develop and deliver products. Several projects could be ongoing in parallel, which meant that software developers could be a part of several development groups at the same time. This thesis was limited to investigating these two types of groups. There was no consideration of

cultural differences based on different geographical locations, nor to any personal factors such as gender, race, religion, nationality, ethnicity and socioeconomic class.

1.3 Thesis Structure

The structure of the remaining chapters in this thesis is as follows: Section 2 contains background on theory in social psychology with focus on collective identity, as well as how to measure effectiveness in software development. Section 3 describes methodologies used to gather and analyze data. Section 4 describes results produced from the analysis of the qualitative data together with quantitative questionnaire data based on the four aspects of collective self-esteem. Section 5 presents conclusions based on the results in addition to thoughts on future work to extend the research of this thesis.

2
Background

This chapter presents research and background in social psychology and how the terms *personal identity*, *social identity*, *collective identity* and *collective self-esteem* are connected to each other. The chapter also describes ways of measuring effectiveness in groups and relevant research on highly effective groups in software engineering. This chapter also presents how collective self-esteem affects group effectiveness.

2.1 Personal Identity

According to Stets and Carter [31], the core of an identity is how one categorizes oneself into a specific role and how it is incorporated by the person. This includes meanings and expectations within that role, such as performance and behavior. For example, individuals who work in law enforcement, will likely categorize themselves into that specific role and expect certain behavior from themselves such as being helpful and just. An individual's expectations on a specific role form a standard that guides further behavior within and around all roles. Stets and Burke [30] explain interaction as an important component in roles, and much of the activity within a role from individuals revolve around these interactions. All of these interactions within and outside roles define our social structure. In short, an individual who strongly identifies with a specific role will try to fulfill expectations, manage interactions and control the environment that the role is responsible for.

Besides categorizing oneself into a specific role, negotiated roles are also evident in identity theory. A team captain in a sports team is an example of a negotiated role. Research has found that individuals with these types of roles become less satisfied when their social group could not verify their identity. As groups affect an individual's role and how they categorize themselves, there is a correlation between personal identity theory and collective identity theory [30].

Factors of why individuals commit to activating a specific identity have been widely discussed by researchers. Stryker and Serpe [32] split it up into two factors: the number of individuals that a person is tied to through an identity and strength in ties to others through an identity. The more an identity is embedded into individuals in a social structure, the more likely it is that the identity will be activated in specific situations. On the other hand, the stronger ties an individual has through an identity the more it leads to a more salient identity, which can become a characteristic of

the identity and not be based on the situation. In this way, one can differentiate the probability of an identity being used in a situation or if a salient identity is activated [30].

2.2 Social Identity

While personal identity theory focuses on specific roles and identities interaction in a social group, social identity instead focuses on social roles within social categories and social groups [33]. Hogg et al. [17] describe a social identity as ”a person's knowledge that he or she belongs to a social category or group”. Luhtanen and Crocker [19] exemplify this with the assessment ”how attractive one feels”, positioning oneself as a member of the group ”attractive people”, or ”non-attractive people”. Hogg et al. [17] also described a social group as ”a set of individuals who hold a common social identification or view themselves as members of the same social category”. People inside a specific social group are often referred to as in-groups, while people outside such groups are referred to as out-groups.

During formation of social identity, two important processes are involved [23]. These are the social comparison and self-categorization and they have different consequences on one's social identity. During self-categorization, an individual emphasizes perceived similarities with the in-group while also emphasizing perceived differences with the out-group. The accentuation regards to attitude, beliefs, behavior and other similar properties.

2.2.1 Collective Identity

According to Tajfel and Turner [33], collective identity is an individuals sense of who they are based on their group membership and a group is a collection of individuals who perceive themselves to be a part of the same social category. Tajfel and Turner [33] also state that social categories classify and orders the social environment in the social world.

Tajfel and Turner [33] also argue that an individual strives to have a positive collective identity by comparing with others in their social group or even outside. Evaluation of social groups is done by comparing them to other social groups with similar characteristics. However, when an individual is not satisfied with their collective identity, they tend to leave their existing social groups to find more positive ones. Therefore, not being able to leave a social group that gives one a negative collective identity, will likely lower ones collective self-esteem [33], [17].

2.2.1.1 Collective Self-Esteem

Luhtanen and Crocker [19] created a scale that describes and assesses parts of an individual's collective identity. It is categorized into four subscales: membership esteem, public collective self-esteem, private collective self-esteem and importance to identity. Membership esteem refers to how an individual sees oneself in a group.

This aspect assesses the most individualistic aspects of one's collective self-esteem (CSelfE) [19]. Public collective self-esteem refers to how the individual's group is evaluated by others, which assesses one's judgment of how other people evaluate the group. Private collective self-esteem refers to how an individual evaluates the group one belongs to, which assesses one's personal judgment of how good the group is. Importance to identity refers to how important group membership is to an individual.

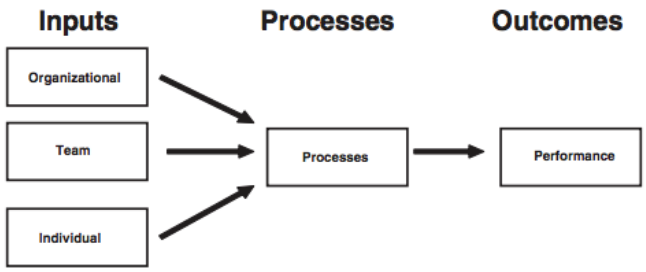
2.3 Group Effectiveness

Cambridge Dictionary [7] defines effectiveness as "the ability to be successful and produce the intended result". Such a definition of effectiveness makes it tangible while it still is used very diversely in different fields and is difficult to measure. For instance, intended results can be customer happiness in a restaurant, fulfilled requirement specifications in software engineering, speed in race car manufacturing.

The organization under investigation does send out a customer satisfaction survey for every completed project. This gives insight into what went well during a project and makes group effectiveness somewhat measurable. However, the response rate for the customer surveys are often low and done several months after project completion. Furthermore, it is only applicable to project groups that deliver to external stakeholders and not only internal stakeholders. Therefore, effectiveness would only be measurable for the development groups and not support groups.

Mathieu et al. [20] describe a team effectiveness framework called input-process-output (IPO), originally developed by McGrath [21]. The IPO framework has, since its creation in 1964, been developed further by various researchers to take further aspects into consideration. According to Mathieu et al. [20], the input is described as a combination of factors that enable and constraint a groups individual's interactions. These are categorized into three factors: organizational, team, and individual. These factors drive the team's process, which in turn transforms the input to output that is valued by stakeholders, as can be seen in Figure 2.1.

Figure 2.1: Input-Process-Outcome (IPO) Team Effectiveness Framework [20]



The groups under investigation in this study break down stakeholder requirements into tangible tasks along with an effort estimate in hours. Such an interaction between the group members can be seen as the input to their process, which would

allow this thesis to consider a tasks effort estimate as input in the IPO framework. Eventually, this task will be completed and given an actual effort in hours that it took to complete it. By fitting the processes of the previously mentioned groups into the IPO framework described by Mathieu et al. [20], effectiveness can be seen as input divided by output, specifically estimated effort divided by actual effort.

3
Methods

In this chapter, we describe the methods used to collect and analyze data that supports this thesis.

3.1 Qualitative Data

The main source of empirical data of this thesis is semi-structured interviews. A total of 7 interviews were conducted. An interview guide was constructed with the CSelfE scale [19] as a basis. The interview guide aimed to obtain information on how the interview participants related to the four aspects of collective self-esteem (*Private*, *Public*, *Membership*, *Importance*).

3.1.1 Interview Construction

We wanted the interview to be flexible and to find any possible explanation of the respondent's collective identity. Thus, we chose to have the interview as a semi-structured interview that further enables emerging of new concepts [13].

The interview guide was constructed and reviewed in iterations. A total of three test interviews were held with participants that did not have any relation with the organization under investigation for the study. For this reason, the specific teams and situations that referred to the organization were replaced with something more relevant for the participants. After reviewing the last test interview, the data was similar enough to the previous one that we felt ready to use the guide in a real scenario.

With the main goal of the interview being to understand the collective identity of the respondent, questions were constructed as very open questions with narrowing probes prepared. For example, we predicted that respondents would relate differently to the support groups than how they related to their usual development group collaboration instances. To collect data to support this prediction, we asked respondents about challenges that they faced in their daily work and if they did not mention the support groups, we would ask them if they saw those as a challenge. We used similar probing questions in many places to answer questions related to the collective identity, such as how the respondents thought that others within the organization viewed their teams.

As a means to make sure that the respondents were as comfortable as possible an introduction was added to the interview guide. The introduction states the purpose of the interview and expresses how the moderator has no personal interest in the discussions that would take place. By doing so we attempted to reduce a source of bias termed ”demand characteristics” where respondents try to give the answers that they think are looked for [24]. We also clarified the terminology to make sure that the respondent considered effectiveness and teams as closely as possible to how we defined it for the study. Lastly, the respondent was ensured that their identity would be confidential and asked for permission to be recorded.

To build an initial relationship with the respondent we also included a warm-up section that started with neutral questions. This proved to be more efficient as it got the respondents talking and by the time we arrived at the more personal questions, the respondents seemed more inclined to speak their minds.

The interview guide states the overall objectives of the interview as a reminder to the moderator what to look for. Each section in the interview also states a goal specific to that section. The test interviews were timed and this data is printed in the interview guide to give the moderator an idea of roughly how much time should be spent on each section in addition to how far into the interview they should have progressed after a certain amount of time. The final interview guide can be found in Appendix A.1.

3.1.2 Interview Conduction

The office of the organization under investigation had a room designed for conducting interviews as one of the many things that the organization does is qualitative research, which we used. The room was equipped with microphones that would capture and output sound into a room right next to it that was separated by a one-way mirror. In addition, each interview was recorded using our own mobile phone device.

We decided to not take turns moderating the interviews for three reasons. Firstly, one of us had a previous relationship with some of the respondents which we wanted to prevent from affecting the interview. Secondly, the one of us that was assigned moderator expressed a higher level of neutrality when asking questions and more often refrained from positively or negatively reinforcing responses with words like "good". According to Potts [24], this is one of the most important things to avoid in order to reduce bias during interviews. Lastly, we chose to let the same individual be the moderator for all interviews for consistency reasons. We believed that this would allow for continuous improvement and yield more consistent results than if we would have been taking turns in moderating the interviews.

The individual who was not appointed as the moderator instead observed the interviews from behind the one-way mirror, providing the moderator with post-session insights and potential probes at the end of each session. We were unable to make use of the interview room and the one-way mirror for four of the seven sessions due

to last-minute rearrangements. Two rooms were used for these four sessions. These rooms did not allow for any observations due to them being much smaller than the interview room.

3.2 Quantitative Data

While the thesis was mainly focused on qualitative data, we considered quantitative data to be of value as it would be able to support our findings and conclusions drawn from the qualitative data. The quantitative data also helped in developing a common vocabulary and communicate our goals to participants in the study.

3.2.1 Collective Self-Esteem Questionnaire

As stated in Section 1, the scale used to measure collective self-esteem was constructed by Luhtanen and Crocker [19] and assesses four aspects of collective self-esteem:

- *Private collective self-esteem*
- *Membership esteem*
- *Public collective self-esteem*
- *Importance to identity*

Each aspect is assessed by four items, resulting in a total of 16 items in the scale. The responses to these were made on a 7-point Likert-type scale that is preceded by the following instructional text:

> ”We are all members of different social groups or social categories. Some of such social groups or categories pertain to *gender, race, religion, nationality, ethnicity* and *socioeconomic class*. We would like you to consider your memberships in those particular groups or categories, and respond to the following statements on the basis of how you feel about those groups and your memberships in them. There are no right or wrong answers to any of these statements; we are interested in your honest reactions and opinions. Please read each statement carefully, and respond by using the following scale:”

For the purpose of this study, we modified the original instructions to instruct the respondent to consider different groups that better represent the software development teams present within the organization under investigation. We constructed two versions of these instructions, one for supportive and one for non-supportive projects. The creators of the scale, Luhtanen and Crocker [19], have validated the scale and questions that belong to the CSelfE questionnaire. Therefore, we did not have to validate each question, but only to adapt the context of each question to fit the narrative of this study. The complete questionnaires used in the study is found in Appendix A.2.1 and Appendix A.2.2 respectively.

3.2.2 Team Effectiveness

We calculated team effectiveness as

$$Effectiveness = \frac{Planned}{Earned}$$

where *Planned* refers to the estimated effort that would be spent and *Earned* refers to the amount of effort spent during a collaboration instance. These values were readily available to the participants due to the nature of how they planned and managed their software development tasks.

We chose not to include any preconceived unit for these values, as they could represent whatever the team deemed fitting for their way of working. For non-supportive collaborations, these are likely to be story points or other subjective estimates [35] while for supportive collaborations we would expect actual hours due to the ad hoc nature of these collaborations within the organization.

As we are interested in the ratio of the estimated and spent effort we disregarded the unit and any implications it would have on the project. Thus, we allowed the participants to interpret the question freely and put whatever unit if any, that they preferred.

By assigning *Planned* as the numerator and *Earned* as the denominator, we interpreted any effectiveness values < 1 as less effective in that more effort than what was estimated was spent and vice versa for values ≥ 1.

3.2.3 Data Modeling

We model our quantitative data as tuples of a score on the CSelfE scale [19] and a value for team effectiveness. These tuples are considered as a cross-sectional measurement. Based on the Cambridge Dictionary's [6] definition of a project, stated in Section 1, a project has a starting and ending point. However, the tuple will be representative of the entire duration of the project. Such a time span is referred to as a collaboration instance. The notations are explained as follows:

- *CSelfE* is a function that takes a software development resource and returns a value from the CSelfE questionnaire [19].

- *Eff* is a function that takes a collaboration instance and returns a value that represents the effectiveness of that collaboration.
- d_i refers to a software development resource, a software developer, that took part in the collaboration instance p_j.
- p_j refers to a collaboration instance, a software related project.

The output of the *CSelfE* function is, in fact, a quadruple consisting of a numerical value for each of the four aspects of collective self-esteem as described by Crocker and Luhtanen [19]. They strongly recommend against creating an overall or composite score for collective self-esteem as the subscales measure distinct constructs and for this reason we keep them separated.

3.3 Data Collection

An online survey was constructed and published using Lighthouse Studio [18]. Links to this survey were then sent out to the subjects to allow them to participate. To ensure the involved subjects that the data collected about them could not be used adversely against them [1], each subject was assigned a randomized nickname that was unknown to us. Subjects were then asked to provide this nickname in the survey so that we would later be able to group the data points to a subject without disclosing their identity. The survey consisted of a series of questions where we would receive the following data for each response:

- Respondent nickname
- Collaboration instance type (support group or development group)
- CSelfE questionnaire answers
- Planned effort for the collaboration instance
- Spent effort for the collaboration instance

A total of seven participants took part in the study. All participants are software developers at the same company. However, one participant is a lead developer and has management responsibilities. Four of the participants has worked less than a year at the company, while the other three has worked at the company for two to four years.

At the end of each collaboration instance, we asked the participants to take the survey. Weekly reminders were also sent out in an attempt to prevent omitted responses. Individuals were reminded daily regarding the supportive questionnaire, while they were reminded weekly regarding the non-supportive questionnaire.

The organization had a weekly rotation on who would take on the supportive projects. To prevent us from gaining knowledge of what individual had submitted a specific answer we collected data during a five-week period without looking at any answers to allow for as many individuals as possible to submit answers where the collaboration instance would be of the supportive type.

The final data output from Lighthouse Studio [18] contained excess information not relevant to the study, such as time stamps and web browser. This information could potentially be used to draw conclusions about a respondents identity. To counter

this, we inserted the data into an application written by us, that would filter out any unwanted columns, leaving only the information mentioned above.

3.4 Ethical Consideration

Before and during the process of data collection, every participant of the study was informed and reassured about the importance of ethics in the study. Information about how and why the thesis would be executed had been communicated throughout the study. Participants were able to question and discuss conditions of the data collection to make sure the collection was done in a manner where they felt safe to collaborate. By making sure that the results would be used for their own benefits, trust and engagement could be built [27].

3.5 Data Analysis

This chapter covers methods on how we analyzed the collected data. Qualitative data acted as the main item of the analysis, while the quantitative existed to support the existing results and conclusions.

3.5.1 Qualitative Data

The interview recordings were transcribed separately and then merged into one for each interview. The reason for this was to even out potential differences in how we would interpret the recordings. The transcriptions were done over a one-week period with roughly one interview being transcribed per day.

3.5.1.1 Summative Content Analysis

According to Hsieh and Shannon [16], keywords in a summative content analysis are derived from interests of the researchers while other approaches to content analysis are derived from the data or theory. As our interest was to understand the collective identity of respondents, we used a summative approach to qualitative content analysis.

We analyzed the final transcripts together, looking for anything that could be tied to any of the four aspects of CSelfE in addition to team effectiveness. Any statement that was deemed to belong to any of the aspects was then labeled with a keyword in consensus where we would discuss what keyword that statement expressed or represented. This yielded an aggregate of grouped keywords that appear several times within one or many aspects which could be handled as quantitative data. This is visualized in Table 3.1.

Table 3.1: Example of how keywords were grouped

Private	Membership	Public	Importance	Effectiveness
A	A	A	A	B
A	C	D	E	
		...		

To further understand the contexts where the derived keywords emerged, we summarized interview answers to the generic questions with the keywords as a criterion for whether or not to include parts of the answer. Content labeled with a keyword would be included in the summary while content from which no keywords were derived would not. This was used to gain further insight into the collective identity of respondents on a general level.

3.5.2 Quantitative Data

The final score of an aspect is the average of its specific four questions:

$$AspectScore = \frac{QuestionA + QuestionB + QuestionC + QuestionD}{4}$$

The questions relate to the aspects of CSelfE as follows:

- Questions one, five, nine and 13 relate to Membership self-esteem
- Questions two, six, ten and 14 relate to Private collective self-esteem
- Questions three, seven, eleven and 15 relate to Public collective self-esteem
- Questions four, eight, twelve and 16 relate to Importance to identity.

Some questions are asked in a negative context of the aspect in consideration:

"I often regret that I belong to some of the social groups I do."

Therefore, as stated by Luhtanen and Crocker [19], these questions should have their score reversed, meaning an answer of seven is regarded as one when calculating the score. The answers to question two, four, five, seven, ten, twelve, 13 and 15 were reverse-scored.

4
Results

In this chapter, the interview responses are presented together with quantitative data with regards to the research question of the thesis. We break down the research question to look into how the relevant aspects of CSelfE correlate to software development effectiveness and present the results to answer the research question.

In addition, communication was found as a potential mediating effect on effectiveness and the aspects of CSelfE. All seven respondents believed that most of the problems that exists within their groups originate from lacking communication. They also mentioned that their development group effectiveness was average due to constant misunderstandings with non-developers.

4.1 Collective Self-Esteem

The interview was constructed with each aspect of CSelfE in mind. Below follows a summary of the responses for the *Private*, *Public*, *Membership* and *Importance* aspect.

4.1.1 Private

How does the Private aspect associate to software development effectiveness?

In general, the seven respondents evaluated their established group of fellow software developers positively, as 75% of the identified keywords were positive. The four keywords: expertise, team spirit and communication made up for 30%, 28% and 24% of the identified positive keywords respectively (see Figure 4.1[1]). When asked to describe how their teams progressed towards their goals, one respondent positively expressed the following about a development group collaboration instance which summarizes the respondents' opinions:

> "We talk things through and estimate together to visualize a common goal. We combine different competencies and experiences to find the best way of doing things, which is due to prestigeless communication. You can speak freely."

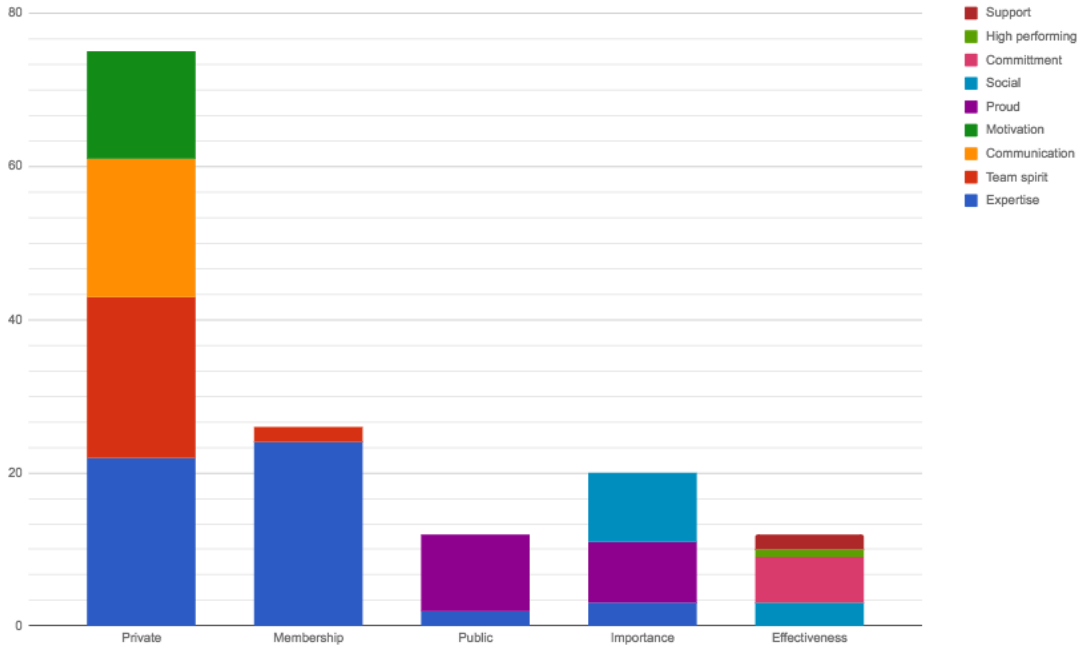
All seven respondents considered the different personalities within their develop-

[1]Data available at: `http://bit.ly/2IBWAPd`

ment group collaboration instances to work well together in and that this enabled good communication within the team. The respondents would also state that the environment within the team was relaxed.

During the assessment of their support groups, communication was mentioned by four respondents as a negative factor. A lack of understanding and differences in technical competence often caused agitation and stress. When asked about the biggest challenge of working as a software developer within the company, six out of seven respondents mentioned meeting deadlines, planning and communicating with managers. Difficulties in communication with individuals outside of their teams or with less experience in software development was also a recurring topic.

Figure 4.1: Positive Keyword distribution



4.1.2 Public

How does the Public aspect associate to software development effectiveness?

When assessing how the respondents think others evaluate their groups, all seven respondents felt proud of their combined expertise and thought that their competence was recognized by others. All twelve identified positive keywords found regarding public evaluation were either *pride* or *expertise*. However, a total of 24 negative keywords were grouped under *Public*, rendering a majority of the keywords found for *Public* as negative. The respondents thought that others viewed them as arrogant, unproductive or not committed. Most respondents mention lack of commitment, friction and lack of understanding as a result of the negative view of their teams. One respondent said the following:

"As developers, we are guests in the environment of the analysts."

This statement summarizes what is described by the respondents on how it is to be software developers within the organization. There is a clear gap between software developers and non-software developers, where communication and understanding are lacking in collaboration instances where non-software developers take part. Even so, previous accomplishments made by the software developer teams were assumed by respondents to contribute to a more positive public image.

4.1.3 Membership

How does the Membership aspect associate to software development effectiveness?

Throughout the interviews, all seven respondents mentioned that they contribute with technical expertise to all of their collaboration instances they are a part of. However, no respondent mentioned their own technical expertise as a factor to group effectiveness and only two respondents mentioned their own expertise more than once. In general, the respondents were content with their group memberships but did not focus on it in any question.

As the respondents had a clear view of their *Membership* but did not express any specific feelings regarding it, we could not find any association to either effectiveness or any other keywords mentioned throughout the interviews.

4.1.4 Importance

How does the Importance aspect associate to software development effectiveness?

The two positive keywords identified were *socializing* and *pride* (see Figure 4.1) both occurring equally many times. Four out of seven respondents considered the social aspect of group belonging important. The respondents spoke about their development groups when discussing the importance and not their support groups. The importance of one's self-concept of belonging to teams was stronger for the established teams and weaker when dealing with support group collaboration instances.

All seven respondents were proud of their development groups. The culture of these development groups and their accomplishments were a few things that made respondents feel pride towards them. It was also brought up that if others, outside of the teams, would recognize their accomplishments they would feel even more proud.

The respondents engaged more in discussions regarding their development groups. According to Bakker and Demerouti [2], work engagement is created by autonomy and social support, which in turn fulfills the need to belong. Therefore, we believe that their need to belong is greater in support groups than in support groups or that the development groups better satisfy that need. We conclude that the respondents

consider their development groups as more important to their identity.

4.2 Software Development Effectiveness

What elements of software development effectiveness are affected by collective self-esteem?

A few areas of improvement were brought to light from the interviews. The requirements for projects are often too few, too vague and they should be more detailed and clear to everyone involved in the project. The respondents thought that this could be resolved by additional communication with stakeholders in order to resolve any uncertainties.

DeFranco and Laplante [12] concludes that project failure can be caused by elements such as lack of clear vision, unambiguous stakeholder requirements, and realistic expectations. This means that with a clear vision, ambiguous requirements from stakeholders and proper management of expectations a project is more likely to be executed successfully. In addition, Dutra et al. [28] stated that good communication is the most common characteristic for describing high performing teams. In some of the projects under investigation, the respondents were satisfied with groups where effective communication was present within the group and these groups are most likely the ones they considered when they expressed feelings of pride due to previous accomplishments.

In general, when evaluating effectiveness, respondents differentiated support groups from their development groups. They believed that projects executed within their development groups are less effective than the support groups, mainly due to the fact that projects taken on by development groups require more complex engagement and communication with stakeholders. Stakeholders were considered to be reactive rather than proactive which led to the end goals changing. The development groups would try to work around this by communicating with the team and sort out any internal uncertainties and in the end work towards the same goal with best possible effort.

Five respondents considered themselves to excel in the problem-solving aspects of working in short-term support groups. The problems to be solved in these projects were however often not stimulating to the respondents.

When the respondents were asked if they considered their teams to be high performing, they focused on development groups. Six out of seven assessed that they are performing average or slightly above average. The respondents also mentioned that work in support groups is very effective. This was due to work in support groups being transactional and easy to plan. Thus, we conclude that development groups are less effective than support groups.

4.3 Analysis of Quantitative Data

Quantitative data was gathered from the seven respondents, who also took part in the interviews, where each respondent was asked to participate in the survey at least once a week[2]. As we collected data for one month, this would yield 28 responses at best. With a response rate of 53% a total of 15 survey responses were gathered. Before making any statistical analysis, the gathered data was tested for normality for each of the aspects measured in addition to *Effectiveness*. Because of findings from the interviews we decided to look at the different types of collaboration instances, grouping data into development groups ($N = 5$) and support groups ($N = 10$). The normality testing was done using Shapiro-Wilk tests at an alpha level of 0.05. A Shapiro-Wilk test was done due to having the highest statistical power when comparing to similar tests, such as a Kolmogorov-Smirnov test [22]. A Shapiro-Wilk test is also preferable when $N < 50$ [25]. The results are presented in Table 4.1 and Table 4.2 for support and for development groups respectively.

Table 4.1: Shapiro-Wilk test for support groups

	Outcome
Private	Not normally distributed
Membership	Not normally distributed
Public	**Normally distributed**
Importance	**Normally distributed**
Effectiveness	**Normally distributed**

Table 4.2: Shapiro-Wilk test for development groups

	Outcome
Private	**Normally distributed**
Membership	**Normally distributed**
Public	Not normally distributed
Importance	**Normally distributed**
Effectiveness	Not normally distributed

We investigated a potential correlation between each not normally distributed CSelfE aspect and *Effectiveness* through Spearman's Rho tests at an alpha level of 0.05. Spearman's Rho was used due to having higher statistical power with non-normally distributed data than a Pearson correlation test [4]. None of these tests showed any statistically significant correlation, as can be seen in Table 4.3 and Table 4.4.

Table 4.3: Spearman's Rho correlation tests with *Effectiveness* in support groups

	r	p
Private	-0.18926	0.76048
Membership	0.18634	0.76413

[2]Data available at: `http://bit.ly/2wZccuD`

Table 4.4: Spearman's Rho correlation tests with *Effectiveness* in development groups

	r	p
Public	0.20702	0.56606

Pearson's correlation coefficient has higher statistical power than Spearman's correlation coefficient but are more sensitive towards outliers, kurtosis and skewness [9]. Therefore, Pearson correlation tests are only calculated for normal distributed data. Specifically between CSelfE aspects and *Effectiveness* in the context of support groups (see Table 4.5). Results from these tests also showed that no correlation was statistically significant.

Table 4.5: Pearson Correlation test with *Effectiveness* for support groups

	r	p
Public	-0.3251	0.593602
Importance	-0.7596	0.136773

In comparison with Cohen's [10] thresholds for effect sizes, the only correlation which is regarded as large ($>\pm 0.5$) is between *Importance* and *Effectiveness* (see Table 4.5). However, as no correlation is statistically significant, all quantitative results are disregarded.

5
Discussion

This chapter presents a conclusion on relevant results based on the aspects of collective self-esteem from a perspective of this thesis' research question. The aspects *Private*, *Public* and *Importance* are discussed as results regarding them were relevant to our research question. We also discuss communication as a potential mediating effect on CSelfE aspects and *Effectiveness*.

5.1 Private

As concluded in Chapter 4, the software developers within the organization chose to focus on their most established groups (development groups) which consists of only software developers. They evaluated their development groups positively, motivated by the fact that these groups are often made up by other software developers. However, such collaboration instances often contain interactions between software developers and stakeholders. As stated earlier in the thesis, Cambridge Dictionary defines a group as "a set of people who work towards a common goal" which would include both developers and stakeholders in one group. No respondent seemed to identify stakeholders as members of their social groups when evaluating their development groups. There is a clear social structure that posits developers and non-developers as strong social groups within the company, which strengthens the respondents social categorization. The software developers' categorization of themselves, non-developers and stakeholders likely has an effect on the end result as communicative issues might arise between the groups. We were unable to find any correlation between effectiveness and the private aspect of CSelfE in either the qualitative data or the quantitative data.

It is however evident that the software developers scored higher on the *Private* aspect and had a more positive view of their development groups than their support groups. Based on the interviews, we believe that the reason for this is the fact that software developers are able to strengthen the positive image of their group when surrounded by others like themselves. Their expertise is recognized and valued higher as understanding is higher among fellow software developers than among less technical individuals, which is the case in support groups. The fact that the support groups are not as positively evaluated as the development groups groups could be a result of a favorable comparison where software developers try to strengthen the positive image that they have of their development groups. It is possible that this comparison is done on a level where the software developers justify their social group

"software developers" and not the group within the organization - the development team - as they effectively compare software developers to non-software developers.

5.2 Public

Each software developer considered all other software developers in their groups to have technical expertise, which enabled them to feel proud that they are viewed as skilled by out-groups. However, Chapter 4 also concludes that there is agitation towards the software developers, in which non-developers occasionally think of software developers as arrogant.

According to the software developers, the negative image is created by miscommunication and lack of understanding which could be the result of the strong social categorization mentioned earlier. One software developer mentioned that task estimates are done in precaution to safeguard from promising too much. This is likely an effect of bad communication, previous misunderstandings and negatively impacts projects which are often planned with respect to estimates. If these estimates are not true or intentionally set higher, overall effectiveness suffers. It is possible that this effect is present in our data, which would render how *Effectiveness* is measured in this thesis as a poor reflection of the true effectiveness. A possible cause of this effect could be the preservation of a positive collective identity, a measure not far from the predictions made by Luhtanen and Crocker [19] where high collective self-esteem individuals were predicted to engage in competition with out-groups in the face of collective threats.

From this, we conclude that a correlation between *Public* and *Effectiveness* may be present in that possible actions taken to counter a negative *Public* assessment could influence estimates and possibly other elements of software development. Estimation is related to planning and in our thesis, the planned effectiveness does not fully capture effects on all elements of software development, such as requirements and communication. Therefore, one should look further into measurements of *Effectiveness* to confirm or reject a potential correlation with *Public*.

5.3 Importance

No software developers considered temporary support groups as important to themselves. One software developer mentioned that the temporary support groups were more effective because it was very transactional and required little communication and interaction compared to the established groups. We believe that the software developers distance themselves from non-developer groups, due to previous misunderstandings and miscommunication, to be able to focus on problem-solving. Therefore, software developers assessed support groups as more effective than their development groups. Thus, we believe that *Importance* is connected to *Effectiveness*, but with communication as an important determinant. However, we were unable find any correlation between *Importance* and planned *Effectiveness* in the quantitative

data.

5.4 Mediating Effect

The qualitative data shun light on a previously discussed element of software development: communication. The agile manifesto [3] states ”Individuals and interactions over processes and tools” which posits communication as a key factor in modern software development in interaction with both in-groups and out-groups. In the context of software development and this thesis, out-group interaction commonly means that technical individuals interact with less technical individuals. We found that when this occurs and a common language is not present, the *Public* aspect of CSelfE is negatively impacted. Furthermore, due to misunderstandings, project participants have different views on what the goals of a project are which further contributes to arguments, agitation, and displeasure.

As all respondents mentioned communication in the context of *Private* and/or *Public*, we believe that the level and quality of communication affects the individual's collective self-esteem. In addition, the respondents also mentioned communication as a factor of group *Effectiveness*, which aligns with the previously mentioned research on project success and effectiveness. Therefore, we believe that communication has a mediating effect on effectiveness and collective self-esteem.

6
Conclusion

This chapter concludes the results in comparison with the research question of this thesis. It also presents what could have improved results and how to extend the findings of this thesis.

6.1 Research Question

How does collective self-esteem correlate to software development effectiveness?

We are confident that there is some interplay between *Private* and *Public* collective self-esteem in addition to *Importance* to one's personal identity. Individuals seem to protect and defend their groups from a negative public view to differing extents, affected by a combination of their private evaluation of the groups and how important they are to them. If their *Private* collective self-esteem is low within a certain group, it is likely that they do not consider it to be of high *Importance* to their identity and the magnitude of these measures is lower as they are able to handle a negative public view without as much impact on their social identity. If it is not important to them they do not value what others think about it. Unfortunately, this has an effect on the quality of communication which in turn feeds back into the cycle and the software development is less effective as a result of this. Therefore, we believe that communication is a mediating effect between CSelfE and effectiveness.

6.2 Sample Size

As the quantitative data was not statistically significant, it could not be used to strengthen the thesis' qualitative findings. We found a large negative correlation coefficient between *Importance* and *Effectiveness* for support groups collaboration instances (-0.7596), but it was not statistically significant. As the p-value of that correlation was 0.1367, a slightly larger sample could have had an impact on the significance and the thesis results. While this would contradict the reasoning in Section 5.2 regarding developers distancing themselves from support groups and thus making them more effective, the quantitative measurement of *Effectiveness* only takes planned and spent effort into account and does not consider elements like communication, which was found to play a big part in the outcome of the projects through the qualitative data.

A larger sample could also have revealed normally distributed data regarding *Effectiveness* which would have made it possible to execute a t-test on each aspect of CSelfE and *Effectiveness*.

6.3 Threats to Validity

Talking about one's collective self-esteem can be sensitive and touch upon matters that one is not comfortable talking about. Therefore, as we were working in the same organization as the respondents, their answers may be biased or not complete. As the interviews could not be anonymized to us, we explained that we were conducting research as students and not fellow employees. However, there is no way to reassure that every respondent answered truthfully, which could threaten the validity of our data.

The interview introduction was added to the interview guide to reduce chances of respondents not being comfortable enough to answer truthfully. In it, we stated why we where conducting the interview and presented the purpose of it. To reduce misunderstandings when discussing effectiveness and teams, we also clarified what we meant with that in the interview introduction. As a final measure to increase the comfortability of the respondents, their confidentiality was reassured and they were asked for permission to record the interview.

One of us had previously worked with some of the respondents and to prevent this from affecting the interviews we decided to not let that individual moderate the interviews. In addition, the appointed moderator was deemed better at conducting neutral interviews without influencing the respondents. Finally, this allowed for more consistent results than if we would have taken turns in moderating the interviews.

Anonymity in the quantitative data was ensured by assigning each respondent a randomized nickname that was unknown to us, in addition to collecting the data through an online survey. The gathered data was passed through a script that would omit any information that could be used to deduce the identity of the respondent such as time of taking the survey, location of the respondent or what operating system was used.

As no good measures were available to measure effectiveness, we used effort estimation to quantitatively measure effectiveness. However, effort estimation is in fact a better predictor of *Efficiency* (doing something well) rather than *Effectiveness* (doing the right thing). It is possible that our measures of effectiveness are incorrect and do not represent the reality. The interviews captured perceived effectiveness of the respondents, which could have been used in the questionnaire as well instead of the planned over earned amount of work.

6.4 Future Work

The study could be reproduced with a larger and more diverse sample in order to verify our findings and conclusions. In a more diverse sample, with software developers across multiple organizations, company culture effects could be identified. As this thesis only surveyed software developers within one organization, it could be that such effects affect the results. Furthermore, a larger sample would allow for a more robust quantitative analysis where we, on the contrary, had a total of 15 data points which we considered as low.

We propose that researchers look into the possible interplay between how individuals evaluate their groups, how non-group members see those groups and how important the groups are to the individuals. We modeled effectiveness in a way that did not directly capture elements of software development such as communication or clarity of requirements. If these elements were modeled, captured and measured in a future study, further insight into how collective self-esteem correlates to software development effectiveness could be gained.

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A

Appendix 1

A.1 Interview Guide

Interview Guidelines

Andreas Bäckevik, Erik Tholén

Objectives

- Find challenges of working as a developer at SKIM
- Deeper knowledge of eventual shortcomings in project execution
- Understand respondents relation to their teams

1 Introduction 3 min 00:00

1. Thank you for taking your time today. I'm here as a student, and not as an employee of SKIM.
2. In general, the purpose of this discussion is to gain a better understanding of how collective identity could impact software development effectiveness.
3. In our study, we measure effectiveness as planned versus spent time on a task. So that is what we refer to when talking about effectiveness.
4. We will also be discussing the term teamåhich refers to a set of people working towards a common goal. The teams we refer to are your teams at SKIM. This includes:
   - Your development teams
   - The teams you belong to when you do support together with the analyst project teams
5. Your identity will be completely confidential; your responses will be combined with other developers and anonymized, so you won't be identified in our report; If you do not feel comfortable answering, just tell me and we will discuss how we can improve.
6. With your permission, I'll record the conversation for use in the analysis. And Erik will be listening in on this interview.
7. We're scheduled to talk for about one hour; does that still work with your schedule?
8. Do you have any questions before we start?

2 SKIM Background 5 min 00:03

GOAL: Warm-up respondent and capture what they find most challenging

1. What do you do at SKIM?
2. In your view, what is the greatest challenge of working as a developer at SKIM?
   - PROBE: Is handling support errands a challenge?

If giving support is mentioned as a challenge, we will mainly refer to that as the team in question.

3 Projects 5 min 00:08

GOAL: Understand software project execution and their effectiveness

1. Could you describe how projects are executed at SKIM, seen from a developer perspective?
   - PROBE: Do you see any areas of improvement? Which?
     - PROBE: How could this/these change(s) affect project effectiveness, according to you?
2. Could you describe one thing that SKIM does well, in terms of software project execution?

4 Results 5 min 00:13

GOAL: Understand how the result is viewed and prioritized within the team

1. Can you describe how your teams progress towards their end goals?
   - PROBE: Are the end goals clear to you?
     - How?
   - PROBE: For each of your team, are the members working towards the same goal?
     - How?

5 Team difference 5 min 00:18

GOAL: Understand how they view their teams in relation to other teams at SKIM

1. How does your software development teams compare to other software development teams?
   - What are the similarities and what are the differences?
   - PROBE: How do your internal software development teams compare to the teams you belong to when giving support?

  - What are the similarities and what are the differences?
- PROBE: How do you think that others within your company view the teams that you belong to?

6 Team existence 8 min 00:23

GOAL: Understand connection to team and if they relate to it

1. What's your experience of belonging to teams at SKIM?
   - How do you feel about the different tasks that you execute within your teams?
     - PROBE: How do you feel about handling support errands?
2. PROBE: Do you feel proud of being a part of the teams you belong to?
   - Why?

7 Team performance 5 min 00:31

GOAL: Capture their view on performance and their personal contribution

1. How do you think that the teams you are part of perform in comparison to other teams with similar goals?
   - How? Why? Examples?
   - PROBE: Would you say that your team is high performing?
     - How?
     - Do you have any examples of when your teams have performed well?

8 Reflection 5 min 00:36

GOAL: Understand if teams have any effect on their private life

1. How does your team affect your work-life balance?
   - PROBE: Does you team shape you as a person?
     - Why?
     - How?
     - Examples?

9 Outroduction 2 min 00:41

1. We have reached the end of the discussion.
   - Are there any points left that you want to discuss?
   - Would you like to add something?
2. Thank you for your contribution and your time! It was very helpful and will help us a lot in our master thesis. If anything comes up that you would like to discuss, please contact any of us!

A.2 Questionnaires

A.2.1 Software Support

CSE Scale Support

INSTRUCTIONS: You belong to different social groups within or outside of your workplace. One social group you belong to at the workplace is/are the team(s) you are in. We would like you to consider your supporting role in your most recent team(s) in your workplace, and respond to the following statements on the basis of how you feel about those teams and your memberships in them. Some such teams can be analyst teams or development teams. There are no right or wrong answers to any of these statements; we are interested in your honest reactions and opinions. Please read each statement carefully, and respond by using the follow scale from 1 to 7:

		Strongly Disagree	Disagree	Disagree Somewhat	Neutral	Agree Somewhat	Agree	Strongly Agree
1.	I am a worthy member of the team I belong to.	1	2	3	4	5	6	7
2.	I often regret that I belong to some of the teams I belong to.	1	2	3	4	5	6	7
3.	Overall, my team is considered good by others.	1	2	3	4	5	6	7
4.	Overall, my team membership has very little to do with how I feel about myself.	1	2	3	4	5	6	7
5.	I feel I don't have much to offer to the team I belong to.	1	2	3	4	5	6	7
6.	In general, I'm glad to be a member of the team I belong to.	1	2	3	4	5	6	7
7.	Most people consider my team, on average, to be more ineffective than other teams.	1	2	3	4	5	6	7
8.	The teams I belong to are an important reflection of who I am.	1	2	3	4	5	6	7
9.	I am a cooperative participant in the team I belong to.	1	2	3	4	5	6	7
10.	Overall, I often feel that the team of which I am a member is not worthwhile.	1	2	3	4	5	6	7
11.	In general, others respect the team that I am a member of.	1	2	3	4	5	6	7
12.	The team I belong to is unimportant to my sense of what kind of a person I am.	1	2	3	4	5	6	7
13.	I often feel I'm a useless member of my team.	1	2	3	4	5	6	7
14.	I feel good about the team I belong to.	1	2	3	4	5	6	7
15.	In general, others think that the teams I am a member of are unworthy.	1	2	3	4	5	6	7
16.	In general, belonging to teams is an important part of my self image.	1	2	3	4	5	6	7

1

A.2.2 Software Development

CSE Scale Software Development

INSTRUCTIONS: You belong to different social groups within or outside of your workplace. One social group you belong to at the workplace is/are the team(s) you are in. We would like you to consider your memberships in your current software project team(s) in your workplace, and respond to the following statements on the basis of how you feel about those teams and your memberships in them. There are no right or wrong answers to any of these statements; we are interested in your honest reactions and opinions. Please read each statement carefully, and respond by using the follow scale from 1 to 7:

		Strongly Disagree	Disagree	Disagree Somewhat	Neutral	Agree Somewhat	Agree	Strongly Agree
1.	I am a worthy member of the team I belong to.	1	2	3	4	5	6	7
2.	I often regret that I belong to some of the teams I belong to.	1	2	3	4	5	6	7
3.	Overall, my team is considered good by others.	1	2	3	4	5	6	7
4.	Overall, my team membership has very little to do with how I feel about myself.	1	2	3	4	5	6	7
5.	I feel I don't have much to offer to the team I belong to.	1	2	3	4	5	6	7
6.	In general, I'm glad to be a member of the team I belong to.	1	2	3	4	5	6	7
7.	Most people consider my team, on average, to be more ineffective than other teams.	1	2	3	4	5	6	7
8.	The teams I belong to are an important reflection of who I am.	1	2	3	4	5	6	7
9.	I am a cooperative participant in the team I belong to.	1	2	3	4	5	6	7
10.	Overall, I often feel that the team of which I am a member is not worthwhile.	1	2	3	4	5	6	7
11.	In general, others respect the team that I am a member of.	1	2	3	4	5	6	7
12.	The team I belong to is unimportant to my sense of what kind of a person I am.	1	2	3	4	5	6	7
13.	I often feel I'm a useless member of my team.	1	2	3	4	5	6	7
14.	I feel good about the team I belong to.	1	2	3	4	5	6	7
15.	In general, others think that the teams I am a member of are unworthy.	1	2	3	4	5	6	7
16.	In general, belonging to teams is an important part of my self image.	1	2	3	4	5	6	7

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