UNIVERSITY OF TWENTE

Examining the relation between team cohesiveness and team effectiveness and the role of verbal communication in this relation

Bachelorthesis

Faculty of Behavioural Science – Conflict, Risk and Safety Psychology

June, 21th, 2016

Eva Stenmans

First supervisor: Stijn de Laat

Second supervisor: Elze Ufkes

Examining the relation between team cohesiveness and team effectiveness

Abstract

Various studies over the relation between team cohesiveness and team effectiveness found differing results. These mixed findings could be due to the complexity of the relation between team cohesiveness and team effectiveness. The relation between team cohesiveness and team effectiveness is possibly influenced by many factors, such as the communication within a team. Based on the described complexity, the present study aims to clarify the relation between team cohesiveness and team effectiveness and to examine the influence of communication on the named relation. Team cohesiveness was determined with a questionnaire. The communication was measured with wearable sensors, which recorded the number of verbal speaking segments within a team. The effectiveness was determined by the time the teams needed to solve the puzzles of an Escape Room. Linear regression and simple slope analysis showed that the relation between team cohesiveness and team effectiveness is significant as the amount of communication within a team is decreased. Thus cohesive teams, which also had a lower number of speaking segments tended to be more effective. The lower amount of verbal communication could be due to a more concise and direct communication within the more effective teams, through which they are able to address issues and conflicts on a more effective manner.

Examining the relation between team cohesiveness and team effectiveness

Abstract

Diverse studies over de relatie tussen team cohesie en team effectiviteit vonden verschillende resultaten. Deze gemengde bevindingen zouden kunnen worden verklaard door de complexiteit van de genoemde relatie. De relatie tussen team cohesie en team effectiviteit is beïnvloed door meerdere factoren, zoals de communicatie binnen een groep. Vanwege de beschreven complexiteit heeft de tegenwoordige studie het doel om de relatie tussen team cohesie en team effectiviteit diepgaander te bestuderen en de invloed van communicatie op de deze relatie te onderzoeken. De cohesie van een team werd gemeten door een vragenlijst. De communicatie werd gemeten door draagbare sensoren, die het aantal spreekbeurten binnen een team op hebben genomen. De effectiviteit werd gemeten door de tijd, die een team nodig had om alle puzzels van een *Escape Room* op te lossen. Lineaire regressie en de simple slope analyse lieten zien dat de relatie tussen team cohesie en team effectiviteit is significant als de hoeveelheid communicatie binnen een team is verlaagd. Dus hechte teams, die ook een lagere aantal spreekbeurten hadden, bleken effectiever te zijn. De lagere aantal spreekbeurten zou kunnen worden verklaard door een preciezere en directere communicatie binnen de effectievere teams, waardoor deze teams in staat zijn om problemen en conflicten op een effectievere manier op te lossen.

Introduction

Teams are defined as social entities, which are consisting of members who share and value common goals. To achieve these goals the members have a high interdependency in terms of information which has to be shared, synthesized and integrated (Salas, Cooke & Rosen, 2008). Achieving common goals with a team has gotten an increasing importance in various settings in the last decades (Salas, Cooke & Rosen, 2008). For example, Harris and Barnes-Farrell (1997) are outlining that many companies were handling the shift to a knowledge-based economy and the demands of increasing productivity and efficiency by introducing the use of formal work teams. These teams are involved in, for example, the production of goods or the development of projects (Harris & Barnes-Farrell, 1997). Also in health care, teamwork is used as an essential component of achieving the high demands concerning the accuracy. The high demands on the accuracy are due to the possible fatal consequences of errors. That is why the occurrence of errors is supposed to be low (Baker, Day, & Salas, 2006). Another example of the increasing importance of teams can be seen in team sports. There, being "a good team player" seems to be valued higher than, for example, being a "talented player" (Gaffney, 2015). In the light of the increasing importance of teams, the effectiveness of a team is getting more and more into the focus of interest (Mathieu, Maynard, Rapp, & Gilson, 2008; Salas, Cooke, & Rosen, 2008).

A number of factors are influencing the team effectiveness, whereby the team cohesiveness is believed to be one of them. However, Casey-Campbell and Martens (2009) are highlighting that some studies found a positive relation between team cohesiveness and team effectiveness, whereas other studies reported a negative relation or only a weak positive relation between team cohesiveness and team effectiveness (Casey-Campbell & Martens, 2009). That is why the relation between team cohesiveness and team effectiveness is still questionable. In addition, one could assume that another variable is possibly influencing the relation between team cohesiveness and team effectiveness. An example of one of these variables could be the communication within a team (Casey-Campbell & Martens, 2009). That is why the following question is coming up: Is there a relation between team cohesiveness and team effectiveness and what is the role of communication within this relation?

The relation between team effectiveness and team cohesiveness

Team effectiveness is characterized by a positive evaluation of the performance processes of a team and their outcomes in relation to a set of criteria (Salas, Cooke & Rosen,

2008). This evaluation is influenced by a number of input- , process- , and outcome-factors, which are described in the IPO-model of Mathieu, Maynard, Rapp and Gilson (2008). Input-factors constrain and enable the interaction between team members and include characteristics of the individuals within a team, characteristics of the team itself and characteristics of the organization and the context. Process-factors play an important role in the transformation of input-factors into output-factors and include transition processes, action processes and interpersonal processes. Outcome-factors are the team activities' results and include performance and affective reactions of the members. These factors can finally lead to a higher performance of a team in successfully achieving a desired result or goal (Mathieu, Maynard, Rapp, & Gilson, 2008).

One of these important contributing factors to the effectiveness of a team seems to be the degree of cohesiveness of a team, which belongs to the emergent states between input- and outcome-factors (Mathieu, Maynard, Rapp, & Gilson, 2008). In general, the team cohesiveness is defined as "group members' inclinations to forge social bonds, resulting in members sticking together and remaining united" (Casey-Campbell & Martens, 2009, p. 224). Within this concept, various antecedents are playing an important role, such as the intention of a member to remain within the team. Another antecedent is the identification of a member with a team, as well as the interpersonal relations between the members of a team (Casey-Campbell & Martens, 2009). These antecedents determine to what degree a team is cohesive. Casey-Campbell and Martens (2009) are describing, that it is believed that a higher level of team cohesiveness results into a higher team effectiveness, because of team members who then work harder to attain the overall team goal. However, Casey-Campbell and Martens (2009) are also outlining that the findings of several studies about the relation between team cohesiveness and team effectiveness are quite mixed. One of the possible reasons for these mixed findings over the relation is the complexity of the relation. The relation of team cohesiveness and team effectiveness is influenced by many factors, such as the type of the team or the communication within a team (Casey-Campbell & Martens, 2009).

Communication as influencing variable

The influence of communication on the relation between team cohesiveness and team effectiveness is hardly studied until now. Only a few studies are indicating an interaction between team cohesiveness and communication, which may affect the effectiveness of a team. For example, Smith, Smith, Olian, Sims, O'Bannon and Scully (1994) describe in their paper the possibility that a lower cohesiveness in a team would require more communication. This

would be due to more conflicts in a team with a lower cohesiveness, whereby the solving of these conflicts would require more communication. This negative interaction between team cohesiveness and team communication is possibly lowering team effectiveness (Smith et al., 1994). In contrast, it seems that highly cohesive teams are more flexible and efficient, because of lower costs in coordination and communication (Smith et al., 1994). These teams also seem to use better techniques for solving problems and seem to have a greater productivity than teams with a lower cohesiveness. Teams with a higher cohesiveness seem to have less conflict than teams with a lower cohesiveness, which is causing highly cohesive teams to have a lower need to exchange and clarify information in order to maintain the team. Because of the lowered need to exchange and clarify information, the maintenance of the team does not consume so much time and does not delay decision making. That is why team effectiveness is supported by a higher team cohesiveness and its interaction with team communication (Smith et al., 1994).

The described lowered costs in coordination and communication in cohesive teams are roughly matching the communication patterns of highly performing teams, which are described by Pentland (2012). According to his work, successful teams are characterized by a communication pattern, in which each team member is listening and talking for roughly the same time and in which the verbal speaking segments of team members are kept short and sweet. In addition, their conversations are energetic and team members are connecting directly with other team members and not just with one of the team members. Furthermore, when team members are speaking to the whole team, their statements are brief and to-the-point. These communication patterns of productive teams seem to be highly consistent across a variety of teams with differing kinds of works, such as work in a call center, work with costumers in a bank, work in a backroom, innovation work or work in a hospital (Pentland, 2012). According to Smith et al. (1994) and Pentland (2012), it can be assumed that in more effective teams the members are condensing the information in less verbal speaking segments or in shorter verbal speaking segments or possibly in both, lesser and shorter verbal speaking segments. The enriched communication may is supported by a higher team cohesiveness.

Research question and hypothesis

In order to clarify the extent and the condition of the relation between the cohesiveness and the effectiveness of a team, this study aims to examine the named relation as well as communication as possible influencing variable. Similar to Smith et al. (1994), the present research focuses thereby on the number of verbal speaking segments within a team to indicate

the communication within a team. Because of this, the following research question will be studied: Is there a relation between team cohesiveness and team effectiveness and is the number of verbal speaking segments within a team moderating this relation? Thereby it is assumed that there is a positive relation between team cohesiveness and team effectiveness. However, this relation is moderated by the number of verbal speaking segments within a team (see Figure 1).

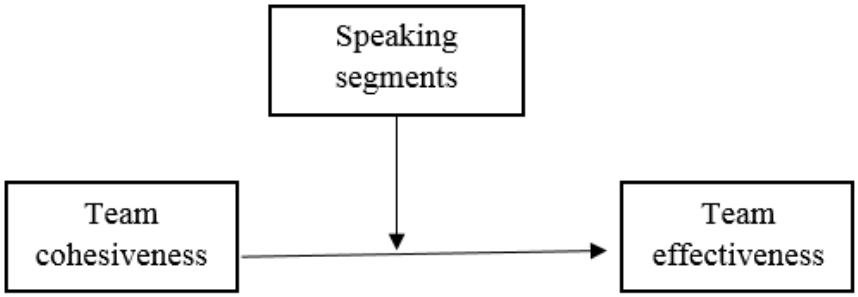

Figure 1 – The number of verbal speaking segments as moderator of the relation between team cohesiveness and team effectiveness.

It is expected, that the moderation is characterized by a lower number of verbal speaking segments within a team. The lower number of verbal speaking segments could possibly be due to more concise and enriched speaking segments of members to the team. It can further be assumed that a higher team cohesiveness is supporting such a concise communication. Thus, it is suggested that more effective teams have both, a higher cohesiveness and a lower number of verbal speaking segments. Based on the present research question and the described assumptions, the following two hypotheses can be summarized:

1. A higher reported team cohesiveness is positively related to team effectiveness.
2. This positive relation between a higher reported team cohesiveness and team effectiveness occurs when it is moderated by the number of verbal speaking segments within a team. This moderation is characterized by a lower number of verbal speaking segments, which is caused by an interaction between team cohesiveness and the number of verbal speaking segments.

Methods

Participants

The sample of the present study consisted of 314 individuals, which were divided into 64 teams. Because of missing data in a number of teams and the circumstance that in one of

the teams three of the four members were autistic, nine of the teams were excluded from the analysis. This resulted in 55 teams with 274 participants, which were taken into account for the analysis. One teams consisted of seven members (1.82%), nineteen consisted of six individuals (34.55 %), fifteen teams of five individuals (27.27 %), nineteen teams of four individuals (34.55%) and one team had two individuals (1.82 %). In all teams, 166 of the individuals were male (60.60 %) and 108 of the individuals were female (39.40 %). Most of the teams were mixed teams (60.00 %), wherein female and male participants worked together. A number of the teams were purely female (14.55 %) or male (25.45 %). Overall the participants were between 18 and 73 years old (mean age: 28.51, SD = 10.94). For the current research, participants had to be 18 years or older and needed to be able to understand Dutch.

Materials

In the present study, the independent variable was the team cohesiveness, the moderator was the number of verbal speaking segments and the dependent variable was the team effectiveness. To collect the data over the described variables, three different measurements were used. For the measurement of the team cohesiveness a questionnaire was used, whereas the number of verbal speaking segments within a team was measured with a wearable sensor, the Sociometric Badge. The effectiveness of a team was measured by the time a team needed to solve the puzzles in an Escape Room. The measurements were done on the team level. Therefore the mean values of all variables of each team were taken into the analysis.

Team cohesiveness

The cohesiveness of a team was measured by a Dutch version of one of the scales of the Prevised Substitute for Leadership scale (Podsakoff, Niehoff, MacKenzie, & Williams, 1993; Jellema, 2016). The used scale consisted of six items, which had to be answered on a five-point Likert-scale, whereby the value 1 stood for “Totally disagree” and the value 5 for “Totally agree”. The items asked participants to rate six indicators of cohesiveness, namely the trust, the collaboration, the cooperation, the support, the backing and the degree of friendship within the team (see Appendix A). In the present study, the mean cohesiveness of a team was between 3.37 and 4.83.

A Principal Component Analysis with an oblique rotation demonstrated that one factor with an eigenvalue higher than 1 (eigenvalue = 3.60) could be extracted from the six items, namely the cohesiveness of a team. The given items all have factor loadings between 0.73 and 0.83 (see Appendix B) and are explaining 59.91 % of the variance. The reliability of the used

scale was shown to be high (Cronbach's alpha = 0.86). The given scale was framed in a Dutch paper-and pencil questionnaire, which also asked participants several questions about some demographical data, such as age, sex or level of education. Because of two other researcher, who studied two other research questions, this questionnaire also consisted of questions over the extraversion and the contentiousness of an individual, which had also to be rated on a five-point Likert-scale (see Appendix A).

Number of verbal speaking segments

The number of verbal speaking segments within a team during a stay in an Escape Room was measured by the use of Sociometric Badges. These badges are wearable sensors, which provide objective data of human behaviour and social interactions and were worn by the participants around their necks. Such badges can record data over several speech features (volume, tone of voice, speaking time), body movement features (energy, consistency) or over the proximity to other people, who wear such a Sociometric Badge (Kim, Chang, Holland & Pentland, 2008). For this research, the badges measured the number of verbal speaking segments to indicate the total number of verbal speaking segments of a whole team. A verbal speaking segment is hereby defined as any uninterrupted and continuous speech of one of the team members (Preliminary User Guide for Sociometric Badges, 2014). In the present study, the mean number of verbal speaking segments of a team was between 105.17 and 361.00.

Team effectiveness

The effectiveness of a team was measured by the time the teams needed to solve the puzzle of an Escape Room. To record the time the researcher or the leader of the game observed the participating teams through a live video-stream during their stay in an Escape Room. In addition the researcher or the leader of the game noted the time when a team began to play one of the Escape Rooms and the time when a team finished to play one of the Escape Rooms. Furthermore, the researcher noted the number of hints, the time of the hint and the number of solved puzzles. This was done by using a scorings-paper, on which the sort of the puzzles were noted (see Appendix C).

For the current research, only the notation of the time of playing on of the Escape Rooms was used. With this time notation a quotient of the actual needed time of a team to escape the room and the available total time was calculated. Teams who managed to escape the room within the available time had a quotient of the value 1 or lower. The time of teams who did not manage to escape the room within the available total time was added with extra minutes, resulting in a quotient of 1.04. This was done, because of differing available total

times in the several Escape Rooms of this study. In two of the three settings the total available time was one hour, whereas in one of the setting the total available time was 45 minutes. In addition, by adding some extra minutes to the times of teams who did not escape the rooms allowed to clearly distinguish these teams with teams who could escape within the available time. The higher the quotient the less effective a team was. A higher quotient thus indicated team ineffectiveness. In the current study, the quotient of the (in)effectiveness of a team was between 0.58 and 1.04.

Escape Rooms

The used Escape Rooms can all be found in Enschede in the Netherlands. All in all, the present study made use of four different Escape Rooms. Two of them can be found in the event company "Roomescape Enschede" and another one of them can be found in the event company "Glowgolf Enschede". The fourth room was a temporarily project of a student organization on the campus of the University of Twente. All rooms offered possibilities to the participants to ask for hints. This communication about hints was enabled by various devices, for example, by an electronic tablet or a walky-talky. All rooms differ from the other rooms in size and sort of puzzles. For example, one of the Escape Rooms was designed like a submersible, whereas another room was designed like a labour. Most of puzzles consisted of finding the right number combination to open several locks. To find out these combinations, it was necessary, for example, to calculate mathematical exercises or to match letters with numbers.

Procedure

The teams and their members were first informed about this research in the confirmation mail of the booking of the Escape Rooms or on the Facebook-page of one of the settings, which offered an Escape Room. Furthermore, the participants were approached by the researcher at the days the teams came to play one of the Escape Rooms. The researchers welcomed the participants and invented them to listen to an explanation of the study. If a team agreed with this invitation, the researchers first explained the purpose as well as the procedure of the research, the duration and how confidentiality will be maintained. Then the participants were asked to read and sign an informed consent (see Appendix D). When one of the team members of a team did not confirm to participate in the study on the informed consent, the whole team was excluded from the research.

When all team members agreed to participate, the teams got an explanation of the Sociometric Badges and how to wear them comfortably. To thank these teams for their

participation, the teams were then asked if they were interested in a visualisation over their own interaction patterns. In order to maintain the confidentiality, the members of the teams who were interested in these visualisations, then had to write down individual nicknames. The visualisation was created by the data of the Sociometric badges and was sent per mail to one of the team members several days after their participation. Next the teams were introduced to the Escape Room, in which they were then locked for maximal an hour or 45 minutes, depending on the setting of playing the Escape Room. In the case that teams did not manage to solve all the needed puzzles in that time, they had to leave the room without completing the overall task. After getting out of the room, the participating teams were asked to fill in the paper-and-pencil questionnaire.

Results

The present research question concerns the relation between team cohesiveness and team effectiveness and the possible influence of communication on the relation between team cohesiveness and team effectiveness. The belonging hypotheses to the described question are that a higher reported team cohesiveness is positively related to team effectiveness and that a lower number verbal speaking segments is moderating the relation between team cohesiveness and team effectiveness. To test the belonging hypotheses, a linear regression was done. For the regression team cohesiveness was used as the independent variable, the number of verbal speaking segments were used as the moderating variable and team (in)effectiveness was used as the dependent variable. The named variables were put into one model to test the present research question and the belonging hypotheses.

Preliminary analysis

Before the data was analysed with the linear regression, the distribution of the data was tested by using the Shapiro-Wilk test. As it was shown by this test, the data of all variable were normally distributed, except the data of the team (in)effectiveness (S-W < 0.01). Because of a missing improvement of normality by a transformation, the data of the team (in)effectiveness was not changed for this analysis. In addition, the Pearson correlations between the team cohesiveness, the number of verbal speaking segments and the team (in)effectiveness was calculated (see Table 1). The correlations between the number of verbal speaking segments and team cohesiveness was found to be significant ($p = 0.04$) as well as the correlation between team (in)effectiveness and the number of verbal speaking segments ($p < 0.01$).

Table 1 – Pearson correlations between team cohesiveness, the number of verbal speaking segments and team (in)effectiveness.

	M	SD	Team cohesiveness	Speaking segments	Team (in)effectiveness
Team cohesiveness	4.06	0.36	1.00		
Speaking segments	230.77	56.74	-0.28*	1.00	
Team (in)effectiveness	0.99	0.11	-0.21	0.40**	1.00

*Correlation is found to be significant with p = 0.04

**Correlation is found to be significant with p < 0.01

Multiple linear regression

The test revealed that the overall model is not significant with $F(3,51) = 2.14$, $p = 0.11$ and $R^2 = 0.23$. Within this model, team cohesiveness is not found to be a significant predictor of team (in)effectiveness [$b = -0.01$, $t(51) = -1.16$, $p = 0.25$]. However, a main effect of the number of verbal speaking segments was found, $b < 0.01$, $t(51) = 2.11$, $p = 0.04$. In addition, the interaction effect of team cohesiveness and the number of verbal speaking segments was found to be significant with $b < 0.01$, $t(51) = 2.16$, $p = 0.04$ (see Table 1).

On basis of these results it can be concluded that the first hypothesis has to be rejected. A higher reported team cohesiveness is not positively related to team effectiveness. However, it can be stated that the number of verbal speaking segments is positively related to the effectiveness of a team. In addition, the significant interaction effect is indicating that the second hypothesis can be retained. Retaining this hypothesis would mean that a positive relation between team cohesiveness and team effectiveness is moderated by the number of verbal speaking segments within a team. To get more insight into the second hypothesis, it was decided to do a simple slopes analyses.

Table 1 – Linear regression of the number of verbal speaking segments, team cohesiveness and an interaction between these two variables based on team effectiveness

	b	t	p
Team cohesiveness	- 0.01	-1.16	0.25
Verbal speaking segments	< 0.01	2.11	0.04
Interaction between team cohesiveness and number of verbal speaking segments	< 0.01	2.16	0.04

Simple slope analysis

Three levels of the number of verbal speaking segments were distinguished by the simple slope analysis, namely lower, average and higher number of verbal speaking segments. The lower and higher numbers of verbal speaking segments were calculated by subtracting or adding one standard deviation from or to the mean. The simple slope analysis revealed that for a lower number of verbal speaking segments (low = 174.03), there is a significant relation between the team cohesiveness and the team (in)effectiveness [b = -0.02, $t(51)$ = -2.18, p = 0.034]. For an average number (average = 230.77) of verbal speaking segments, there is no significant relation between team cohesiveness and team (in)effectiveness [b = -0.01, $t(51)$ = -1.16, p = 0.250] as well as for higher numbers of verbal speaking segments (high = 287.51), b = 0.01, $t(51)$ = 0.81, p = 0.424 (see Figure 1). Thus, when the number of verbal speaking segments is lower, team cohesiveness and team effectiveness are positively related to each other.

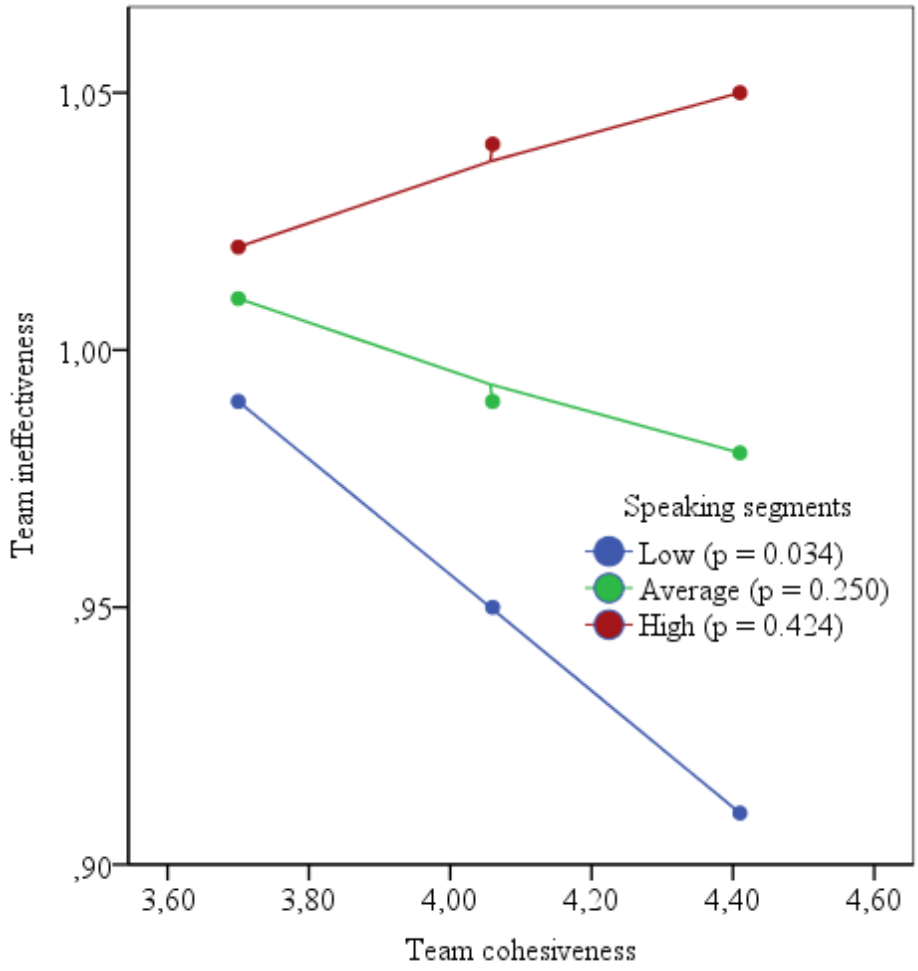

Figure 1 - Scatterplot of the number of verbal speaking segments (low, average and high) based on the team cohesiveness and the team ineffectiveness.

In addition, the simple slopes were analysed with the number of verbal speaking segments as the independent variable and team cohesiveness as the moderator variable. Team (in)effectiveness stayed the dependent variable. Team cohesiveness was divided in lower, average or higher team cohesiveness. One standard deviation was subtracted from or added to the mean for the lower or higher team cohesiveness. In this model the relation between the number of speaking segments and team (in)effectiveness is not significant with a lower team cohesiveness (low = 3.70), $b < 0.01$, $t(51) = 1.22$, $p = 0.229$. However, it gets significant, when the team cohesiveness is increasing, with an average team cohesiveness of 4.06 [$b < 0.01$, $t(51) = 2.11$, $p = 0.040$] and a higher team cohesiveness of 4.70 [$b < 0.01$, $t(51) = 2.27$, $p = 0.027$] (see Figure 2). The described results show that the relation between the number of verbal speaking segments and team effectiveness is positive when the team cohesiveness has an average or higher degree.

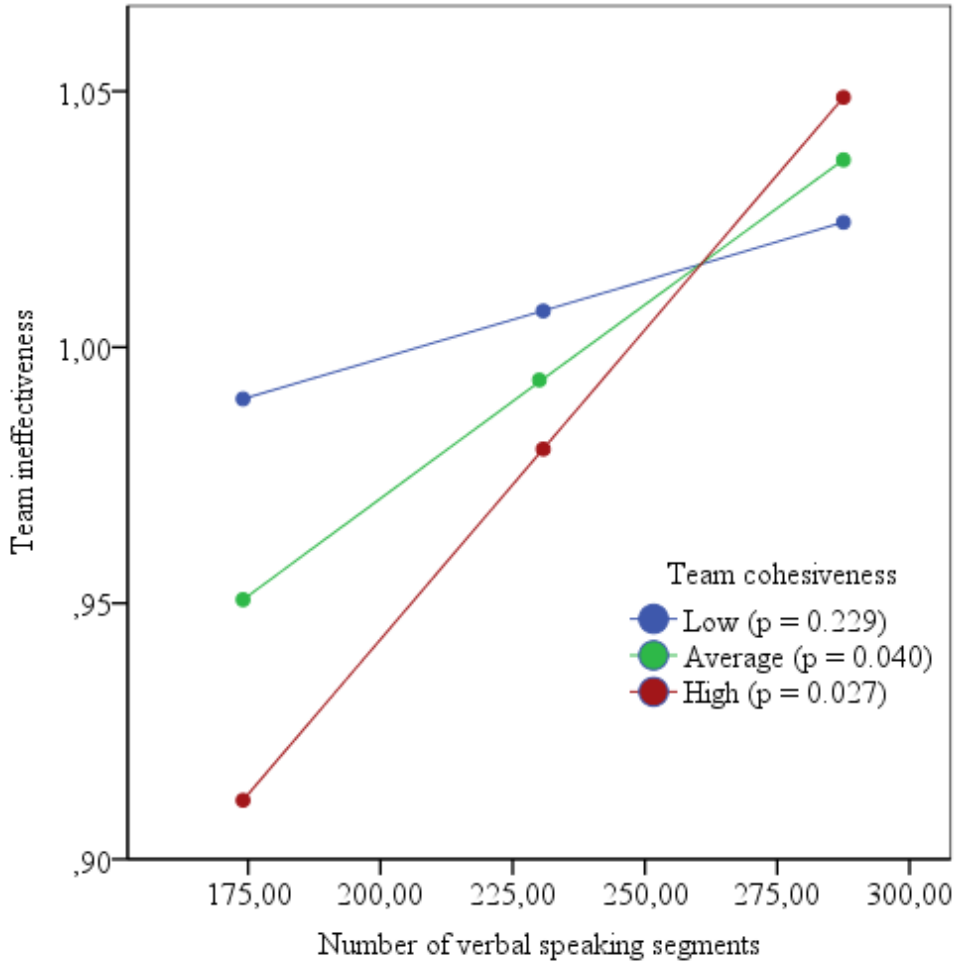

Figure 2 – Scatterplot of team cohesiveness based on the number of verbal speaking segments and team ineffectiveness.

These findings indicate that the second hypothesis can be retained. The relation between team cohesiveness and team effectiveness seems to be actually moderated by the number of verbal speaking segments. The named moderation is characterized by a lowered number of verbal speaking segments. The lower number of verbal speaking segments seems to be supported by an average or higher degree of team cohesiveness, because of an interaction between team cohesiveness and the number of verbal speaking segments. This number of verbal speaking segments have a positive relation to team effectiveness as teams have an average or higher degree of cohesiveness.

Discussion

This study aimed to examine the relation between team cohesiveness and team effectiveness and a possible influence of verbal communication on the relation between team cohesiveness and team effectiveness. This in order to clarify the extent and the conditions under which the cohesiveness and the effectiveness of a team are related to each other. By clarifying the extent and conditions of the described relation, meeting the growing importance of achieving goals with a team could be optimized. In the present study participants were asked to rate the cohesiveness of their team on a questionnaire. While playing an Escape Room participants wore wearable sensors, which could record the amount of communication in terms of the number of verbal speaking segments within a team. The time the teams needed to play an Escape Room was used as a measurement for the team effectiveness. As it is shown, the relation between team cohesiveness and team effectiveness on its own is not significant. However, the relation between team cohesiveness and team effectiveness becomes significant as the number of verbal speaking segments within a team is lowered. That is why it seems that the relation between team cohesiveness and team effectiveness is moderated by the number of verbal speaking segments within a team. Additionally, the analysis of the present research revealed that the relation between the number of verbal speaking segments and team effectiveness is significant with an average or higher degree of team cohesiveness. Thus, the degree of team cohesiveness is moderating the relation between the number of verbal speaking segments and team effectiveness. Due to the described findings it can be assumed that team effectiveness depends on an interaction between the number of verbal speaking segments and team cohesiveness. When teams have an average or higher degree of cohesiveness, the relation between verbal communication and team effectiveness is positive, as well as there is a positive relation between team cohesiveness and team effectiveness as the

amount of verbal communication is lowered.

The lower number of verbal speaking segments could be explained by a more concise communication within more effective teams. An effective communication is characterized by open, concise and to-the point verbal speaking segments within a team (Amos, Hu & Herrick, 2005; Pentland, 2012). Team members then would be able to condense their information into fewer and stronger speaking segments. This ability would lead to an overall lower number of speaking segments. In addition, according to Amos, Hu and Herrick (2005), an improved and concise communication among the members of a team leads members to feel more comfortable in solving problems, addressing issues and resolving conflicts. This, in turn, also can result in a lower number of speaking segments, because of the possibility to concentrate the communication on the task of a team and not on the process of resolving conflicts among team members.

Such a concise communication is supported by the cohesiveness of a team (Amos, Hu & Herrick, 2005). Amos, Hu and Herrick (2005) found in their study that a team-building intervention to improve the cohesiveness of a team resulted in an increased ability of the team members to address existing conflicts more directly among themselves. Furthermore, the improved cohesiveness also enabled stronger interpersonal ties between the team members. These ties not only lead to an increased ability to address conflicts within a team, but also lead to an overall decreased number of conflicts, which have to be resolved (Smith et al., 1994). Based on the given information, it could be explained why an average or higher team cohesiveness is positively influencing the relation between the number of verbal speaking segments and team effectiveness. An average or higher degree of team cohesiveness is supporting the verbal communication within a team. This in terms of a higher psychological safety within these teams, through which the members get the certainty that a direct communication will not disturb the safe team climate. The members of cohesive teams feel ensured enough to communicate openly their opinion about something as well as they are not feared to confront other members with a conflict (Edmondson, Kramer & Cook, 2004). All in all it can be stated that there is an interaction between team cohesiveness and team communication. An average or higher degree of cohesiveness seems to positively support the team communication, which leads to a more concise communication. This concise communication is also positively influencing the relation between team cohesiveness and team effectiveness.

The described positive support of team cohesiveness on team communication, which leads to a positive influence of a concise communication on the relation between team

cohesiveness and team effectiveness seems to be applicable to a great range of teams. The widely applicability can be assumed because of the variety of teams, who participated. The teams consisted of members with a wide spread of age and differing functions. For example, there were teams consisting only of students, teams of colleagues who worked together in various settings, teams who were a family as well as teams of friends or sport teams. Due to this variety in the teams it can be assumed that the given findings not only are the case for a special kind of teams, but for teams with two to seven members in general. It seems that most teams with two to seven team members are more effective as they are cohesive and are able to communicate concise and open.

Limitations

However, there were also some limitations to the present study. One of these limitations was the use of different Escape Rooms. Through the several setting, it is possible that the conditions for the participants were differing. For example, it is unclear in what extent the difficulty of the several rooms varied. All the rooms consisted of different puzzles and a combination of these puzzles. Due to this differences, the comparability of the rooms is hard to estimate. But as in the current research the effectiveness of a team is defined by the needed time to escape the room, the difficulty of the rooms could have had a great influence on the team effectiveness. Teams who did manage to escape a more difficult room may are more effective than teams who escaped an easier room in the same time. In a further research the standardized by only using Escape Rooms, which are approximately the same.

Another limitation to the current study are the different times when the teams played the Escape Rooms. The time of playing was spread from 10.00 a.m. to 22.00 p.m.. However, the time of day can affect the effectiveness indirectly. The effect from the time of day on the team effectiveness is due to the effect from the time on the cognitive abilities. For example, teams who played at 22.00 p.m. were probably less able to attend to the overall task than team who played one of the rooms at 13.00 p.m.. According to Kraemer, Danker-Hopfe, Dorn, Schmidt, Ehlert and Herrmann (2000), after a peak in the afternoon, the overall attention is slowly decreasing. However, a decreased ability to attend may also influence the effectiveness of a team. This in terms of being less able to focus on the task and thus probably needing more time to solve the puzzles. In the present study, the extra needed time would be interpreted as being less effective. This described limitation could be improved in a future research by only taking teams into account who played an Escape Room in a limited period of time of a day. For example, researchers could only measure teams who played an Escape

Room between 12.00 p.m. and 16.00 p.m..

A further limitation is that the analysis of the data of the current research has been done with a parametric test, even though the dependent variable was not normal distributed. This was due to the limited time of the recent research. However, even if the multiple linear regression for normal distributed data can be expected to be robust in some extent, the analysis could have been done with a more suitable non-parametric test. With the currently used analysis it stays unclear in what extent the results can really be generalized. That is why in a further research, researcher should find a way to normalize the data to can use a parametric test or should do the analysis with a non-parametric test.

Further research

There are several aspect which could be taken into account in a further research. One of these aspects, is the number of hints. While playing an Escape Room, the teams have the possibility to ask for hints. As the hints can affect the effectiveness of a team, it would be interesting to examine them more in depth. In the light of the ability of a team to recognize that they cannot solve a puzzle without external help, asking for hints could be advantageous for team effectiveness. On the other hand, asking for a lot of hints could also be an indicator for a kind of helplessness within a team and a dependence on external help. That is why, it would be interesting to clarify the role of the number of hints in the effectiveness of a team.

Another suggestion for further research is concerning the non-verbal communication within a team in broader terms. The current study focused only on the verbal communication within a team. However, according to Burgoon, Guerrero and Floyd (2016), 66% to 93% of the meaning is derived from the nonverbal communication. Understanding the nonverbal communication is crucial for a suitable interpretation of a message. It even seems that successful human interactions and relation depend on the ability to understand others' nonverbal communication and on the ability to express oneself nonverbally (Burgoon, Guerrero & Floyd, 2016). In the light of the minor part of verbal communication on the overall communication, studying the role of non-verbal communication in the relation between team cohesiveness and team effectiveness could give even more insight into the relation of these two variables.

A third aspect, which could be taken into account in a further research, is the lengths of the verbal speaking segments within a team. Pentland (2012) is outlining that highly performing teams have a communication pattern in which the verbal contributions of team members are kept sweet and to-the-point. The lengths of verbal speaking segments within

these teams thus seem to be shorter than in other teams. Because of this, researching this aspect could clarify the characteristics of an effective communication and its role in the relation between team cohesiveness and team effectiveness.

Conclusion

Examining the research question and the belonging hypotheses of the current study gave more insight into the relation between team cohesiveness and team effectiveness and clarified the role of verbal communication in this relation. It can be stated that verbal communication is moderating the relation between team cohesiveness and team effectiveness. The verbal communication within a team is supported by an average or higher degree of team cohesiveness. An average or higher degree of team cohesiveness is resulting in a more concise communication. Thus, average or higher cohesive teams, who also have a concise and direct communication seem to be more effective. In the light of this insight team trainings could be adjusted in order to improve the effectiveness of a team and to meet the growing importance of achieving goals with a team. Based on the present study it becomes clear that the verbal communication should get a greater role within these trainings. This could be done by, for example, informing participants over the important role of a concise communication in the relation between team cohesiveness and team effectiveness. Then some team-buildings exercises could be done with the explicit goal to improve the verbal communication within a team. All in all, it can be concluded that a cohesive team can only work effectively together as the members are enabled to communicate concisely and directly to each other.

References

Amos, M. A., Hu, J., & Herrick, C. A. (2005). The impact of team building on communication and job satisfaction of nursing staff. *Journal for Nurses in Professional Development*, *21*(1), 10-16.

Baker, D. P., Day, R., & Salas, E. (2006). Teamwork as an essential component of high-reliability organizations. *Health services research*, *41*(4p2), 1576-1598.

Burgoon, J. K., Guerrero, L. K., & Floyd, K. (2016). *Nonverbal communication*. Routledge.

Casey-Campbell, M., & Martens, M. L. (2009). Sticking it all together: A critical assessment of the group cohesion–performance literature. *International Journal of Management Reviews*, *11*(2), 223-246.

Edmondson, A. C., Kramer, R. M., & Cook, K. S. (2004). Psychological safety, trust, and learning in organizations: A group-level lens. *Trust and distrust in organizations: Dilemmas and approaches*, *12*, 239-272.

Gaffney, P. (2015). The Nature and Meaning of Teamwork. *Journal of the Philosophy of Sport*, *42*(1), 1-22.

Harris, T. C., & Barnes-Farrell, J. L. (1997). Components of Teamwork: Impact on Evaluations of Contributions to Work Team Effectiveness1. *Journal of Applied Social Psychology*, *27*(19), 1694-1715.

Jellema, J. (2016). *Leiderschap in formele en informele groepen voorspellen door middel van GPS*.

Kim, T., Chang, A., Holland, L., & Pentland, A. S. (2008). Meeting mediator: enhancing group collaboration using sociometric feedback. In *Proceedings of the 2008 ACM conference on Computer supported cooperative work* (pp. 457-466). ACM.

Kraemer, S., Danker-Hopfe, H., Dorn, H., Schmidt, A., Ehlert, I., & Herrmann, W. M. (2000). Time-of-day variations of indicators of attention: performance, physiologic parameters, and self-assessment of sleepiness. *Biological psychiatry*, *48*(11), 1069-1080.

Mathieu, J., Maynard, M. T., Rapp, T., & Gilson, L. (2008). Team effectiveness 1997-2007: A review of recent advancements and a glimpse into the future. *Journal of management*, *34*(3), 410-476.

Pentland, A. (2012). The new science of building great teams. *Harvard Business Review*, *90*(4), 60-69.

Podsakoff, P. M., Niehoff, B. P., MacKenzie, S. B., & Williams, M. L. (1993). Do Substitutes for Leadership Really Substitute for Leadership? An Empirical Examination of Kerr and Jermier′ s Situational Leadership Model. *Organizational Behavior and Human Decision Processes*, *54*(1), 1-44.

Salas, E., Cooke, N. J., & Rosen, M. A. (2008). On teams, teamwork, and team performance: Discoveries and developments. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *50*(3), 540-547.

Smith, K. G., Smith, K. A., Olian, J. D., Sims Jr, H. P., O'Bannon, D. P., & Scully, J.A. (1994). Top management team demography and process: The role of social integration and communication. *Administrative science quarterly*, 412-438.

Preliminary User Guide for Sociometric Badges 03-02, Revision 1.21. Sociometric Solutions (2014).

Appendix

Appendix A: Questionnaire

Beste escape room deelnemer,

Dit is een korte vragenlijst waarin we aan alle deelnemers aan deze escape room een aantal vragen stellen over kenmerken van het team en hun ervaring in de escape room.

Wat vragen we van u?

- Het duurt ongeveer 5-10 minuten om de vragenlijst in te vullen.
- Vul deze vragenlijst zo eerlijk mogelijk in zonder hulp van anderen.
- Sta niet te lang stil bij elke vraag en antwoord het eerste wat bij u opkomt. Meestal is het antwoord waar u het eerst aan denkt het antwoord dat het best past bij uw mening.
- Het kan voorkomen dat bepaalde vragen op elkaar lijken maar dit is vereist voor de nauwkeurigheid van de vragenlijst. Het is voor ons dus wel van belang dat u op alle vragen antwoord geeft.

Vrijwillige deelname

Het is voor het onderzoek erg belangrijk dat zoveel mogelijk deelnemers deze vragenlijst zo volledig mogelijk invullen. Meewerken aan dit onderzoek gebeurt echter op vrijwillige basis; u kunt op elk gewenste moment stoppen met de medewerking.

Privacy

Uw persoonsgegevens en antwoorden worden uitsluitend ten behoeve van het onderzoek gebruikt en anoniem verwerkt. De uitkomsten van het onderzoek zullen nooit terug te herleiden zijn naar individuele deelnemers. We zullen bijvoorbeeld alleen de gemiddelde eindscores rapporteren en niet uw individuele antwoorden.

U kunt nu beginnen met het beantwoorden van de vragen.

Hartelijk dank voor uw deelname,

Stijn de Laat, Eva Stenmans en Eric Gerritsen (Universiteit Twente)

Examining the relation between team cohesiveness and team effectiveness

Vraag 1: Wat is uw geslacht?

- Man
- Vrouw

Vraag 2: Wat is uw leeftijd? _____

Vraag 3: Wat is uw hoogst genoten opleidingsniveau?

- Geen
- Basisonderwijs
- Lager beroepsonderwijs (LBO)
- Middelbaar algemeen voorbereidend onderwijs (VMBO)
- Hoger algemeen voorbereidend, wetenschappelijk onderwijs (HAVO, VWO)
- Middelbaar beroepsonderwijs (MBO)
- Hoger beroepsonderwijs (HBO)
- Wetenschappelijk onderwijs (WO)

Vraag 4: Wat is uw huidige beroep of opleiding?

_____

Vraag 5: Met wie bent u naar deze escape room gekomen?

- Vrienden
- Collega's
- Bekenden
- Familie
- Anders, namelijk _____

Vraag 6: Hoe lang bent u al onderdeel van deze groep mensen?

_____ jaar en _____ maanden.

Vraag 7: Hoe vaak heeft u in deze groepssamenstelling het afgelopen jaar activiteiten ondernomen?

- □ Alleen voor vandaag (1e keer)
- □ Enkele keren per jaar
- □ Iedere maand
- □ Iedere week
- □ Iedere dag

Vraag 8: Heeft u al eerder een escape room gespeeld, zo ja hoe vaak?

- □ Nee
- □ Ja Aantal: _____

Vraag 9: Heeft u *deze* escape room al eens gespeeld?

- □ Ja
- □ Nee

Vraag 10: Heeft u vandaag alcohol genuttigd?

- □ Nee
- □ Ja Aantal glazen: _____

De volgende stellingen gaan over hoe u zichzelf als persoon *over het algemeen* ziet.

	Helemaal mee oneens	**Mee oneens**	**Neutraal**	**Mee eens**	**Helemaal mee eens**
1. Ik blijf onaardig tegen iemand die gemeen was.	□	□	□	□	□

2. Mensen mogen mij graag.	□	□	□	□	□
3. Ik geef vaak kritiek.	□	□	□	□	□
4. Ik houd me in een groep op de achtergrond.	□	□	□	□	□
5. Ik pas mijn mening aan die van anderen aan.	□	□	□	□	□
6. Ik werk liever alleen dan met anderen.	□	□	□	□	□
7. Ik reageer soms erg fel als iets tegenzit.	□	□	□	□	□
8. Ik heb altijd zin in het leven.	□	□	□	□	□
9. Ik vertrouw anderen weer snel nadat ze mij bedrogen hebben.	□	□	□	□	□
10. Niemand vindt mij leuk.	□	□	□	□	□
11. Ik leg gemakkelijk contact met vreemden.	□	□	□	□	□
12. Ik ben vaak ongerust dat er iets misgaat.	□	□	□	□	□
13. Ik geef gemakkelijk anderen gelijk.	□	□	□	□	□
14. Ik ben het liefst in m’n eentje.	□	□	□	□	□

15. Ik ben zelden kwaad op iemand.	□	□	□	□	□
16. Ik ben vaak somber.	□	□	□	□	□
17. Ik ben lang op mijn hoede bij mensen die mij kwaad hebben gedaan.	□	□	□	□	□
18. Niemand wil graag met mij praten.	□	□	□	□	□
19. Ik reageer negatief als iemand fouten maakt.	□	□	□	□	□
20. Ik ben vaak de woordvoerder van een groep.	□	□	□	□	□
21. Het is moeilijk mijn ideeën te veranderen.	□	□	□	□	□
22. Ik ga het liefst met veel mensen om.	□	□	□	□	□
23. Zelfs als ik slecht behandeld word, blijf ik kalm.	□	□	□	□	□
24. Ik ben over het algemeen vrolijk.	□	□	□	□	□
25. Ik ben goed van vertrouwen.	□	□	□	□	□
26. Ik denk dat veel mensen mij onaardig vinden.	□	□	□	□	□

27. Ik laat het direct merken als ik iets stom vind.	□	□	□	□	□
28. Ik voel me slecht op mijn gemak in een onbekende groep.	□	□	□	□	□
29. Ik ben het snel met anderen eens.	□	□	□	□	□
30. Ik praat graag met anderen.	□	□	□	□	□
31. Mensen hebben mij wel eens woedend gezien.	□	□	□	□	□
32. Ik ben zelden opgewekt.	□	□	□	□	□

De volgende stellingen gaan over het team waarmee u net de escape room heeft gespeeld.

	Helemaal mee oneens	**Mee oneens**	**Neutraal**	**Mee eens**	**Helemaal mee eens**
1. Er is veel vertrouwen tussen de groepsleden van mijn groep.	□	□	□	□	□
2. Leden van mijn groep werken samen als een team.	□	□	□	□	□
3. De leden van mijn groep zijn coöperatief met elkaar.	□	□	□	□	□
4. Mijn groepsleden weten dat ze op elkaar kunnen rekenen.	□	□	□	□	□

5. De leden van mijn groep komen voor elkaar op.	□	□	□	□	□
6. De leden van mijn groep zien elkaar als vrienden.	□	□	□	□	□

Hartelijk dank voor het invullen van de vragenlijst.

U kunt deze inleveren bij de aanwezige onderzoeker.

Appendix B - Oblique rotated factor loadings of the items of the Prevised Substitute for Leadership scale over cohesiveness

Item	*Factor loadings*
1. Er is veel vertrouwen tussen de groepsleden van mijn groep	0.83
2. Leden van mijn groep werken samen als een team.	0.77
3. De leden van mijn groep zijn coöperatief met elkaar.	0.78
4. De leden van mijn groep weten dat ze op elkaar kunnen rekenen.	0.80
5. De leden van mijn groep komen voor elkaar op.	0.74
6. De leden van mijn groep zien elkaar als vrienden.	0.73

Appendix C – Scorings paper

Resultaten/scoringsformulier

Datum: _____ Teamnummer: _____ Room: Name Escape Room

Starttijd: Eindtijd:

Puzzel	**Opgelost (noteer *tijd*)**	**Hint (*tijd* + letterlijke notatie)**	
Puzzle 1			
Puzzle 2			

Puzzle 3			
Puzzle 4			
Puzzle 5			
Puzzle 6			
Puzzle 7			
Puzzle 8			
Totaal aantal hints:			
Totaal aantal opgeloste puzzels:			

Final check:

Heeft het team weten te ontsnappen binnen het uur?

- ☐ Ja
- ☐ Nee

Opmerkingen:

_____

_____

_____

_____

_____

_____

_____

Appendix D – Informed Consent

Informed consent

Enschede,

Ik verklaar hierbij op voor mij duidelijke wijze te zijn ingelicht over de aard en methode van het onderzoek. Mijn eventuele vragen zijn naar tevredenheid beantwoord. Ik stem geheel vrijwillig in met deelname aan dit onderzoek. Ik behoud daarbij het recht deze instemming weer in te trekken zonder dat ik daarvoor een reden hoef op te geven en besef dat ik op elk moment mijn deelname mag stoppen. Daarnaast zijn de volgende afspraken gemaakt:

- Opnames van de Sociometric Badge tijdens de escape room en de ingevulde in het kader van het onderzoek zullen enkel door de betrokken onderzoekers worden ingezien.
- Bij de verwerking van de resultaten voor wetenschappelijke publicaties of andere rapportages, wordt volledig geanonimiseerd. Namen van teamleden zullen nooit openbaar worden gemaakt.

Als ik nog verdere informatie over het onderzoek zou willen krijgen, nu of in de toekomst, kan ik me wenden tot de onderzoeker Stijn de Laat (telefoon: 053-4896680; e-mail: s.delaat@utwente.nl).

☐ Ja, ik neem wel deel aan het onderzoek

☐ Nee, ik neem geen deel aan het onderzoek

_____

Naam en handtekening respondent

Stijn de Laat, MSc.