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Examining the relation between Leadership Effectiveness and Team Performance and the Mediating Role of Communication in a Simulated Cardiopulmonary Resuscitation Setting.

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Abstract

Various studies report different findings about the relation between leadership effectiveness, communication and team performance in a cardiopulmonary resuscitation (CPR) setting. Some studies report communication to be a prerequisite alongside leadership effectiveness for a better team performance. Other studies see communication as a tool through which leadership effectiveness influences the team performance. Based on these different findings, the current study aims to examine the exact relationship between leadership effectiveness, team performance and the role of communication in this relation in a CPR setting. It was hypothesized that leadership effectiveness and team performance would have a positive relation with communication as a mediator in this relation. The study was conducted during the Advanced Life Support-course (ALS) of the master programme of Technical Medicine at the University of Twente. In this course, resuscitation teams consisting of students performed in simulated CPR scenarios. Leadership effectiveness and team performance were measured via two assessment scales which were filled in by the teachers of the course. The communication was defined as the ratio of speaking turns between the team leader and the other members of the team and was measured via Sociometric Badges. Mediation analysis showed that there was a significant relation between leadership effectiveness and team performance. A higher leadership effectiveness resulted in a better team performance. The ratio of speaking turns did not show to be a mediator in this relationship. The current study therefore provided confirmation of the importance of a good and effective team leader in a resuscitation team. An effective team leader results in a better performing team and as a result in better patient outcomes and survival rates in the case of cardiac arrest. Next to that, the current study ruled out one aspect of communication, ratio of speaking turns, as a mediator in this leadership – team performance relationship. This provides a good direction for further research on this topic and is another step into the direction of understanding the role of communication in resuscitation teams.

Introduction

All over the world, more than 135 million people die of cardiac arrest and cardiovascular diseases every year (Meaney et al., 2013). In comparison, cardiac arrest was responsible for more deaths than the combined deaths of colorectal cancer, breast cancer, prostate cancer, influenza, pneumonia, car accidents, HIV, firearms and house fires (Center for Disease Control and Prevention, 2012). Given these numbers, the importance of cardiopulmonary resuscitation (CPR) is evident since CPR is, or should be, a series of lifesaving actions that improve the chance of survival following cardiac arrest (Hazinski & Field, 2010). When a cardiac arrest occurs, early initiation of CPR and defibrillation are critical for the chance of survival. That is, for every minute that CPR is delayed, the chance for survival decreases by as much as 10% (Hunziker et al., 2011a). Although timely CPR has a significant impact on survival, it is also complex and therefore trained rescuers are needed to provide CPR of the highest quality as possible (Meaney et al., 2013). This complexity of performing CPR comes from the fact that health care workers need to possess technical skills as well as non-technical skills to adequately perform CPR. And because of this complexity and the limited time in a case of cardiac arrest, routine training in CPR is recommended for health care providers (Hunziker et al., 2011a).

For health care workers to perform high quality CPR, they firstly have to be trained in the technical skills that CPR requires. A way in which the performance of technical skills in CPR is enhanced, is by CPR guidelines. These guidelines provide a logical, sequential algorithmic approach to a CPR situation. However, despite extensive efforts to make these technical CPR skills and corresponding algorithms known to healthcare workers, resuscitation teams often deviate from these algorithms (Hunziker et al., 2011a). These algorithms mainly emphasize the technical tasks performed by individual rescuers but do not address issues of

adapting to the complexity of most actual resuscitations (Hunziker et al., 2011a). This is due to the fact that next to these technical skills and the corresponding guidelines, non-technical skills are also part of the complex 'CPR-puzzle' (Hunziker et al., 2011a).

The fact is that resuscitations are usually performed by a team of responders instead of single rescuers (Hunziker et al., 2011a). And given the fact that in hospital resuscitations are performed by teams, the resuscitation team performance is what makes CPR successful or not. Therefore, human factors such as team behavior and team building are also associated with the performance and outcome of CPR (Hunziker et al., 2011b). Evidence therefore suggests that next to the technical skills of individual rescuers, non-technical skills like teamwork and leadership influence the deviation from CPR algorithms and therefore affect the outcome of CPR. These findings are in line with research performed by Calleja, Aitken, and Cooke (2011) and Capella et al. (2010), which showed that leadership and communication in a resuscitation team are an integral part of team performance, and thus success, in a resuscitation team.

There is however no unanimous consensus how the non-technical skills of leadership and communication are exactly related to team performance within resuscitation teams. Some research state that leadership and communication are essential prerequisites of CPR team performance (Castelao, Russo, Riethmüller, & Boos, 2013). Other research suggest that communication is the tool through which leadership influences team performance (Andersen, Jensen, Lippert & Østergaard; Cooper & Wakelam, 1999). Thus, the first possibility is that communication is a factor that directly influences team performance in resuscitation teams alongside leadership effectiveness. The second possibility is that communication is the factor through which leadership exerts its influence on team performance in resuscitation teams. Therefore the following question arises: Is there a positive relation between leadership

effectiveness and team performance and what is the role of communication within this relation?

Team Performance

As mentioned above, resuscitations are usually performed by a team of responders and therefore the team performance is one of the factors that determine the outcome of patients in a case of cardiac arrest (Hunziker et al., 2011a). When looking at teams in general, they can be defined as social entities, consisting of two or more members who share and value common goals (Salas, Cooke & Rosen, 2008). To achieve these goals the members have a high interdependency in terms of information which has to be shared, synthesized and integrated (Salas et al., 2008). In the case of CPR, this goal of the resuscitation team is to save a person's life by working together in an effective and efficient manner. Effective and efficient teamwork in CPR comes down to performing the actions of CPR in the correct manner and also by performing the these actions at the right time. Furthermore it is often important to do these actions within a set period of time, e.g. as quick as possible, since time is of the essence in a case of cardiac arrest (Hunziker et al., 2011a).

Leadership

In a resuscitation team, it is usually attempted to maximize team effectiveness by assigning different roles to each member of the resuscitation team. One of these roles is that of the team leader who is responsible for managing the team and its performance in a case of cardiac arrest (Hunziker et al., 2011a). In a CPR-setting effective leadership, or effectively managing the CPR, can be deduced according to five principles: the leader considers situational demands, facilitates contributions of the non-leading team members, asks problem related questions, keeps his 'hands-off' the patient and promotes the exchange of information (Hunziker et al., 2011a). Keeping his hands-off the patient is important since the leader has to manage the situation and has to see the overall picture. The other team members are

responsible for performing the physical technical tasks. Moreover, the team leader has to perform these five principles of effective leadership through clear and unambiguous behavior (Künle, Kolbe & Grote, 2010). In other words, a team leader in a CPR-setting has to tell the other team members what needs to be done and how it should be done. And he has to do this through clear communication and through a clear organization during the resuscitation (Cooper & Wakelam, 1999).

Clear leadership is essential for effective teamwork because it leads to clear objectives, higher levels of participation and effective participation in team decision making (West et al., 2003). An effective and clear team leader lets the other team members perform optimally and therefore has its influence on team performance via his other team members. Research has shown that when a team leader manages to perform clear leadership behavior, it has a positive influence on patient outcomes in critical care teams and that poor leadership behavior is associated with significant flaws in CPR (Hunziker et al., 2011a; Künzle, Kolbe, & Grote, 2010; Marsch et al., 2004). Cooper and Wakelam (1999) also examined the relationship between leadership behavior, team behavior and the performance using video-recorded real-life resuscitation events. Clearer leadership was associated with more efficient cooperation in the team and also with better task performance. Furthermore, Helmreich and Davies (1996) suggest that leadership training may be one of the crucial factors enhancing team performance. Moreover, Castelao, Russo, Riethmüller, and Boos (2013) found leadership to be one of the three essential prerequisites of effective teamwork and therefore also for the quality of CPR and the patient's safety. The other two prerequisites are task management/planning and communication (Castelao et al., 2013). In the case of a resuscitation team, task management/planning is an essential element of leadership behavior. This leaves leadership and communication as the two main interlinked mechanisms to have an effect on CPR performance (Castelao et al., 2013).

Communication

In general, communication can be defined as the transmission of information between one person to another person or group (Castelao et al., 2013). More particularly, in medical emergencies like CPR, communication serves the function of coordinating team processes, information exchange and the facilitation of interpersonal relationships (Castelao et al., 2013). Also according to Castelao et al. (2013), communication has a direct link to the performance of resuscitation teams. For example, inaccurate verbalizations by the team leader and failures of information are linked to treatment errors (Castelao et al., 2013). Next to that, information sharing, inquiry and teamwork skills including communication are found to be positively related to following the CPR algorithms and CPR performance (Thomas et al., 2006; Gaba et al., 1998).

In relation to leadership, verbal communication serves as the best medium how the team leader can facilitate the contribution of other team members, ask problem related questions and promote the exchange of information while at the same time keeping his hands off (Castelao et al., 2013). Next to that, the lack of communication skills is seen to be reduced by a more significant emphasis on teaching leadership skills in Advanced Life Support Courses (Pittman, Turner & Gabbot, 2000). In other words, verbal communication is thé vehicle for information sharing in a CPR-setting for a resuscitation team and more importantly the team leader (Andersen et al., 2010). Thus, next to the direct relation between communication and team performance mentioned by Castelao et al. (2013), communication is also reported to play a mediating role for the influence of leadership on team performance. It is possible that the team leader influences the team performance via the communication with his other team members. Clear and effective communication could be the factor that enables the team leader to successfully manage the resuscitation team and as a result positively

influence the team performance. Either way, clear and effective communication within a resuscitation team is of significant importance for the resuscitation team performance.

A method to make sure that communication within teams occur in a clear, unambiguous and effective manner is by applicating the principle of closed-loop communication. Closed-loop communication is the explicit expression of orders by the team leader, followed by the verbal confirmation of the order by the team member to which the order was directed. This closed-loop strategy involves three steps: (1) the team leader transmits a message, (2) the team member accepts the message and acknowledges its receipt and (3) the team leader verifies that the message has been received and interpreted correctly (Härgestam, Lindkvist, Brulin, Jacobsson, & Hultin, 2013). In this way, closed-loop communication is suitable for taking away the ambiguity that might occur in communication and it is positively related to the quality of performance in a CPR-setting (Castelao et al., 2013; Tschan, 1995). Therefore, closed-loop communication is recommended for resuscitation teams to communicate effectively (Manser, 2009; Andersen et al., 2010). When applying closed-loop communication correctly and continuously, the team leader will have two speaking turns compared to one speaking turn for another team member in a single closed-loop. Next to that, Rehim, DeMoor, Olmsted, Dent and Parker-Raley (2017) found that when task urgency was high, which is the case in a CPR-setting, the overall proportion of communication episodes from the team leader to the other team members increased. And especially since a CPR-setting uses closed-loop communication, communication could play a mediating role in this setting. A good leader leads to a better performance by communicating more clearly and effectively, and in the case of a resuscitation team this could mean that the team leader does so by speaking more frequently than the other team members. It can therefore be expected that a higher number of speaking turns of the team leader compared to

the number of speaking turns of the other team members is related to a better team performance.

The current study

To examine the exact relation between leadership effectiveness, communication and team performance, the current study will take place during the Advanced Life Support-course (ALS) of the master programme of Technical Medicine at the University of Twente. The major part of the course consists of sessions in which knowledge and skills have to be integrated and applied on a simulated patient case in a cardiopulmonary resuscitation (CPR) setting. In this course, the students of the ALS-course are expected to apply the concept of closed-loop communication in the simulations.

Education in medical emergencies via high-fidelity simulations have become increasingly important and are a widely accepted alternative research method (Soar et al., 2010). Due to logistical, safety and obviously also ethical reasons, a controlled systematic investigation of individual and team factors in the early moments of real-life cardiac arrest situations were rarely feasible (Hunziker et al., 2011a). This is exactly what makes these simulation studies such a popular way of training since it allows the teaching of theoretical knowledge and algorithms as well as hands-on skills of rescuers without harming patients or traumatizing the members of the resuscitation team (Hunziker et al., 2011a). Furthermore it gives the opportunity to practice situations that occur infrequently, but where quick application of necessary skills and knowledge is crucial (Hunziker et al., 2011a).

Research question and hypotheses

Following the mentioned literature, previous studies are not unanimous on the exact relation between leadership effectiveness, communication and team performance. Therefore this relation will be examined. Next to that, Castelao et al. (2013) suggest that the influence of communication on the quality of leadership and team performance deserve to be especially

focused upon in research. Hunziker et al. (2011a) also stress the need for further research on the effects of team interactions on performance of complex medical emergency interventions such as resuscitations in order to improve CPR performance and medical outcome of patients.

The following research question will be studied: *What is the relation between leadership effectiveness and team performance and is the number of speaking turns of the team leader mediating this relation?*

Given the literature on these subjects there are two hypotheses that can be formulated: *H1: There is a positive relation between leadership effectiveness and team performance. H2: The positive relation between leadership effectiveness and team performance is mediated by the number of speaking turns.*

These hypotheses follow from the literature that effective leadership results in a better team performance. And within this relationship, the current study aims to examine the role of communication since previous research were not unanimous on this subject.

Method

Participants

All participants in this study were first year master students of the master programme of Technical Medicine at the University of Twente. There were 95 students enrolled in the course of which 87 students (92%) participated in this study. The total of 87 participants were divided between 21 teams of four and one team of three. The team with three participants used a stand-in from another group so that they had a team of four students during every scenario. Therefore they were not excluded from the analysis. The participants were able to form groups themselves. There were 47 female participants (54%) and 40 male participants (46%) and the mean age of the participants was 22.3 ($SD = 1.55$) years old, ranging from the age of 21 to the age of 32. Most teams were mixed teams in which female and male

participants worked together (50.00%). The other teams consisted of only female (31.82%) or male (18.18%) participants. Due to technical failure of the sociometric badges, three more teams had to be excluded from the analysis. For two of these teams, there was no data for the team leaders and in the other team sociometric badges failed for all team members except the team leader.

Materials & design

In the present study, the independent variable was leadership effectiveness, the mediating variable was the ratio of speaking turns and the dependent variable was the team performance. To collect data of these three variables, three different measurements were used. leadership effectiveness and team performance were measured using two assessment scales and the ratio of speaking turns via wearable sensors called Sociometric Badges.

Leadership effectiveness

leadership effectiveness was measured by an assessment scale from Hooijberg (1996) and was filled in by the teachers of the course. The scale consisted of 5 items which were translated to Dutch by one of the researchers and had to be answered on a five-point Likert-scale. For 4 items the value 1 stood for "totally disagree" and the value 5 for "totally agree". An example of one of these four items is: "The way in which this team leader functions is a good example for other team leaders". For the fifth item ("I think this team leader is") the value 1 stood for "very ineffective" and 5 for "very effective". The teachers were asked to rate these items in accordance with their perception of the team leader's effectiveness during the scenario (see Appendix A). The internal consistency of the scale was shown to be high (Cronbach's alpha = 0.97).

Team Performance

The team performance was measured via the assessment scale from Gibson, Cooper, & Conger (2009). Like the leadership effectiveness scale, the team performance assessment

scale was also filled in by the teachers of the course. The scale was also translated to Dutch by one of the researchers and consisted of four items which had to be filled in on a seven-point Likert-scale. For all four items, the value of 1 stood for "very inaccurate" and the value of 5 stood for "very accurate". The items consisted of statements about the performance of the team and the teachers were asked to fill in the items in accordance with his or her perception of the team's performance (see appendix A). An example of one of the items is: "This team is effective". The internal consistency of the scale was shown to be high (Cronbach's alpha = 0.97).[1]

The ratio of speaking turns

The ratio of the number of verbal speaking turns of the team leader to the other team members, was measured by the use of Sociometric Badges. These badges were worn around the necks of the participants and recorded data over several speech features (volume, tone of voice, speaking time), body movement features (energy, consistency) and the proximity to others that are wearing a Sociometric Badge (Kim, Chang, Holland, & Pentland, 2008). For the current study, the badges measured the number of verbal turns of each team member. A turn was hereby defined as "a speaking segment that occurred after and within 10 seconds of another speaking segment" (Preliminary User Guide for Sociometric Badges, 2014). A speech segment had to be made within ten seconds after the previous one ended in order to be considered as a turn. For the second hypothesis, the number of verbal speaking turns of the team leader had to be compared to that of the other team members. In order to do so, the number of speaking turns of the team leader was divided by the average number of speaking turns of the other team members.

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[1]   Additionally, a principal factoring analysis with oblique rotation was done on both scales. This resulted in a one-factor solution based on eigenvalues higher than 1. However, due to time constraints the two concepts were taken as separate factors for the rest of the study.

This resulted in the ratio of speaking turns of the team leader to the other team members. The ratio of speaking turns was chosen since the scenarios in which the data was collected could vary in length. Using the ratio made sure that different lengths of scenarios did not have an influence on the comparison of the teams.

Scenarios

There were ten different resuscitation scenarios which the teachers could present to each team. Of these scenarios, four were shock scenarios, five were non-shock scenarios and one scenario was a combination of shock and non-shock. All scenarios were comparable to each other regarding the degree of difficulty. However, the teachers were able to increase the degree of difficulty during a scenario by adding an incident or adjusting the situation. Also one way of adjusting the situation was by switching from shock to non-shock or vice versa. This could be done when the teachers thought a team was performing well and the scenario in its current state was too easy for them. The average length of the scenarios was 25.32 minutes.

Procedure

The current study was part of a larger study so that the team of researchers during data collection consisted of four researchers. Due to the other studies that were part of the whole larger study, there was also a personality test taken during the lecture in which the informed consent was taken. Furthermore, the team leader of each team was also wearing a wristband that measured the heart rate and skin conductance during the scenarios. The procedures and results of these materials can be found in the study of Van Sas (2017) and Swinkels (2017) and will not be taken into account in the rest of the current study.

Prior to the study, the researchers were contacted by the teachers of the Advanced Life Support-course of the master programme of technical medicine at the University of Twente. Permission for this study was granted by the teachers of technical medicine. At the same time, permission was also granted by the ethics committee of the University of Twente to perform

the study. During the first lecture of the course, the students of the ALS-course were informed about the current study and asked to sign an informed consent form. If one member of a team was not willing to participate, the whole team was excluded from the study.

For each team there were four practice scenarios, one trial assessment scenario and the assessment scenario in the course. During practice scenarios, every participant got the chance to be the team leader once and they could choose the team leader themselves. During the trial assessment scenario and the assessment scenario the team leader was selected at random. For the current study only the data of the assessment scenario will be used. There were two simulation rooms and the four teachers of the course were divided over these two rooms. Therefore it was possible for two teams to perform a random scenario at the same time. In between the two simulation rooms there was a control room where the researchers of this study were seated. The control room consisted of two two-way mirrors so that the researchers were able to see the participants and teachers in the simulation rooms and not the other way around.

Of the participating teams in this study, each member was provided with a sociometric badge prior to a scenario and the badge was switched on by the researchers. Each sociometric badge had a unique number which was registered alongside the student number of the participant. Also it was noted which one of the four participants was the team leader during a scenario. During a scenario, a team was given a scenario of a patient and the objective of each team was to perform the CPR-treatment that was suitable for the case. At the beginning and end of a scenario, the time was written down so that the data of the sociometric badges could be filtered to the time in which the teams were actually performing the scenario. The teachers were instructed to fill in the assessment scales for leadership effectiveness and team performance during every scenario. After the practice scenarios and the trial assessment scenario, a debriefing followed the scenario where the teachers debriefed the participants on

their performance. When the debriefing was done, the teachers gave a sign to the researchers so that they could come into the room and remove the Sociometric Badges from the participants. The teachers then also gave the filled in assessment scales for the leadership effectiveness and the team performance to the researchers.

Data analysis

To answer the research question; *What is the relation between leadership effectiveness and team performance and is the number of speaking turns of the team leader mediating this relation?,* a mediation analysis was conducted to explore the possible relations between the three variables. The mediation analysis was conducted using the process macro of Hayes (2014). The four steps of a mediation analysis were followed (Hayes, 2013).

Results

The research question of the current study addressed the relation between leadership effectiveness and team performance and the possible mediating influence of the ratio of speaking turns. The corresponding hypotheses of this research question are that there is a positive relation between leadership effectiveness and team performance and that this relation is mediated by the number of speaking turns. To test these hypotheses, a mediation analysis was conducted. For the mediation analysis leadership effectiveness was used as the independent variable, the ratio of speaking turns was used as the mediating variable and team performance was used as the dependent variable.

Preliminary analysis

Before the mediation analysis was conducted, the distribution of the data was tested for normality using the Shapiro-Wilk test. Only the data for the ratio of verbal speaking turns was normally distributed (S-W > 0.075). The data for leadership effectiveness (S-W < 0.001) and team performance (S-W < 0.004) where not normally distributed. Following this, the data for leadership effectiveness and team performance was transformed. Neither a logarithmic,

square root or reciprocal transformation improved the normality of the leadership

effectiveness and team performance data so the data was not transformed for the analyses.

Furthermore, following visual inspection of the plots of standardized residuals and

standardized predictor values, the assumptions of linearity and homoscedasticity were met

(see Appendix B).

In addition to this, descriptive statistics and the Pearson correlations between the three

variables were calculated (see Table 1). The correlation between leadership effectiveness (M

= 3.96, SD= 1.07) and team performance (M = 5.37, SD= 1.33) was found to be significant (r

= 0.86, $p < 0.001$). The ratio of speaking turns (M = 1.76, SD= 0.52) did not have a significant

correlation with leadership effectiveness (r = -0.06) nor team performance (-0.06).

Table 1

Descriptive Statistics of and Pearson Correlations between Leadership

effectiveness, the Ratio of Speaking Turns and Team Effectiveness

	1.	2.	3.
1. Leadership effectiveness			
2. Speaking turns ratio	-0.06		
3. Team performance	0.86*	-0.06	
M	3.96	1.76	5.37
SD	1.07	0.52	1.33

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

Mediation analysis

In the first step of the mediation model, leadership effectiveness showed to be a significant

predictor for team performance when ignoring the mediator, $b = 1.02$, $t(16) = 5.64$, $p < 0.001$.

Step two showed that the relation of leadership effectiveness and the mediator for the ratio of

verbal speaking turns, was not significant $b = -0.03$, $t(16) = -0.22$, $p = 0.829$. Because the relation between leadership effectiveness and the ratio of verbal speaking turns was not significant, no mediation could be found. This was confirmed at step three and step four of the analysis. Step three of the mediation process showed that the ratio of verbal speaking turns, controlling for leadership effectiveness was not significant $b = -0.05$, $t(16) = -0.12$, $p = 0.905$. Step four logically showed that, controlling for the ratio of verbal speaking turns, no difference was found in the relation between leadership effectiveness and team performance, $b = 1.02$, $t(16) = 5.64$, $p < 0.001$. Following all the previous, it was also clear that a Sobel test could not find any mediation in the model ($z = 0.03$, $p = 0.979$).

Discussion

The aim of this study was to examine the relation between leadership effectiveness and team performance and the possible mediating role of the number of speaking turns on this relation. This in order to clarify the exact relation of leadership effectiveness and communication on team performance in resuscitation teams. There were two hypotheses. The first hypothesis was that leadership effectiveness would be positively related to team performance. The second hypothesis was that this relation would be mediated by the number of speaking turns. In the current study, this was examined by watching students perform in a simulated resuscitation setting.

On the basis of the results it can be concluded that the first hypothesis can be retained. Leadership effectiveness had a positive relationship with team performance. The second hypothesis however had to be rejected. No relation between leadership effectiveness and the ratio of verbal speaking turns could be found, therefore no mediation through the ratio of verbal speaking turns on the positive relation between leadership effectiveness and team performance was present.

A regression analysis between the reported leadership effectiveness and team performance confirmed that there was a positive relation between these two variables. A more effective team leader showed to be related to a better team performance. This result is in line with the studies of West et al. (2003); Hunziker et al. (2011a); Künzle et al. (2010) and Marsch et al. (2004), that all found that clear leadership behavior has a positive influence on patient outcomes in critical care teams. The current study confirms effective leadership to be an essential prerequisite of effective teamwork within a resuscitation team (Castelao et al., 2013). Teams with a leader that on average scored higher on leadership effectiveness also showed a better team performance.

It was also hypothesized that the positive relation between leadership effectiveness and team performance would be mediated through the ratio of verbal speaking turns between the team leader and the other team members. A mediation analysis showed no significant relation between leadership effectiveness and the ratio of speaking turns. The second step in this analysis was to find a significant relationship between leadership effectiveness and the ratio of speaking turns but this was not found. However, speaking turns is just one of multiple aspects of verbal communication and there might be other aspects of communication that do reflect the mediating role of communication in the relation between leadership effectiveness and team performance.

Limitations and further research

The first limitation follows from the above mentioned, and is that the assumed mediating role of communication was only accounted for via the ratio of verbal speaking turns. The data from the Sociometric Badges only produced quantitative data and speaking turns are just one of many aspects of communication. The badges did, for instance, not show anything about what the team leader was actually saying. The quality of each speaking turn therefore remains unknown. It could be possible that a team leader has the highest ratio of speaking turns but is

not saying anything that is of use in the resuscitation scenario. Castelao et al. (2013) for instance found that inaccurate verbalizations by the team leader and failures of information are linked to treatment errors. If inaccurate verbalizations were the case in the current study, only the quantity of these verbalizations would have been registered. But the fact that they were inaccurate would not have been represented by the data since the data is only quantitative. Furthermore, the principle of closed-loop communication was applicated during the scenarios in order to take away ambiguity in communication (Castelao et al., 2013; Tschan, 1995). But since the quality of speaking turns are unknown, it could be that despite a good ratio of speaking turns the ambiguity still remained.

Next to that, the number of speaking turns does not show how long they were talking during each turn. It could for instance be the case that a good team leader has turns in which he gives a lot of information to his team members, and therefore longer speaking segments of the leader are related to a better team performance. The contrary might also be the case, namely that a good team leader is concise in his speaking turns and provides all the necessary information as efficient as possible. This might especially be the case in resuscitation teams where concise closed-loop communication is used to maximize the effectiveness of communication.

Despite the limitation mentioned above, the current study was a step forward towards understanding the role of communication in resuscitation teams. It showed that turn taking on itself was not a mediator for the relationship between leadership effectiveness and team performance but other aspects of communication might be. And following the above mentioned two other possible relevant aspects of communication, a mixed-methods study is suggested for further research. Combining the quantitative aspects of communication with the qualitative aspects might provide a better insight in the exact role of communication in resuscitation teams. For example it could be registered what the resuscitation members are

actually saying in their speaking turns and how long they spoke alongside the number of speaking turns. It might be that one of these other aspects might be a mediator for the relation between leadership effectiveness and team performance or provide a better insight in why speaking turns are not moderating this relation.

Another limitation is that the calculation of the ratio of speaking turns made use of the average number of speaking turns for the other team. Because of this, a speaking turn ratio above 1.00 did not necessarily mean that the team leader had more speaking turns than the other team members. It was possible that the ratio of speaking turns was larger than 1.00 (indicating that the team leader had more turns than the other team members) but that a single team member had more speaking turns than the team leader. This was actually the case in one team. The team leader had 688 turns and the other team members respectively 712, 567 and 290. The ratio of speaking turns therefore was 1.10 although one team member had more turns than the team leader. The situation in this team might be explained by the studies of Künzle et al. (2010) and Xiao et al. (2004), who found that leadership can be divided among team members. It can depend on the situation and the composition of the team which of the team members is fulfilling the role of team leader (Künzle et al., 2010; Xiao, Seagull, Mackenzie & Klein, 2004). This might have been the case in this team and maybe also in other teams. This aspect can also be included in a mixed-methods approach. It can be interesting to see of the role of a team leader within a resuscitation team shifts from one team member to another. A dynamic leadership role could in resuscitation teams could be especially interesting since resuscitation teams are very structured beforehand.

A fourth limitation is the fact that the factor analysis demonstrated that only one factor could be extracted from the combined items of both the leadership effectiveness scale and the team performance scale. Both scales showed to measure the same factor, effectiveness, and not the two different factors they intended to measure. It could be that the scales were not

translated correctly or were not correctly interpreted by the raters. It is also possible that the two concepts are so strongly related that it is important for theory to make a better distinction between the two, or to consider the two concepts as the same in the case of a resuscitation setting.

Finally, the small sample size of eighteen teams could have caused that the data of leadership effectiveness and team performance was not normally distributed. This could also have caused the fact that no significant relation between the mediator and the other two variables were found, let alone a mediating relation. For further research, a larger sample of resuscitation teams is advised.

Conclusion

In the current study the relation between leadership effectiveness and team performance was measured in a simulated resuscitation setting. Also the assumed mediating role of the number of verbal speaking turns on this relationship was examined. The study found that leadership effectiveness was positively related to team performance. It was found that a more effective resuscitation team leader was positively related to a better resuscitation team performance. The mediating role of the number of verbal speaking turns was not confirmed.

The current study provided confirmation of the importance of a good and effective team leader in a resuscitation team. An effective team leader results in a better performing resuscitation team and as a result of this in better patient outcomes and survival rates in the case of cardiac arrest. Next to that, the current study showed that the ratio of speaking turns can be ruled out as a mediator for the relation between leadership effectiveness and team performance. Following the above, the current study provides a good direction for further research on this topic and was another step into the right direction of understanding the role of communication in resuscitation teams.

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Appendices

Appendix A – Team effectiveness and team performance scales

<table>
<tr><td></td><td>Groep:</td><td>_____</td></tr>
<tr><td></td><td>Datum:</td><td>__ / __</td></tr>
<tr><td></td><td>Practicum:</td><td>_____</td></tr>
<tr><td></td><td>Rater:</td><td>_____</td></tr>
</table>

Team effectiveness

and performance scales

Hieronder volgen enkele uitspraken. Geef aan in hoeverre je het eens of oneens bent met de uitspraak of item. Teken daarvoor een kruis in de desbetreffende cirkel. Noteer ook je voorletters in de rechterbovenhoek van deze bladzijde.

Geef bij elke uitspraak een antwoord, zelfs als je niet helemaal zeker van je antwoord bent. Belangrijk om te weten: er is geen goed of fout antwoord. Alle gegevens worden enkel ten behoeve van dit onderzoek gebruikt.

Team performance

	Erg inaccuraat						Erg accuraat
	1	2	3	4	5	6	7
1. Dit team is een consistent goed presterend team	◯	◯	◯	◯	◯	◯	◯
2. Dit team is effectief	◯	◯	◯	◯	◯	◯	◯
3. Dit team maakt weinig fouten	◯	◯	◯	◯	◯	◯	◯
4. Dit team verzet kwalitatief hoog werk	◯	◯	◯	◯	◯	◯	◯

ALS performance
1 = onvoldoende, 5 = uitstekend

	- -	-	+/-	+	+ +
	1	2	3	4	5
5. ALS-protocol	◯	◯	◯	◯	◯
6. Uitvoering handelingen	◯	◯	◯	◯	◯
7. Diagnostiek en klinisch redeneren	◯	◯	◯	◯	◯
8. Therapeutisch plan	◯	◯	◯	◯	◯
9. Werkwijze	◯	◯	◯	◯	◯

Leadership effectiveness

	1	2	3	4	5
	Volledig mee oneens				Volledig mee eens
10. Vergeleken met andere leidinggevenden is deze leidinggevende **niet** erg efficiënt	◯	◯	◯	◯	◯
11. De manier waarop deze leidinggevende functioneert is een goed voorbeeld voor andere leidinggevenden	◯	◯	◯	◯	◯
12. Deze leidinggevende slaagt er vaak **niet** in doelen te halen	◯	◯	◯	◯	◯

13. Deze leidinggevende heeft succes binnen het team	○	○	○	○	○

		Zeer ineffectief			Zeer effectief
14. Ik vind deze leidinggevende: zeer ineffectief (1) - zeer effectief (5)	○	○	○	○	○

Appendix B

Appendix B.1 – Regression standardized residuals for mean scores of the team performance scale

Regression Standardized Residual
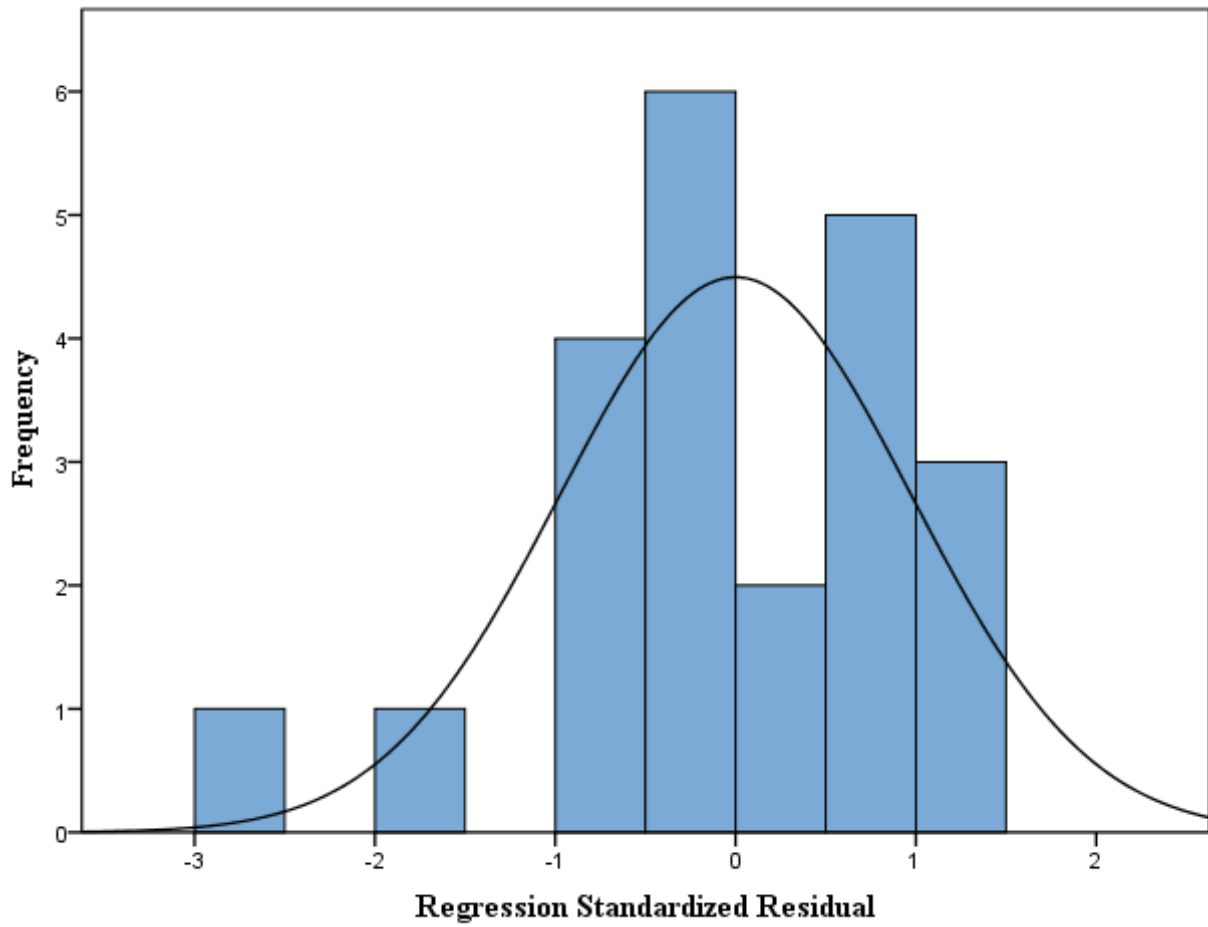
Appendix B.2 – Regression Standardized Residual and Predicted Values for the leadership effectiveness scale

Scatterplot

Dependent Variable: Gemiddelde score op de Team Performance scale