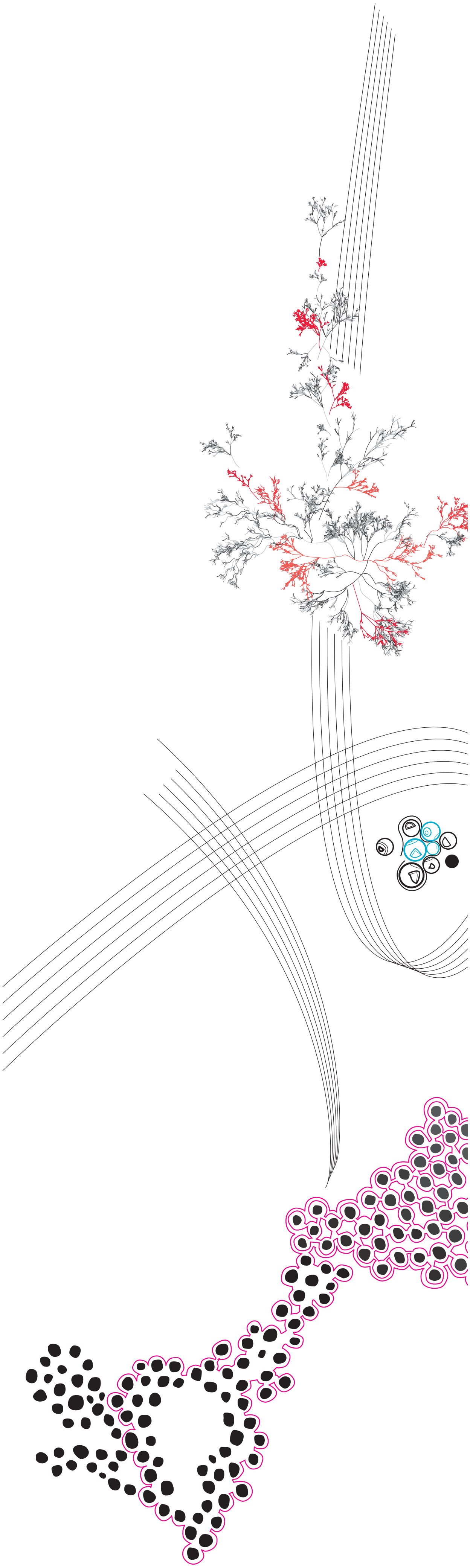

MASTER THESIS

THE EFFECT OF TEAM LEADER STRESS ON TEAMS PRACTICING CARDIOPULMONARY RESUSCITATION IN A SIMULATION ROOM

An exploratory study into the effect of team leader stress on team leader behaviour, closed-loop communication, and team performance of a simulated medical emergency team

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MASTER THESIS

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SUMMARY

In previous research, both leader behaviour and stress were found to be important antecedents of teams who perform cardiopulmonary resuscitation, but it has not been studied how these concepts are related and what micro-leader behaviours positively impact team performance in a simulated context. Therefore, the purpose of this study was to find out if and how the concepts of team leader stress, team leader behaviour, closed-loop communication, and team performance were related. To find out, 22 teams of Technical Medicine student participated in an exploratory research, with psychological and physiological stress measurement, coded video observation, and team performance measurement. On basis of correlational analysis and t-tests insight could be obtained in which leader behaviours and stress levels were found in the high and lower performing teams. The t-tests did not result in significant differences between high and low performing teams regarding stress level, behaviour and closed-loop communication. However, correlation testing showed a moderate positive relation between physiological stress and closed-loop communication, and a moderate negative relation was observed between psychological stress and team performance. Additional exploratory analysis showed a strong correlation between team leader behaviour (focused on task distribution and information gathering) and closed-loop communication. Also, the duration of the CPR-session was negatively related to team performance and positively related to self-reported stress. The paper finalizes with a conclusion, practical implications, and with suggestions for future research.

Keywords: Team leader stress – cardiopulmonary resuscitation – simulation – team performance – communication – behaviour – closed-loop communication

1 EXPLORATION AND DEFINITION OF THE RESEARCH PROBLEM

1.1 Problem statement

Within the medical world, effective cooperation between team members is a core element for establishing high quality patient-care. Next to teamwork, also good coordination of actions within a team is important to improve performance during life-threatening situations for the patient, for example during cardiopulmonary resuscitation (CPR). These complex emergency situations are characterized by "extreme time pressure, diagnostic uncertainty, and rapidly evolving situations" and thus require a high level of coordinated and efficient communication within the surgical team (Doumouras, Keshet, Nathens, Ahmed, & Hicks, 2012, p. 274; Hunziker, Johansson, et al., 2011). The ineffective team leader coordination and occurrence of team member stress within this challenging situation can contribute to an increase of medical errors in the intensive care unit (Piquette, Reeves, & LeBlanc, 2009). Therefore, it is important to better understand how medical teams can interact effectively and team leaders can act adequately to enhance team performance and reduce errors.

While performing stressful medical tasks, good team performance consists of mastering both technical and non-technical skills. Within this context, technical skills include medical expertise, technical expertise and clinical decision making (Bearman et al., 2012). These skills are the main focus during formal medical education. Nontechnical skills are primarily taught on the job and are defined as "important contributory factors influencing CPR performance" (Bearman et al., 2012; Hunziker, Tschan, Semmer, & Marsch, 2013, p. 1). This includes teamwork, leadership, communication, professionalism, collaboration and workload management (Bearman et al., 2012; Carlson, Min, & Bridges, 2009; Hunziker et al., 2013).

To enhance the performance of medical teams, and to prepare students and medical professionals for life-threatening medical emergencies, several universities and hospitals built simulation units for simulation-based training (SBT). Salas, Wildman, and Piccolo (2009) describe SBT as "any synthetic practice environment that is created in order to impart these competencies (i.e., attitudes, concepts, knowledge, rules, or skills) that will improve a trainee's performance" (p. 560). The amount of medical simulation settings has expanded with the development of complex technologies which enable simulations that come close to reality, especially when combining them with high-fidelity scenario's and human factors (Dias & Neto, 2016; Grenvik & Schaefer, 2004). A meta-analysis of 114 studies comparing SBT to no intervention (concerning knowledge, skills, satisfaction, patient effects, behaviour towards patients) concluded that SBT is highly effective (Mundell, Kennedy, Szostek, & Cook, 2013). Simulation offers a risk-free context in which students can learn how to manage stress (Andreatta, Hillard, & Krain, 2010; Klass, Tam, Cockburn, Williams, & Toms, 2008) and improve performance (Shapira-Lishchinsky, 2014). It allows to learn from mistakes by immediate feedback, post-event debriefing and by the opportunity to make mistakes without the risk of harming patients (Hayes, Rhee, Detsky, Leblanc, & Wax, 2007; Salas et al., 2009). In conclusion, a simulation environment provides a learning situation in which technical and non-technical skills can be assessed together (Andreatta et al., 2010; Shapira-Lishchinsky, 2014).

Still, practicing and being assessed on medical skills within a simulation environment can be stressful. In fact, in simulation settings especially CPR scenarios are seen as a challenging experience which causes physiological as well as psychological stress responses (Piquette et al., 2014; Sandroni et al., 2005) similar to those observed in a real emergency room (Dias & Neto, 2016). The influences of stressful situations on performance in simulated medical settings have been thoroughly studied. However, previous research focused on different aspects (such as individual versus team performance, and self-reported versus physiological stress) and showed mixed results: some studies found a positive relationship between perceived stress during the CPR simulation and individual performance (DeMaria et al., 2010; LeBlanc, Woodrow, Sidhu, & Dubrowski, 2008; Pottier et al., 2015), while others found a negative relationship between self-reported stress and team performance (Hunziker, Laschinger, et al., 2011; Hunziker et al., 2012). Even other researchers found no significant association between individual stress and team performance (Bjørshol et al., 2011; Piquette et al., 2014). Two studies provided reasons why stress affected individual performance positively: Pottier et al. (2015) explain this positive effect by stating the in stressful scenario's, certain cognitive functions (such as reasoning) may temporary enhance, which leads to improvement of some aspects of individual performance. Johnston, Driskell, and Salas (1997) suggested that the effect of stress on human performance is because people make different decisions in stressful situations. Even though these studies merely explain the effect of stress on individual performance, it implies that factors such as leadership behaviour might also provide an explanation for the link between stress and team performance, as decision making is a central team leader task (Tschan et al., 2006). However, to the extent of our knowledge, no research provided reasons for the effect of stress on team performance. This provides reason to investigate if behaviours displayed during the CPR simulation could provide insight into the link between stress of the individual and team performance. It is empirically established that in an emergency setting such as CPR, team performance is positively influenced by team leader and team behaviour (Hunziker, Johansson, et al., 2011; Siassakos et al., 2011). Next to this, interaction between leader and follower is also of importance. Closed-loop communication (CLC) is an interaction method in which feedback is central (Jacobsson, Hargestam, Hultin, & Brulin, 2012). CLC has its origin in Crisis Resource Management, and has been trained and used in aviation teams because of its explicit and unambiguous coordination character. This is also relevant in CPR situations, and has proved to be beneficial for team performance (Schmutz, Hoffmann, Heimberg, & Manser, 2015). Still, to the best of our knowledge, almost no study has integrated stress and team interaction in a CPR setting.

In conclusion, it becomes clear that a lot of research has been done on the effects of stress on clinical team and individual performance. However, results regarding these factors are contradictory, with negative effects on team performance and positive or no effects on individual performance. LeBlanc (2009) argued that more research is needed in order to obtain a deeper understanding of how stress influences clinical team performance. Behavioural factors could explain the link between individual (team leader) stress and team performance, as previous studies highlighted the effects of team leader behaviour on team performance in emergency situations (Tschan et al, 2006; Hunziker et al., 2013; Siassakos et al., 2011). However, previous research did not study the relations between individual stress, behaviour and team performance in a simulated CPR context. Therefore, the goal of the present research is to find out whether and how verbal behaviour of the team leader as well as CLC play a role in the relation between team leader stress and team performance in a simulated CPR environment.

1.2 Theoretical conceptual framework

Action teams. The type of team performing CPR in a simulation setting or during real emergencies, can be regarded as an action team. Action teams are defined as "teams where members with specialized skills must improvise and coordinate their actions in intense, unpredictable situations" (Edmonson, 2003, p. 1421; Marks, Zaccaro, & Mathieu, 2000; Sundstrom, de Meuse, & Futrell, 1990). In other words, it is the task of action teams quickly establish effective coordination in unexpected situations, using an information transfer system which is free and open (Edmonson, 2003). Action teams have to adapt to rapidly changing conditions (Marks et al., 2000). Communication in action teams cannot be "scripted" in advance and has to be real-time, to keep up with the "fast-paced reciprocal coordination" (Thompson, 1967, as cited in Edmonson, 2003, p. 1422). However, it is possible to train reactions to extreme events, such as the coordination and start-up of CPR when a patient is in a critical state. The team leader has an important position in an action team to establish effective coordination. His/her task is to coordinate and initiate tasks, divide roles, communicate, and monitor progress of the patient and the team (Marks, Mathieu, & Zaccaro, 2001; Zaccaro, Rittman, & Marks, 2001). Because the actions of the team leader have a direct effect on team performance (Cole & Crichton, 2006; Cooper

& Wakelam, 1999; Marsch et al., 2004), taking on a leader role in an emergency team can be stressful (Schull, Ferris, Tu, Hux, & Redelmeier, 2001).

Stress. A widely accepted and used definition of stress has been created by Lazarus and Folkman (1984). They describe that psychological stress emerges when the perceived demands of the environment exceed a person's ability to cope with these demands. In line with Lazarus and Folkman, Boucsein (2012) defines stress as a "state of high general arousal and negatively tuned but unspecific emotion, which appears as a consequence of stressors (i.e., stress-inducing stimuli or situations) acting upon individuals" (p.381). Therefore, it can be defined as a cognitive process, despite its emotional facets (Pfaff, 2012). Many scholars have used Lazarus and Folkman's model as basis for their study (Hunziker, Laschinger, et al., 2011; LeBlanc, 2009; Müller et al., 2009; Pfaff, 2012; Pottier et al., 2015). Because stress is a concept which encompasses a broad spectrum of variables and cognitive processes, it can be challenging to measure (Lazarus & Folkman, 1984; Piquette et al., 2014).

In literature, two general types of responses to stress in a medical context are described (LeBlanc, 2009; Piquette et al., 2014). The first category consists of negative emotional responses such as anxiety. For instance, Bjørshol et al. (2011) found that, when students in a simulated emergency resuscitation situation were exposed to socioemotional stress (i.e. psychological pressure, such as personal items, emotional bystanders, telephone calls in the background), their subjective workload increased, as well as feelings of frustration. The second category contains physiological responses to stress controlled by the sympathetic nervous system, which emerge after a challenge or threat is experienced (LeBlanc, 2009). As an example, it is known that stress causes reactions such as changes in skin conductance (sweating), tachycardia (a heart rate higher than the heart rate in resting state) and increased blood pressure during and immediately after performing CPR (LeBlanc, 2009; Sandroni et al., 2005). Also, an increased amount of the stress hormone cortisol emerges in the blood, which spreads to saliva within minutes (LeBlanc, 2009).

Measuring stress. In accordance with the types of stress responses, stress can be measured in several ways. Firstly, emotional responses can be measured with a self-report. However, this is highly subjective (LeBlanc, 2009). Secondly, physiological stress can be measured in electrodermal activity (EDA) (Boucsein, 2012; Setz et al., 2010), salivary cortisol (Hunziker et al., 2012; Müller et al., 2009; Piquette et al., 2014) and heart rate (Andreatta et al., 2010; DeMaria et al., 2010; Gilligan et al., 2005; Hunziker et al., 2012; Sandroni et al., 2005; Waller, Reitz, Poole, Riddell, & Muir, 2017). Research found that the objectively measured arousal using heart rate, EDA, or cortisol sensors is not always in line with perceived feelings of stress (Hunziker et al., 2012; Waller et al., 2017). This is because physiological reactions emerge while experiencing distress (negative stress), but also while experiencing eustress (positive stress) (Boucsein, 2012). In other words, with a sensor to measure physiological stress only the intensity can be assessed, not the valence. This makes it difficult to determine what was the cause of a physiological reaction. Moreover, the intensity of physiological reactions differs per individual. Therefore, it is advised to administer a baseline measurement for each respondent (Boucsein, 2012). Concerning disadvantages of physiological stress measures, Hunziker et al. (2012) warns for the limiting value of heart rate measurements in CPR settings, due to the influences of physical activity, such as giving compressions. Also, in the same research, no association between salivary cortisol levels and team performance was found. The disadvantages of every stress measurement option make it challenging to capture stress. The reliability of stress measurement can be improved by using psychological as well as physiological measures. In research on aviation teams, skin conductance is an established method to measure arousal and/or stress.

EDA. In a medical setting, EDA is considered "one of the most sensitive psychophysiological indicators of stress" (Boucsein, 2012, p. 459; Poh, Swenson, & Picard, 2010). EDA is defined as the surface changes in skin conductance (Poh et al., 2010) and reflects sympathetic nervous system activity (Benedek & Kaernbach, 2010; Lin, Lin, Lin, & Huang, 2011; Poh et al., 2010). In other words, in EDA, the skin's responses to sweat secretion, a common feature of arousal (and thus stress), are measured.

Noordzij, Dorrestijn, and Berg (2016) describe the skin conductance signal as “small, short waves (Skin Conductance Responses: SCR’s) riding on a larger wave (the Skin Conductance Level: SCL)” (p.81). Figure 1 visualizes these two concepts. The SCR’s give an indication of the intensity of arousal, but does not provide information on the valence (positive/negative) or emotion connected to the affect, such as joy, anger, or fear (Figner & Murphy, in press). Still, in many team settings, such as during flight simulations, EDA arousal has been used as an established measurement instrument to give an indication of stress. Nonetheless, within the scope of our knowledge, it has not been used in a simulated CPR setting. This could be because measuring EDA on the palmar site (with a high density of sweat glands) could disrupt the medical task (Boucsein, 2012). As a solution, Poh et al. (2010) suggest that an EDA wearable on the distal forearm is an unobtrusive and viable alternative closely paralleling EDA on the palmar sites.

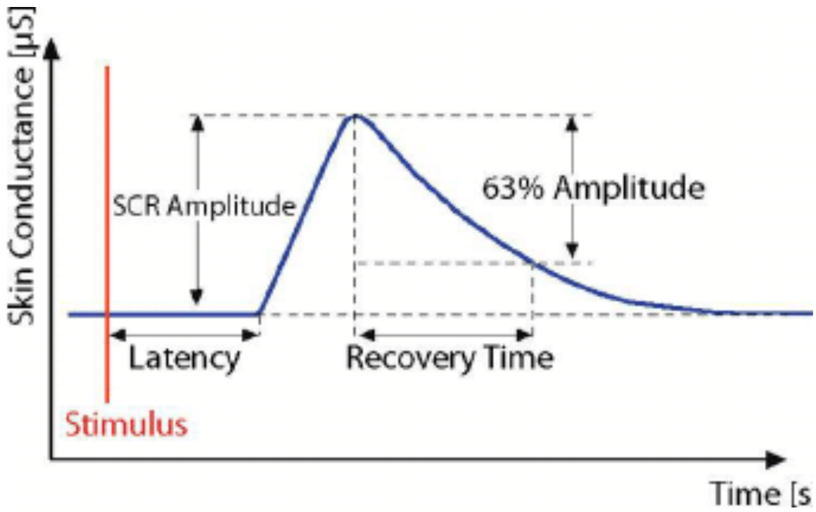

Figure 1. Visualization of an ideal SCR, with the SCL indication on the left axe (Setz et al., 2010)

Team performance. When looking at the effects of individual stress on the quality of work and the performance of the team, research results are contradictory. Neither Piquette et al. (2014), nor Bjørshol et al. (2011) found a significant association between self-reported stress of students performing resuscitation in a simulation environment and team performance. However, these findings do not mean that stress has no effect on team performance in such a setting. Hunziker, Laschinger, et al. (2011) and Hunziker et al. (2012) show a negative relation between self-reported stress of each team member and team performance. In addition, it was found that stressful conditions (such as a higher task load, auditory distraction, and time pressure) have a negative influence on team performance compared to non-stressful conditions in a simulated naval decision-making task (Driskell, Salas, & Johnston, 1999). A loss of team perspective that occurred under stress was identified as one reason for this impaired team performance.

On an individual level, however, several researchers found a positive effect of stress on performance: In a prospective randomized crossover study, Pottier et al. (2015) compared four groups of medical students performing two simulated medical ambulatory tasks with added intrinsic stressors (i.e. stressful components integral to the task) and/or extrinsic stressors (i.e. stressful components peripheral to the task), depending on the assigned group. They observed positive effects of both extrinsic and intrinsic stressors on clinical individual performance, encompassing clinical skills, diagnostic accuracy, and argumentation. They suggest that “under stressful conditions, medical students resort to an increased panel of clinical skills”, such as clinical reasoning. Also, DeMaria et al. (2010) found that for novice medical trainees, simulations with added emotional stressors induced psychological and physical stress (heart rate), but also correlated with improved individual performance of practical Advanced Cardiac Life Support skills in an assessment 6 months after the training. LeBlanc et al. (2008) observed similar results: Perceived stress in surgery residents was accompanied by individual improvements in following the technical protocol (i.e. “the itemized sequence of movements during technical procedures”). However, these studies only focused on individual performance, rather than on team performance. To the extent of our knowledge, positive effects of individual stress on the functionality of a medical team, have not been published. Also, no study integrated the effect of the role within the team (i.e. team leader, follower) on this process. The findings regarding team performance provide reason to assume a negative relation between team leader stress (psychological as well as physiological) and team performance, despite the measured positive effects on individual performance. Thus, the following hypothesis emerges:

Hypothesis 1: In a simulated CPR scenario, the stress level of the team leader is higher in low performing teams than in high performing teams.

In addition to stress, researchers point out the importance of effective communication behaviour in complex situations like emergency CPR (Bergs, Rutten, Tadros, Krijnen, & Schipper, 2005). More specifically, nontechnical skills, such as teamwork and effective coordination, are important contributors to the performance of a team in a CPR setting (Hunziker et al., 2013). Also, literature reviews point out the importance of effective communication (e.g. explicit communication, thinking out loud, CLC, clear messages), as it has been proven to influence the performance of medical teams (Fernandez Castelao, Russo, Riethmüller, & Boos, 2013; Hunziker, Johansson, et al., 2011). For example, failure in communication can cause medical errors, while higher levels of team information sharing increases team performance in a CPR setting (Fernandez Castelao et al., 2013). In the following paragraph, we will elaborate on the importance of how the team leader behaves and how this influences team performance in a CPR setting.

Team leader behaviour. It is known that effective leadership skills can improve team performance in general (Edmonson, 2003; Hunziker et al., 2013). In fact, team leaders have an important role to help coordinate team actions in stressful situations where members might not know how to act (Edmonson, 2003; Hayes et al., 2007). Especially in emergency situations, the leader needs be proactive and has to ensure fast coordination and clear decision making (Tschan et al., 2006). Effective leadership behaviour (i.e. structuring and coordinating actions during team communication) also plays a key role in team coordination and communication (Tschan et al., 2006; Zaccaro et al., 2001), and can be seen as a form of task-related or directive leadership behaviour (van der Haar, Koeslag-Kreunen, Euwe, & Segers, 2017). In a CPR setting, this task-related type of leadership enhances group performance (Tschan et al., 2006).

Looking deeper into the task-related behaviour of the team leader, Zaccaro et al. (2001) states that communicating clear goals and clear tasks by the leader reduces the emotional reactions by team members, leading to an increase in performance in stressful situations . The importance of clear task distribution was also highlighted by several other researchers (Andersen, Jensen, Lippert, & Østergaard, 2010; Marsch et al., 2004). In addition, next to delegating tasks, it is also important to maintain open and extensive communication towards and within the team, so information can be transferred between leader and follower: Hannah, Uhl-Bien, Avolio, and Cavarretta (2009) state that in extreme contexts[1], effective leaders are receptive to the input of team members, are approachable, explain their choices and actions and communicate abundantly. Moreover, van der Haar et al. (2017) argue the importance of leader structuring behaviours, such as clarifying and summaries, in emergency command-and-control teams[2]. In CPR settings, creating a shared goal is a central team leader task

[1] An extreme context is “an environment where one or more extreme events are occurring or are likely to occur that may exceed the organization's capacity to prevent and result in an extensive and intolerable magnitude of physical, psychological, or material consequences to—or in close physical or psycho-social proximity to—organization members” (p. 898). Examples of this are an ambulance team or medical emergency teams.

[2] Emergency command-and-control teams are multidisciplinary emergency management teams in which authorities such as the fire department, police, medical assurance unit, and government work together to

(Jacobsson et al., 2012). Findings from previous research has not gone by unnoted: in their guidelines for Advanced Adult Life Support, the American Heart Association (2015) states that the team leader of a CPR team is required to be able to maintain an overview of the team, guide team members in specific tasks, and have an overview of the total situation. In spite of this, the European Resuscitation Council has not included such guidelines for Adult Advanced Life Support (Soar et al., 2015).

To summarize, behaviours related to task distribution, information gathering and summarizing have been found to influence team performance in emergency contexts. These task-related behaviours lie far from social behaviour, which was has not been discussed in CPR research. Based on this knowledge, we hypothesize:

> *Hypothesis 2*: In a simulated CPR scenario, a high performing team has a team leader who shows (a) more behaviour oriented at task distribution, (b) more behaviour to gather information, (c) more summarizing behaviour, and (d) less social behaviour than team leaders in low performing teams.

In the previous section, it became clear that many researchers confirm the importance of effective leadership in challenging situations such as CPR. Consequently, while hypothesis 2 focuses on the connection between team leader behaviour and performance, there might also be a connection between team leader stress and leader behaviour. For example, there is evidence pointing to the direction that the experience of individual stress is positively correlated with leader behaviour. It was observed that when the task load in a CPR setting increases, “the communication process becomes vulnerable to both time delays and errors” (Fernandez Castelao et al., 2013, p. 518). This suggests that increased stressors can influence the communication process negatively. However, scant literature is available in which the link between team leader stress and team leader behaviour during CPR is examined. The present research will attempt to address this gap in literature by testing the following hypothesis:

> *Hypothesis 3*: In a simulated CPR scenario, a stressful team leader shows (a) less behaviour oriented on task distribution, (b) more behaviour to gather information, (c) less summarizing behaviour, and (d) more social behaviour than a team leader who is not stressed.

Closed-loop-communication. In relation to effective team interaction in a CPR setting, several researchers promote the positive effects of CLC (Fernandez Castelao et al., 2013). This structured communication strategy originated from the field of aviation and has the goal to reduce errors by improving task completion with clear, structured, and standardized communication (Brindley & Reynolds, 2011; Härgestam, Lindkvist, Brulin, Jacobsson, & Hultin, 2013). As is visible in Figure 2, CLC is characterized by three phases: First, an initial message sent by the sender (call-out, e.g. “*Frank, will you turn on the electrocardiogram?”*). Secondly, this is confirmed or acknowledged by the receiver (check back, e.g. “*Yes, I will”*). Finally, this is then confirmed back by the sender (closing the loop, e.g. “*Great, thank you”*) (Davis et al., 2017; Härgestam et al., 2013; Jacobsson et al., 2012; Schmutz et al., 2015). This way of communicating has been found to have a positive correlation with team efficiency in simulated emergency tasks (Siassakos et al., 2011). Also, after coding medical emergency teams during critical medical tasks in simulation, Schmutz et al. (2015) confirmed a positive correlation between check-backs and team performance. However, this relationship was only found in algorithm-driven tasks (i.e. quick and correctly executed tasks driven by specific triggers which provoke stored actions) in a CPR setting, and not for knowledge-driven tasks (i.e. “actions on a higher cognitive level, including identification of certain cues that must be integrated with existing knowledge about possible diagnoses”: p. 764), which are known to have more room for diagnosing, setting up a treatment plan, and treating the patient. Based on these findings from previous research, we hypothesize:

create an overview and shared representation of an emergency situation. They create a shared goal, initiate and assign actions, and report on these (van der Haar et al., 2017).

Hypothesis 4: In a simulated CPR scenario, high performing teams exhibit (a) more check-backs, and (b) more closing-the-loop-behaviour than low performing teams.

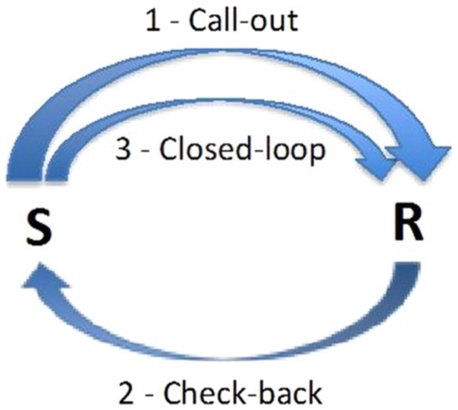

Figure 2 Closed-Loop Communication between sender (s) and receiver (r) (Härgestam et al., 2013)

To the extent of our knowledge, possible effects of team leader stress on CLC have not yet been studied. However, previous research, described for hypothesis 3, provides reason to assume that individual stress of a central figure in the team (the team leader) can have influence on team behaviour, and thus, CLC. Therefore, we hypothesize:

Hypothesis 5: In a simulated CPR scenario, a stressful team leader (a) receives less check-backs from followers, and (b) exhibits less closing-the-loop-behaviour than a team leader who is not stressed.

1.3 Research question and model

Based on theoretical implications and findings from previous research, it becomes clear that especially the relation between team leader stress, behaviour, and team performance has not yet been studied within the context of a simulated emergency CPR. However, previous findings imply that behaviour plays an important role in teams in these situations, which are known to be stressful, and require high performance. Therefore, this research will attempt to find an answer to the following question: *What is the role of team leader verbal behaviour and closed-loop communication in the relation between team leader stress and team performance in a simulated cardiopulmonary resuscitation setting?* In this explorative study, the present research will test the whether and how the hypothesized independent and mediator factors (as depicted in Figure 3) have an effect on team performance.

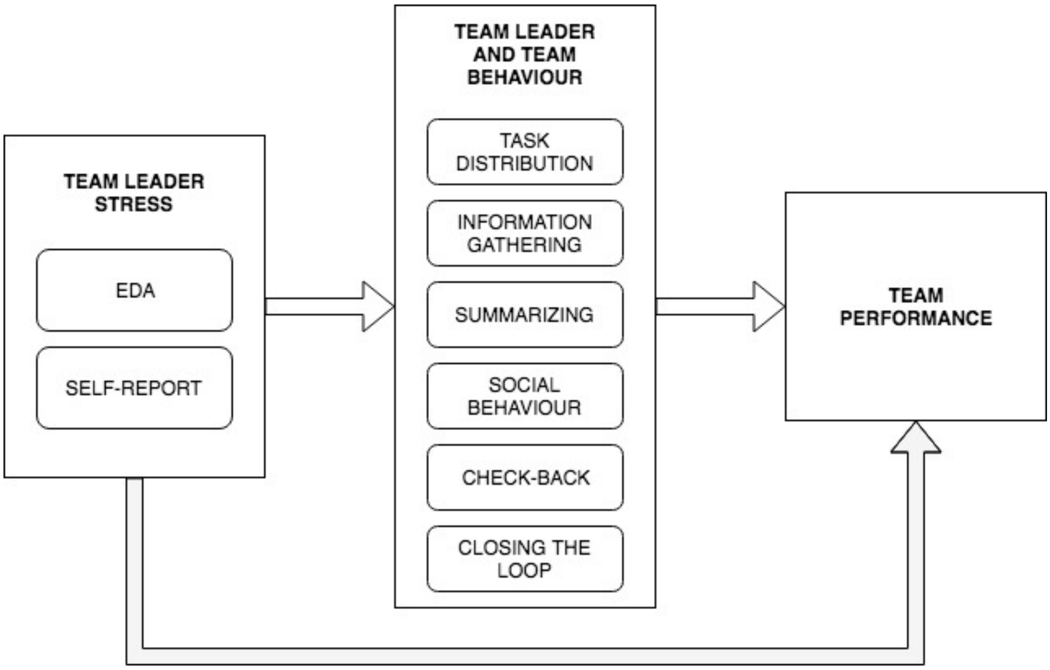

Figure 3. Research model

1.4 Scientific and practical relevance

Scientific relevance. Recent studies within (simulated) CPR settings focused mainly on the direct effect of stress on team or individual performance (e.g. Bjørshol et al. (2011); DeMaria et al. (2010); Hunziker, Laschinger, et al. (2011); Hunziker et al. (2012); LeBlanc et al. (2008); Piquette et al. (2014); Pottier et al. (2015)). Mixed results were found; this could be due to not including the underlying processes between these two concepts. The present research will contribute to the extant literature as it will search for a better understanding of the effects of stress in a simulated clinical emergency setting, by studying the underlying behavioural processes within the team. Simultaneously, it will, on an exploratory basis, give insight in the validity of measuring stress with EDA using a wristband in a simulated CPR setting.

Practical relevance. Because the present study is conducted with the cooperation of an Advanced Life Support course at the University of Twente, it's chosen methods are context-specific. The findings of this study could therefore be of use to the Experimental Centre for Technical Medicine (ECTM), the faculty of Science and Technology at the University of Twente, and the prospective students of this course. Alongside, it could also be beneficial for communication and leadership training of hospital teams. Better insight into the effects of stress on the team leader, on communication within the team and eventually on the learning of students, can result in improvements of simulated medical CPR-training in teams, and eventually in better trained professionals. Possibly, findings could be generalizable to other courses which assess medical skills in simulation rooms (e.g. endoscopic skills, surgical skills, and injections, punctures and catheterizations).

2 RESEARCH APPROACH

2.1 Research design

During this exploratory research, four constructs were measured in order to test underlying relationships: (1) team leader stress, (2) verbal team leader behaviour, (3) CLC in the team, and (4) team performance. In order to give answer to the research question, a mixed-method approach was used in a cross-sectional design. Four different data sources were used: (1) skin conductance measurement, (2) self-reported stress, (3) video-coded behaviour of team leaders and CLC in the team, and finally, (4) technical and non-technical team performance scores.

2.2 Research context

The present research was a cooperation between the faculty of Behavioural, Management and Social Sciences and the Experimental Centre of Technical Medicine (ECTM), both located at the University of Twente. The ECTM is a centre which provides simulation units for Technical Medicine students. Its high-tech, high-fidelity simulation rooms provide a safe learning space for students "in which the authentic professional environment is simulated" (ECTM, 2016b). All data was collected and analysed at the ECTM at the University of Twente. Two simulation rooms were used to facilitate the resuscitation scenarios within the ALS-course, namely a simulated Intensive Care Unit (ICU) and a simulated operation room (OR). Each room has a Human Patient Simulator (CAE iStan/CAE HPS) as well as a patient monitor (Infinity, Dreager) and defillibrator (Philips) (ECTM, 2016a). Moreover, a METIvision system provides audio-visual material of the sessions using (1) the simulator data, (2) three ceiling mounted camera's capturing the greater part the room, (3) the patient monitor, and (4) the audiosignal from the ICU.

Advanced Life Support. Master students of Technical Medicine at the University of Twente receive an ALS-course from February to April. As can be seen in the course description in Appendix I, the goal of this course is to enable "students to adequately assess and treat a patient in resuscitation setting according to protocolled guidelines by making use of a systematic clinical approach and medical technology". During the ALS course, students receive theoretical information about medical technologies and skills and its underlying principles about critical body functions and the clinical approach of patient assessment, which they have to "integrate and apply on a simulated patient in a resuscitation setting". During the course, guidelines provided by the European Resuscitation Soar et al. (2015) are followed, but it is not the goal to provide any certificates. The goal of the course is to provide students with an optimal learning curve, and make sure that the required skills are taught to effectively perform CPR. In five practical sessions and one assessment session, the students are presented with a case in which ALS is necessary. In the simulation room, one of the two teachers is present, as well as a professional with extensive experience in medical emergency situations.

The formal assessment, which takes about 20 minutes, is considered as a high stress condition in comparison with the earlier practice sessions because of time pressure, simulated interventions by bystanders, the fact that performance grades are documented in the student's grade list, and that students are assigned to their role one minute before start of the assessment. Also, Sandroni et al. (2005) emphasize that the practical assessment of ALS-courses in particular is usually experienced as stressful to the student. For these reasons, only data from the final assessment was analysed.

2.3 Respondents and sampling

Data was collected from a group of students following an ALS-course as part of their Technical Medicine master's programme. 92 students agreed to participate, divided over 24 teams. Because some teams had team members who did not give informed consent, two teams were excluded from the study. Finally, 87 students participated in 22 groups[3] (*N* = 87). Their ages ranged from 21 to 32 years old (*M* = 22.33, *SD* = 1.55), and the group included 40 males (46%) and 47 females (54%). Four participants indicated that they had already followed ALS or a similar course before.

Each team practiced four resuscitation scenarios over a period of four weeks, had one practice exam, and finally performed one scenario during their final assessment. During all sessions data was collected from the students, so they were used to the procedure by the time the assessment took place. Each student performed the role of the team leader at least once during practice sessions. Hence, during the final assessment the randomly[4] assigned team leader had practiced his/her role one to three times. Team leaders (*n* = 22) had a mean age of 22.5 (*SD* = 1.26, min. 21, max. 26). Other demographic characteristics of the team leaders are presented in Table 1. Because the range age, gender, BMI, and ALS experience of the team leaders lie closely to those of the whole sample, the team leaders can be regarded are a representative sample of the target group.

Table 1. Frequency table of nominal and ordinal variables.

		Frequency	Percent
Gender	Male	10	45.5
	Female	12	54.5
	Total	22	100.0
Body Mass Index	Underweight (BMI <18,5)	1	4.5
	Normal (BMI 18,5 – 25)	17	77.3
	Overweight (BMI > 25)	4	18.2
	Total	22	100.0
ALS experience [a]	Yes	2	9.1
	No	20	90.9
	Total	22	100.0

Note. [a] "Did you previously follow ALS or a similar course?"

2.4 Ethical considerations

Prior to implementation of the study, the research team, existing of two master students and two bachelor students, wrote a study protocol in close cooperation with thesis supervisors as well as the contact person of Technical Medicine and the tutors of the ALS course where data was collected. Consequently, the study protocol, in which ethical considerations and procedure plans were described (see Appendix II and III), was read and approved by the BMS Ethics Committee of the University of Twente. Respondents were informed about the details of the study protocol for which they signed written consent forms. Participation was not obligatory. Every respondent participated in the scenarios as part of their education program, data was only collected from students who had approved to participate in the study. Data were analysed anonymously.

[3] 21 teams of 4 members, 1 team of 3 members.
[4] By blindfolded draw of each role

2.5 Measures

Team performance. Overall team performance on technical skills and non-technical skills was analysed using two scales. First, it was measured with the team effectiveness scoring list by Gibson, Cooper, and Conger (2009). A Likert-scale from 1 to 7 is used for each of the four items in the scale. Secondly, all teams were scored using a summarized version of the scoring list used for assessing the technical and non-technical skills of the teams, based on the ALS-course competencies. These competencies are: (1) following the ALS-protocol, (2) execution of technical skills, (3) diagnostics and clinical reasoning, (4) therapeutic plan, and (5) method. A 5-point scale ranging from insufficient to excellent was used to score these competencies. The two main teachers of the course were trained to use these scales and were given a written manual for the use of the scales. Because assessment took place with two groups at a time, each teacher scored half of the teams during the assessment. The complete scoring list can be found in Appendix IV. Both scales showed sufficient internal consistency reliability, with Cronbach's Alpha of .97 for team performance and .74 for ALS performance. Due to the fact that there was only one teacher scoring team performance, it was not possible to define interrater reliability of this variable. Spearman's rho testing resulted in a significant positive correlation between the scales for team effectiveness and ALS performance (r_s = .81, 95% BCa CI [.56, .93], p < .001 (two-tailed)). This means that when the team effectiveness score increased, the ALS performance score increased, and vice versa. For this reason, and because the ALS performance scoring list is a better representation of how effective a team is in this specific context[5], it was decided to only use ALS performance in further analysis.

Team leader behaviour and closed-loop communication. Analysis of team communication is found to be an effective method for understanding the dynamics of team performance in detail within technical and complex work environments (Pfaff, 2012). Using three ceiling mounted cameras, the METIvision system recorded the practical sessions. The research team got approval for access to these recordings, which were coded in order to get more understanding of team leader behaviour and closed-loop communication. Based on the audio-visual material of the CPR sessions, verbal behaviour patterns between team leader and team members were coded using an adaptation of the codebook by Lei, Waller, Hagen, and Kaplan (2016), which was used for flight crews in a simulation setting. On basis of previous theoretical insights and groupings in the behavioural literature, the behaviours of interest for this study were categorized into three clusters: (1) task distribution, (2) information gathering, and (3) summarizing. Additionally, on basis of the theory described in the theoretical framework, two items were added in order to code CLC, more specifically: (1) check-back (by a team member), and (2) closing the loop (by the team leader). A full overview of the coding book, which was developed by the research team, can be found in Table 2. After pilot-testing, training, and adjusting the codebook where needed, one of the coders parsed all sessions, that is: segmented speaker utterances (Klonek, Burba, Kauffeld, & Quera, 2016), using a unit of analysis as defined by Strijbos, Martens, Prins , and Jochems (2006, p. 37): "a sentence or part of a compound sentence that can be regarded as meaningful in itself, regardless of the meaning of the coding categories". Subsequently, two observers coded all preparsed sessions independently. Interrater reliability of the codebook was measured using Cohen's kappa. This statistic measures reliability based on the agreement amongst coders (Field, 2013). All reliability scores lower than K=.70 lead to a discussion on basis of the codebook about the behaviours scored in that particular session. After this, percentage of agreement between coders was 81.8% (K = .79, p < .001, 95% CI, .78 to .81), which proves a sufficiently reliable codebook. Because the codebook was built based on previous literature, also validity could be ensured for the measurement instrument.

The duration of the session videos ranged from 17.84 to 34.88 minutes (M=26.51, SD=5.02), and were coded using specialized software: Noldus the Oberver XT 12 (Noldus Information Technology, The Netherlands). This software can be used to systematically code and analyse observational data. Because previous research highlighted that team behaviour changed over the progress of a CPR

[5] It measures the level of both technical and non-technical skills, and was based on the official scoring list used for the assessment of ALS candidates at the University of Twente.

session (Tschan et al., 2014; Tschan et al., 2006) and that leadership is important during the first few minutes of CPR (Marsch et al., 2004; Tschan et al., 2014), the choice was made to code 33 % of the total duration of the each video, divided in a fragment at the beginning and a fragment at the end of the session (each 16,5% of the total duration of the recording). Contrary to previous research, the end of the session was also coded because it would provide a more complete picture of the total stress and communication process.

Team leader stress. In the present research, the EDA, also referred to as skin conductance, was used to give an indication of physiological stress. Even though the wrist gives fewer EDA responses that finger tips, its advantage is that it is unobtrusive to the user (Payne, Schell, & Dawson, 2016). After comparing a wrist-worn sensor against other skin conductance measurement sensors, Poh et al. (2010) found the wrist a viable EDA measurement site. Because of its unobtrusiveness, the Empatica E4 wristband was chosen as the most appropriate method for measuring physiological stress in a CPR context. The E4-wristband measures EDA four times per second, as well as heart rate (HR), motion-based activity and skin temperature. From the wristband, SCR (expressed in the mean amount of SCR's per minute) was analysed. To correct for variance, it is advised to collect a baseline measurement (Boucsein, 2012). However, due to time constraints right before the exam started, it was not possible to establish such a baseline.

In order to get insight in the valence of the stress responses, it is advised to measure and compare both objective and subjective stress responses (Boucsein, 2012; Figner & Murphy, in press; Piquette et al., 2014). Therefore, in the present study, individual stress was also collected as a self-reported measure (see Appendix V). Immediately after the ALS assessment, each participant filled in two appraisal questions on a 10-point Likert scale, in which (1) the level of stress as perceived by the student, and (2) the coping level as perceived by the student is determined (Tomaka, Blascovich, Kelsey, & Leitten, 1993; Tomaka, Blascovich, Kibler, & Ernst, 1997). As Piquette et al. (2014) suggest, a ratio between the two questions determined the level of stress appraisal during the task (*Question 1 / Question 2*). This resulted in one stress appraisal ratio.

Table 2. Coding rules for behaviour

Cluster	*Category*	*only for (*)*	*Description*	*Examples*
Task distribution	Command	TL	The team leader gives an individual a specific assignment of responsibility (addressed call-out)	*#1: Wil jij het ECG aanzetten? ; #2: Dat mag je gelijk toedienen.*
	Suggest (talking to the room)	TL	The team leader suggests a future action without delegating it to a specific team member (call-out not addressed)	*#1: Misschien kunnen we een echo van de buik aanvragen. ; #2: Binnen 30 seconden moeten we een hartritme check doen.*
Information gathering	Inquiry	TL	Request for factual information, statement, or analysis from one or more individuals	*#1: Ademt de patient? ; #2: Is de luchtweg vrij?*
	Question	TL	Request for confirmation or rejection of statement from one or more individuals	*#1: Zullen we even samen kijken naar het scherm?*
-	Observe	TL	The team leader recognizes or notices a fact or occurrence	*#1: Ik zie een hartslag. ; #2: Ik zie een asystolie.*
-	Confirmation	TL	The team leader answers to a question by giving a confirmation	*#1: Ja.*
CLC	Closing the loop	TL	The team leader closes the communication loop by confirming the check-back of the follower	*#1: Super, dank je. ; #2: Oke.*
-	Opinion	TL	The team leader makes a statement to express personal view	*#1: Dan denk ik toch dat het hypokalemie is. ; #2: Mee eens.*
Summarizing	Summary	TL	Summarization or discussion on the current situation, diagnose and/or information to other team members on what to expect in the next stage. Any repetition of what was discussed with a bystander is also coded as *summary*.	*#1: We verwachten iets van hypokalemie… ; #2: We gaan de patient beoordelen op zichtbare symptomen.*
-	External communication	TL	Any communication directed at someone outside the CPR-team and the team leader. This may include a specialist, doctor, nurse, or relative of the patient. Also communication to someone outside of the simulation (i.e. the teacher) is coded as external communication.	*#1: Is er iemand van familie aanwezig? ; #2: Heeft de meneer klachten gehad voor dat hij hier binnen kwam?*
CLC	Check-back	F	Reaction by the follower to a call-out of the TL (i.e. command, suggest, question, or inquiry) in the form of a confirmation, answer or observation.	*#1: Ja, doe ik. ; #2: Schok toegediend*
-	Other	F	Any utterance by the follower that is not a check-back	
Social	Laugh	TL	Laughter or clearly humorous remark by the team leader	*#1: Haha.*
	Sorry	TL	Apology remark from the team leader	*#1: Oh, sorry.*
	Social	TL	Social non-task communication	*#1: Kut.*
-	Incomprehensibl e	TL	The team leader says something but the content is not understandable or not relevant. Code only when the verbal behaviour is incomprehensible due to half sentences, simultaneous speaking, or background noise (e.g. beep-sound from the patient monitor), or not relevant to the research.	*#1: Jongens ; #2: Robert, wil jij eh..*
-	Intervention	B	Intervention by a teacher, simulating a family member, friend or professional	*#1: Teacher: kan iemand mij hier vertellen wat er aan de hand is? ; #2: Teacher: help, mijn vriend ademt niet meer!*

Note. (*) TL = team leader, F = follower, B = bystander. In general: Only verbal behaviour is coded; all behaviour of the TL, follower, and bystander is coded; Always place code at the beginning of the behaviour.

Potential confounders. An individual pre-programme survey gathered basic information about the participants. The characteristics which were asked, were age, gender, length, weight, team composition, team history (more specifically: Did the students work in the team composition before?), and course history (more specifically: Has the respondent already followed an ALS-course before?). Demo- and biographic information from this survey was necessary to exclude participants based on the exclusion criteria (i.e. having followed the course before), and to control for potential confounders. As an example, previous research within simulated resuscitation settings found that females perceived more stress/overload than men (Hunziker, Laschinger, et al., 2011), used more verbal emotional expressions and made fewer leadership statements (Fernandez Castelao et al., 2013). In addition, Jacobsson et al. (2012) promotes the need for further research in the field of CPR in high-fidelity simulation studying associations between team leader communication and performance while taking gender into consideration. Hence, information about the gender of respondents was collected. Secondly, in a study by Sandroni et al. (2005), it is observed that the age of respondents as well as body mass index (BMI) were factors associated with an increased physical stress response in ALS-courses, even though it did not have an influence on knowledge on the subject. Therefore, also age, length, and weight were collected as control variables.

Looking at further potential confounders, the duration of the session was recorded and collected, to check for a possible influence of duration on stress, behaviour or performance. Finally, language differences could not pose a threat to stress, communication or performance, as all respondents spoke fluently Dutch in daily life and during CPR sessions.

2.6 Procedure

Prior to data collection, the study was approved by the Ethical Committee of the University of Twente (Appendix II and III). At the beginning of the course, the students were informed about the research, its goals and procedure and were asked for participation. After giving consent, the respondents were asked to fill out a form in which personal information is asked. During the next five weeks, the respondents followed theoretical lectures. During practical sessions, in total five resuscitation scenarios were executed within the same team. Each team member practiced the team leader role at least once. Finally, the students were assessed in a practical test using simulation technology. During this final assessment, data was collected.

At entrance, all students were asked to fill in the stress scale[6]. The team leader, who was randomly selected, received the E4 wristband. Subsequently, a simulated emergency case was randomly selected out of eight possible scenarios (in as well as out of the hospital) where immediate CPR (shock or non-shock therapy) was necessary. The respondents were not aware of the content of those cases. The cases were equal in difficulty level and all scenarios contained a challenging component. Difficulties lied in the complexity of the diagnosis and symptoms, or in environmental factors such as wrong intubation or comments and actions from bystanders. The case was explained to the team leader. After this, the simulation session started, as well as video recording and EDA measurements. The team leader explained the situation to the team and delegated tasks. The CPR session was finished when the patient was resuscitated and handed over or when the evaluator indicated the end of the scenario. This was also the cue for ending video recordings and EDA measurements. After finishing the CPR session, a researcher entered the room to collect the wristband from the team leader. Immediately after the team left the room, the team leaders filled in the stress scale again.

During data collection, two researchers were present at the entrances of the ICU and OR, and two in the control room. Two evaluators were present in the simulation room. These evaluators filled in the team performance scale after the team finished the CPR scenario.

[6] This measurement was not used in the present study, as it did not result in usable information because team leaders were not yet aware of their role when filling in the stress scale.

2.7 Data analysis

The EDA-data was downloaded from Empatica Manager. Subsequently, all files were renamed and data was trimmed, meaning that measurements before and after the actual session were cut out. A continuous decomposition analysis (CDA) was conducted in Ledalab, a program which can be used via Matlab and which is also recommended by Empatica (Empatica, 2015). The CDA extracts the phasic information of the skin conductance signal and allows a detailed analysis of the SCRs. Data was imported into Ledalab & the CDA was conducted per individual, using a frequency of 4 Hz, which is the same as the frequency used during recording. The results were then exported in the form of a SCR list whereby the onset and the amplitude of the individual SCR were given. For this, a program written by a university student was used, in order to calculate the number of SCRs each minute. This program, written in Python, can be used for the analysis of Ledalab results, such as the results for CDA. Analysis in the program provided the total amount of SCR's, the mean of the amplitudes, the standard deviation of the amplitude, the total duration, the mean of SCRs per minute, the standard deviation per minute, the minimum SCR's per minute and the maximum of SCRs per minute per individual.

Recordings of the CPR sessions were coded by two observers using the software Noldus the Observer XT. From this behavioural data, the rate per minute over the observation duration was computed. The rate per minute over the observation duration is defined as "the mean number of occurrences of a behaviour (either with or without duration) per minute over the total duration of the observation: *RPM (observation) = Total number of occurrences * 60 / Duration of Observation (sec)"* (Noldus, 2015, p. 320). This provides a standardized result for all behaviour measurements. The codes were grouped into clusters (i.e. task distribution, information gathering, summarizing, social behaviour, check-back, and closing the loop) by computing the mean of these results.

All further analysis was done using SPSS version 24. First descriptive statistics were obtained in order to get a picture of all variables. Secondly, correlations between all variables was examined. The main goal of this was to find out whether the different measures of stress on the one hand and team performance on the other hand correlated. Moreover, correlation results provided support for hypothesis testing. Consequently, all variables concerning stress and team performance (more specifically: SCR, stress appraisal pre- and post-session, team effectiveness, and ALS performance) were divided into two groups (high or low ASL performance / stress appraisal / physiological stress responses), using median splits. Finally, all hypotheses were confirmed or rejected using independent samples t-tests.

3 RESULTS

3.1 Descriptive statistics

As can be seen in Table 3, the total amount of SCR's within a session had a high range with a high standard deviation (min. 61, max. 3797, *SD* = 1248.81). Looking at the standardized measure, the mean amount of SCR's per minute varied between 0 and 120 responses per minute. Mean amount of SCR's per minute in a session was 68.73 (*SD* = 46.07). Because one team leader skipped a stress appraisal question, the sample size for this variable is 21. For all other variables, the sample size remained 22.

Table 3. Descriptive statistics of all continuous variables.

	N	Minimum	Maximum	*Mean*	*SD*
Mean score team effectiveness [a]	22	3	7	5.35	1.24
Mean score ALS performance [b]	22	2.40	4.80	3.83	.64
Total amount of SCR's*	22	61	3797	1814.23	1248.81
Mean amount of SCR's per minute*	22	1.97	119.77	68.73	46.07
Stress appraisal *	21	.63	2.00	1.30	.40
Task distribution: command, suggest*	22	.58	5.98	3.00	1.49
Gathering information: inquiry, question*	22	.06	1.42	.64	.38
Summarizing*	22	.05	.87	.41	.22
Social*	22	.00	.15	.03	.04
Check-back	22	.33	3.40	1.63	.76
Closing the loop*	22	.04	1.31	.49	.30

Note. *measured on team leader level. [a] on a 7-point Likert-scale. [b] on a 5-point Likert scale.

Of the videos, in total 4210 communication behaviours were coded (team leader behaviour: 1959, follower behaviour 1823, bystander behaviour 428), of which 1478 utterances were used for the present study. Figure 4 shows an overview of all coded behaviours; more detailed information can be found in Appendix VI. 48.74 % of the coded behaviours used in this study was task distribution (command + suggest), 9.64 % was gathering information (inquiry + question), 7.81 % included summarizing and 1.10 % was socially related. 25.99 % of the behaviours used in this study encompassed check-backs by followers (following a command, suggestion, inquiry or question), and finally 7.81 % was closing the loop by the team leader.

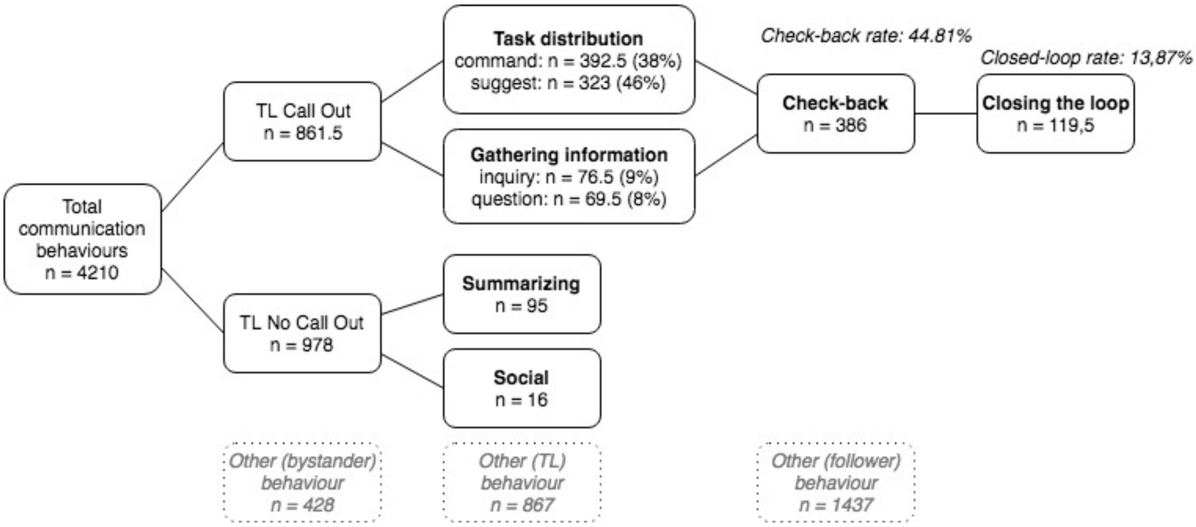

Figure 4. Overview of all coded communication behaviour

Looking at CLC specifically, of all call-outs by the team leader (i.e. task distribution and information gathering, in total a mean rate per minute of 3.64), 45 % was followed by check-backs by followers (with a rate per minute of 1.63), and 14 % was followed by team leaders closing the loop (RPM = .49). This means that, 14 % of all call outs (the mean RPM of closing the loop, .49, divided by the mean RPM of call-outs, 3.64), and 30 % of the check-backs (the mean RPM of closing the loop, .49, divided by the mean RPM of check-backs, 1.63) resulted in closing-the-loop behaviour.

The distribution of all continuous variables was checked by looking at skewness and kurtosis values, z-scores and by using the Shapiro-Wilk normality test. This test is considered appropriate for small sample sizes (Field, 2013). Normality was accepted for all variables, except mean SCR's ($W(22)=.84$, $p<.01$), and social behaviour ($W(22)=.69$, $p<.01$). Transforming the data for social behaviour with LOG10 and SQRT did not make a difference in normality. A plausible reason for this is the minimal amount of observations of this behaviour. Therefore, it was decided to exclude this variable from further analysis.

Because the mean amount of SCR's per minute was not normally distributed, they did not meet the assumptions for parametric tests. For this reason, non-parametric tests were used when applying inferential statistics. Accordingly, correlations between continuous variables were computed using Spearman's rho (see Table 4). Correlations between dichotomous (e.g. gender) and continuous variables were computed using point biserial correlation, which is an adapted version of Pearson's r.

Concerning potential confounders, Spearman's rho correlation testing showed that the control variable BMI did not have a significant relation to physiological stress indicators (SCR), $r_s = -.26$, 95% BCa CI [-.58, .12], $p = .25$. Also, neither age nor gender correlated with any of the tested variables, excluding the possibility of influences by these two control variables. Finally, the duration of the session showed a significant relatively strong positive correlation with self-reported stress, $r_s = .71$, 95% BCa CI [.36, .91], $p < .001$. Also, duration of the session was significantly and negatively correlated with ALS performance scores, $r_s = -.48$, 95% BCa CI [-.80, .00], $p = .03$.

Table 4. Correlation table

	1	2	3	4	5	6	7	8	9	10	11	12
Team performance												
1. ALS performance	-											
2. Team effectiveness	.81**	-										
	[.60, .91]											
Team leader behaviour												
3. Task distribution	-.05	-.20	-									
	[-.41, .31]	[-.53, .15]										
4. Gathering information	-.02	.00	.55*	-								
	[-.40, .36]	[-.45, .42]	[.15, .80]									
5. Summarizing	.01	-.07	.60**	.37	-							
	[-.48, .48]	[-.47, .38]	[.23, .84]	[-.07, .70]								
Closed-Loop Communication												
6. Check-back	.04	.11	.86**	.71**	.55**	-						
	[-.37, .40]	[-.23, .43]	[.64, .95]	[.38, .89]	[.09, .84]							
7. Closing the loop	-.01	.01	.68**	.75**	.50*	.71**	-					
	[-.50, .44]	[-.46, .42]	[.47, .79]	[.44, .92]	[.05, .81]	[.43, .86]						
Team leader stress												
8. Stress appraisal	-.48*	-.49*	-.01	-.33	-.05	-.19	-.18	-				
	[-.78, .00]	[-.77, -.08]	[-.54, .54]	[-.69, .15]	[-.53, .47]	[-.67, .31]	[-.54, .28]					
9. Mean SCR's/minute	.26	.07	-.40†	-.26	-.22	-.50*	-.33	-.24	-			
	[-.19, .63]	[-.44, .60]	[-.65, .00]	[-.70, .26]	[-.55, .23]	[-.76, -.09]	[-.73, .17]	[-.66, .25]				
Potential confounders												
10. Age	-0,12	0,04	0,04	-0,07	0,29	0,07	-0,01	.07	-0,31	-		
	[-.49, .31]	[-.47, .57]	[-.45, .52]	[-.65, .54]	[-.12, .69]	[-.50, .57]	[-.57, .53]	[-.31, .46]	[-.71, .21]			
11. Gender [a]	0,10	.22	-0,17	-0,17	-,42	-0,02	-0,10	-.04	0,27	-.44*	-	
	[-.34, .57]	[-.26, .66]	[-.59, .27]	[-.57, .30]	[-.73, .01]	[-.46, .37]	[-.55, .29]	[-.51, .46]	[-.17, .68]	[-.71, -.06]		
12. Duration session	-.48*	-.53*	.05	-.10	-.12	-.10	-.09	.71**	-.12	.00	-.02	-
	[-.80, .00]	[-.79, -.08]	[-.50, .59]	[-.50, .32]	[-.54, .38]	[-.59, .41]	[-.51, .44]	[.36, .91]	[-.51, .32]	[-.37, .38]	[-.42, .39]	

note. N = 21. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed). † Correlation is significant at the .10 level (2-tailed). Values in square brackets indicate 95 % confidence intervals for each correlation. Bootstrap results are based on 1000 bootstrap samples. Unless otherwise noted, Spearman correlation was used. a. Point biserial correlation.

3.2 Hypothesis 1: Relationship between team leader stress and team performance

First, we determined the relationship between the dependent and independent variables, namely team leader stress (both psychological and physiological) and team performance (using the ALS performance scale). As can be seen in Table 4, a significant negative correlation was observed between ALS performance and stress appraisal, $r_s = -.48$, 95% BCa CI [-.76, -.06], $p = .03$.

T-tests were chosen to check hypotheses and compare stress means when team performance is divided into two groups: high and low performing teams. The results of these tests are depicted in Table 5. As no results were significant (p > .05), we cannot state that there are any significant differences in stress level between high and low performing groups. The stress appraisal ratio of team leaders in the high performing group (*M* = 1.19, *SD* = .33), was lower than in the low performing group (*M* = 1.41, *SD* = .45). On the contrary, a higher mean amount of SCR's was measured in the high performing teams (*M* = 77.53 in the high performing teams versus *M* = 56.01 in the lower performing teams). However, because of the high standard deviations of the EDA measurements, these results should be interpreted with care. Also, important to note is that differences between groups were not significant (with $t(19) = 1.30$, p = .21 for stress appraisal, and $t(19) = -1.60$, $p = .30$ for mean SCR's per minute). With the results of the t-test, hypothesis 1, which argues that the stress level of the team leader is higher in low performing teams than in high performing teams, cannot be confirmed, despite being in line with our expectations. Still, when looking at the effect sizes, it becomes clear the Cohen's *d* shows medium effects (Cohen, 1988) for stress appraisal ($d = -.49$) and the mean amount of SCR's per minute ($d = .47$).

Table 5. Comparison of stress measurements and ALS performance.

	low or high ALS performance[a]						
	Low (n = 10)		High (n = 11)				
Parameters	*M*	*SD*	*M*	*SD*	*t* (19)[b]	*p*	*Cohen's d*
Stress appraisal	1.41	.45	1.19	.33	1.30	.21	-.49
Mean SCR's/minute	56.01	45.53	77.53	47.46	-1.06	.30	.47

Note. Sig. 2-tailed. The same results apply when using Gibson's team effectiveness scale. [a]Based on median split. [b]Unless otherwise noted, equal variances assumed (based on Levene's test for equality of variances).

3.3 Hypotheses 2 and 4: Relationship between behaviour and team performance

Spearman's rho showed no correlations between any of the behaviours and team performance (see Table 4). In order to check whether there was a difference between high and low performing CPR teams regarding the behaviour of the team leader or the amount of CLC, an independent t-test was performed. As can be seen in Table 6 and Figure 5, on average, the high performing teams had a lower mean rate per minute of all behaviours than the lower performing teams, which contradicts our expectations. These differences were not significant and had small effect sizes (Cohen, 1988). Based on these findings, hypotheses 2 and 4 were rejected.

Table 6.Comparison of TL behaviour and CLC and high or low ALS performance

	Low (*n* = 11)		High (*n* = 11)				
	M	*SD*	*M*	*SD*	*t (20)*	*p*	*Cohen's d*
Gathering information	.69	.39	.59	.37	.65	.52	-.26
Task distribution	3.21	1.41	2.80	1.61	.64	.53	-.29
Summarizing	.42	.21	.41	.24	.13	.90	-.05
Check-back	1.67	.64	1.59	.90	.24	.81	-.13
Closing the loop	.52	.25	.47	.34	.39	.70	-.20

Note. Sig. 2-tailed. The same results apply when using Gibson's team effectiveness scale. [a] Unless otherwise noted, equal variances assumed.

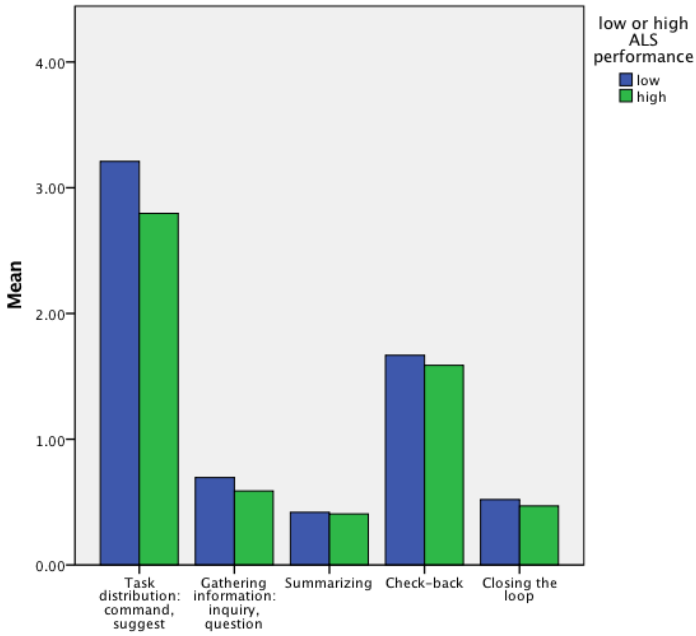

*Figure 5. Mean rate per minute coded behaviours * high/low ALS performance*

3.4 Hypotheses 3 and 5: Relationship between team leader stress and behaviour

Hypotheses 3 and 5 argue that there is a relation between the level of team leader stress on the one hand, and team leader behaviour (task distribution, information gathering, and summarizing) and CLC (check-back and closing-the-loop) on the other hand. Figure 6 depicts the visual differences in behaviour between groups with a high or low stress appraisal during the CPR task. This shows that overall, more communication happens when team leaders have low stress appraisal. When checking these results for correlations (see Table 4), Spearman's rho showed no significant relations between team leader stress and behaviour, except for SCR's and the amount of check-backs (r_s = .50, 95% CI [-.76, -.09], *p* = .02). Also, at the level of *p* > .10, a negative correlation was visible between the amount of SCR's and task distribution (r_s = -.40, 95% CI [-.65,.00], *p* = .07).

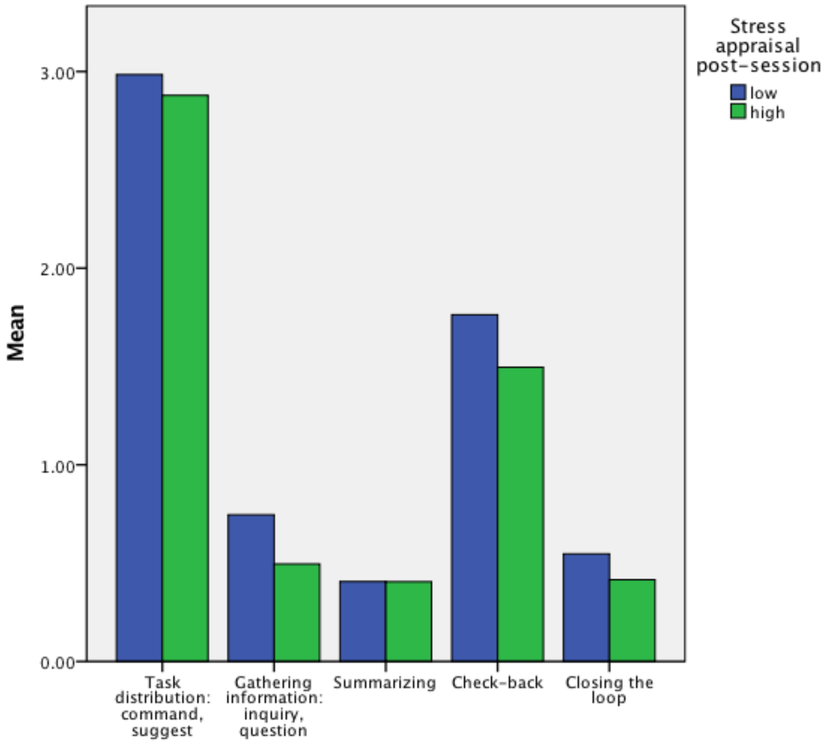

Figure 6. Histogram showing behavioural differences between groups with team leaders appraising high or low stress levels

In order to check hypotheses 3 and 5 and determine whether team leader behaviour and CLC differed between high and low stressful team leaders, several t-tests were computed (as is visible in Tables 7 and 8). Mostly in line with our expectations, CLC was less present when team leaders had a high stress appraisal or larger amount of SCR's. Contradicting hypothesis 3, highly stressful team leaders (appraised and in SCR's) showed (a) more task distribution, and (b) less gathering information. However, these differences in means were minimal. None of the t- tests resulted in a significant effect, meaning that the hypotheses concerning a possible relationship between team leader stress, team leader behaviour and CLC (H3 and H5) could not be confirmed. However, Cohen's d did show some remarkable effect sizes. For example, a medium-sized effect, d = -.57, was found for stress appraisal and gathering information. However, since the effect size accounts for showing more behaviour to gather information of team leader in the low stress group, this contradicts our expectations. Also, medium-sized effects appeared for less CLC in teams where team leaders showed more SCR's: Cohen's d was -.64 for check-backs and -.53 for closing the loop. This is in line with our expectations in hypothesis 5. Summarizing behaviour showed minimal effect sizes, with d = .00 for stress appraisal, and d = .11 for mean SCR's.

Table 7. Comparison of TL behaviour and CLC between low or high stress appraisal

	Low stress (n = 11)		High stress (n = 10)				
Parameters	*M*	*SD*	*M*	*SD*	*t (20)*[a]	*p*	*Cohen's d*
Gathering information	,75	,44	,50	,27	1.56	.13	-.57
Task distribution	2,98	1,47	2,88	1,59	.16	.88	-.07
Summarizing	,41	,22	,41	,24	.01	.99	.00
Check-back	1,76	,71	1,50	,86	.78	.45	-.37
Closing the loop	,55	,35	,42	,23	1.01	.33	-.37

Note. Sig. 2-tailed. [a] Unless otherwise noted, equal variances assumed.

Table 8. Comparison of TL behaviour and CLC between high or low SCR's

	Low (n = 11)		High (n = 11)				
Parameters	*M*	*SD*	*M*	*SD*	*t (20)*[a]	*p*	*Cohen's d*
Gathering information	,68	,40	,60	,37	.49	.63	-.20
Task distribution	3,14	,78	2,87	2,01	.42[b]	.68	-.35
Summarizing	,40	,19	,42	,25	-.26	.80	.11
Check-back	1,81	,58	1,44	,90	1.15	.26	-.64
Closing the loop	,58	,32	,41	,25	1.36	.19	-.53

Note. Sig. 2-tailed. [a] Unless otherwise noted, equal variances assumed. [b] Based on Levene's test: equal variances not assumed.

3.5 Additional exploratory analyses: Relationship between team leader behaviour and CLC

In Table 4, significant correlations between CLC and team leader behaviours were visible. For example, task distribution had a strong positive correlation with check-backs, r_s = .86, 95% BCa CI [.64, .95], p < .001, and closing the loop, r_s = .68, 95% BCa CI [.47, .79], p = .001. Based on these observations, it was decided to check possible correlation between all coded behaviours individually. In order to investigate this, both Spearman's rho and Kendall's tau correlations were computed for all behaviours in the codebook, and are depicted in Appendix VII. The results from this test confirmed the assumption that team leader behaviour is connected to CLC. Command, suggest, question, inquiry and summarizing all showed a significant positive correlation with both check-backs and the amount of times the loop was closed, with the strongest positive correlation between commands and check-backs, r_s =.82, τ = .65, both p = .01 (two-tailed). Moreover, check-back's and closing the loop also seemed to correlate positively with each other, r_s =.67, τ = .51, both p = .01 (two-tailed). Additionally, a positive relationship was found between check-backs and confirmation, r_s =.66, τ = .51, both p = .01 (two-tailed), and between closing the loop and observe, r_s =.44, τ = .30, both p = .05 (two-tailed). These results imply that a team leader behaviour could predict CLC, and/or vice versa.

4 DISCUSSION AND CONCLUSION

4.1 Discussion of results

The goal of the present study was to investigate the role of team leader behaviour and CLC in relation to team leader stress and team performance in a simulated CPR setting. In this respect, innovative research methods, such as a wrist-worn measurement instrument for EDA, were combined with traditional methods, such as a video-observation and validated scales and surveys. Correlations and independent t-tests tests provided quantitative insight into the functioning of a team performing simulated CPR.

First, based on previous research, the assumption was made that team leader stress was lower in high performing teams (H1). Correlation testing showed a significant negative correlation between self-reported stress and team performance. Indeed, when comparing self-reported stress means of high versus low performing teams, the means had 0.5 of a standard deviation difference between the two groups. However, because this difference was not significant, hypothesis 1 had to be rejected. Still, with correlation testing, it can be confirmed that with the used sample, team leader stress appraisal during the CPR session was lower in high performing teams. This is in accordance with the findings of Hunziker et al. (2012). The same conclusion did not occur when testing the same hypothesis with EDA measurements. As previous research did not test stress using EDA on team performance, this result provides a first insight into the EDA measurement of stress in simulated CPR situations. In accordance with the different results concerning stress, correlation testing also did not show any relation between psychological and physiological measurements of stress. Therefore, it can be concluded that EDA and psychological stress measure different constructs.

Second, no correlations between the coded behaviours and team performance were found, nor was any significant difference between high and low performing teams regarding the coded behaviours observed. Therefore, hypotheses 2 and 4 were both rejected. Contrary to our expectations, higher performing teams even showed less behavioural utterances than lower performing teams. Communication during CPR is complex (Bergs et al., 2005; Jacobsson et al., 2012) with many facets which can be studied and tested. This study observed merely a small part of this construct. It could therefore be possible that a third variable influenced the result. The same accounts for team performance: Many methods exist for measuring this variable. In the present study, the combination of technical as well as non-technical skills was included in the ALS performance scale. As an example, the frequency of CLC behaviour (i.e. check-backs and closing the loop) did not correlate with our performance scores. Possibly, CLC is relevant for variables other than team performance which were not considered in this study, such as misunderstandings (Jacobsson et al., 2012) and patient safety (Härgestam et al., 2013).

Third, even though more behaviour utterances were measured in teams with team leaders in the high stress appraisal groups, results indicated that there is no significant difference between groups with high or low team leader stress regarding team leader behaviour (H3). This means that in the present study, it was not possible to prove that the stress level of the team leader resulted in changes of team leader behaviour aimed at information gathering, task distribution, or providing summaries. The same results apply to the differences of the amount of closed loop behaviour in groups with high or low team leader stress (H5): Even though a significant relation between the amount of SCR's and the amount of check-backs was observed, and CLC was indeed lower in teams with highly stressful team leaders in this sample, our indicators of team leader stress did not significantly differ when comparing it with the mean amount of check-backs or team leaders closing the loop using t-tests.

In sum, for most hypotheses, correlation testing showed significant results, contrasting the lack of significant results using t-tests. Therefore, research on a larger scale is needed in order to get better insight into stress and behaviour of team leaders in CPR teams, for example using regression analysis.

The results of every study can be strongly dependent on the context and the chosen measurement instruments. Therefore, attention was given to descriptive analyses. Based on these results, additional exploratory analysis lead to valuable insights regarding the behaviour within a student-team providing simulated CPR. In fact, a strong connection was found between team leader behaviour and CLC. More specifically, closing the loop correlated significantly with call-outs (i.e. task distribution, information gathering) and check-backs. This means that there is a significant confirmation that behaviours concerning CLC are positively related to each other (p = .01). When a team leader used a lot of commands, the amount of check-backs and closing-the-loops also increased. Despite the strong connection between team leader behaviour and CLC, almost no call out became an actual closed loop. In fact, 45 % of call-outs resulted in check-backs, and only 14 % of all call outs (commands, suggestions, questions, and inquiries) resulted in closed loops. This is in line with previous findings from a similar study by Härgestam et al. (2013), where one in seven call-outs (14 %) ended up in closed loops during simulated medical emergency teamwork. In their paper, this result was discussed as a limitation, and no explanation was given. Still, many studies promote the importance of structured and audible communication in medical emergency teams (Bergs et al., 2005; Jacobsson et al., 2012). Contrary to this, the present study found no proof of CLC benefitting team performance. A plausible explanation for this paradox could be that full closed loops might not always be necessary in every situation. Indeed, Schmutz et al. (2015) argue that acknowledgement (in the present study referred to as check-backs) is the central part of CLC, and not the third phase: closing the loop.

Another possible explanation for not using full CLC during both coded fragments of the CPR session might be the following: While observing the recordings of the CPR-sessions, it became clear that the importance of CLC depended on the progress of the simulated patient and situation. It was observed that CLC seemed more important at the beginning of the session, where tasks had to be distributed in order to achieve stability in the most urgent care for the patient (i.e. giving chest compressions, oxygen and medication) (Soar et al., 2015). The present study collected behavioural data from the beginning and ending of the CPR-session, in total accounting for 33 % of the whole recording. In the light of the hypotheses for this study, no difference was made between these two time points. Still, several researchers highlight that the needs for specific behaviours or CLC change over time, depending on the state of the simulated patient, the progress of situation, and the needs of the team (Davis et al., 2017; van der Haar et al., 2017). In fact, Davis et al. (2017) point out the importance of “quality” communication immediately after an acute change in the medical state of the patient has been observed. Moreover, Schmutz et al. (2015) conclude after high fidelity in situ simulation research with medical emergency teams, that CLC is only effective in algorithm-driven tasks, and not in knowledge-driven tasks. In future research, it might be of interest to compare the beginning of a CPR simulation with the end of that simulation. Based on the observations made during the present research and in accordance with the findings of Schmutz et al. (2015), it could be hypothesized that more algorithm-driven behaviour and structuring TL behaviour happens at the beginning of a CPR-session, while knowledge-driven behaviour and communication aimed at setting a diagnose might become more present as the situation of the patient becomes more stable. Accordingly, CLC would also become less important as the situation evolves.

Still, making assumptions based on observations must be done with caution, as several situational aspects could also explain why call outs did not end up in closed loops. As an example, for the present study, teams were formed at the start of the educational programme. Therefore, the team members had the opportunity to practice together in thus improve team communication and teamwork. By the same token, the respondents were free to form teams themselves. Consequently, it might be possible that within the sample used for this study, team members formed teams on basis of friendship of previous successful teamwork. Therefore, team members would become so attuned to one another that CLC became of minor importance. These two factors also decrease the external validity of the findings obtained with this sample.

Finally, a possible influence of control variables on the hypothesized model was checked. To start with, age did not correlate with team performance, team leader stress, or any of the coded behaviours. Also, BMI did not relate to physiological stress results. As stated in the method section of this paper, also language differences could be ruled out as all participants spoke fluently Dutch during daily life as well as during CPR session. However, interesting to note is that the duration of the session (a control variable) did show a significant and relatively strong positive correlation with self-reported stress. This means the longer a session endured, the higher the team leader's stress appraisal was. The same results were not found for physiological stress. In the future, it might be interesting to compare physiological responses to self-reported stress during various phases of a CPR session. Because the duration was strongly correlated with self-reported stress, it is acceptable to assume that the perception and physiological reaction to stress might evolve as the CPR session progresses. Also, duration of the session showed a significant negative correlation with team performance. This means that teams with lower performance scores generally had a higher session duration.

4.2 Limitations, strengths, and future research

The present research provided relevant information on the effective functioning of a team in a simulated CPR scenario, and creates opportunities for future research focussing on this topic. Studying the relation between three constructs (team leader stress, team leader and closed-loop communication, and team performance) makes the present paper a valuable addition to recent literature in the field of team learning in simulated medical emergencies. Even though quantitative methods were used for testing the hypothetical model, explorative research provided room for approaching the research question in a qualitative way. The measures which were used had high inter-item and (when applicable) interrater reliability. Nevertheless, this research comes with inevitable limitations.

To begin with, the small sample size (*N* = 22) resulted in limitations regarding the statistical power of the analyses. Therefore, this research has a more descriptive character, and results should be interpreted with caution. In the future, more reliable results could emerge from a similar study with a bigger sample. Alongside this, qualitative studies on the concepts presented in this study could provide more insight in the underlying processes of medical teams in an emergency situation.

Furthermore, it is known that stress is a complex phenomenon which is difficult to measure (Boucsein, 2012). Therefore, in the present research it was chosen to measure stress both psychologically and physiologically. Still, both measurements have limitations. First, self-reported stress is highly subjective and relies on the student's own perception and definition of stress. Therefore, stress appraisal scores are not fully comparable between team leaders. Second, for EDA, substantial differences were observed in the SCR results of the team leaders. This might be due to not having the possibility to obtain a baseline EDA measurement of the respondents. Also, it might be possible that using the forearm cannot provide a reliable measurement when comparing it to measurements on the palmar sites. Because using palmar sites could impede the working conditions, most researchers used HR measurements for stress. However, as stated in the conceptual framework of this paper, like all physiological measures, heart rate is influenced by physical actions, and can therefore only be used for measuring team leaders as they delegate and coordinate, but usually do not carry out physical tasks. A second limitation of using physiological measures of stress, is that eustress and distress produce similar physiological results. Therefore, EDA might not be the ideal method for measuring negative stress only. Moreover, it is influenced by several other nervous processes such as attention and activation (Mestanlk, Vlsnovcova & Tonhajzerova, 2014). In the present study, the parameters of the testing environment were not sufficient to control of the EDA caused by these other processes. In future research, it is therefore advised to select another measure of stress or to focus on improving the controlling conditions of the experimental environment. Additionally, it is advised to measure longer periods of EDA in order to obtain a baseline measurement and improve the quality of results.

Finally, in their feedback, respondents expressed that their role would have had an effect on their stress level prior to the session. In future research, it would be interesting to measure stress also at two points before start of the session: a first time before knowing their role, and a second time after the students have been assigned to their role. This way, new insight into the effects of individual team roles (e.g. team leader, surgical assistant, CPR giver) on psychological and physiological stress, behaviour, and team performance in a CPR-team could improve CPR training and eventually CPR quality.

4.3 Practical implications

This study explored the relation between four central concepts within CPR teamwork, namely team leader stress, team leader behaviour, team communication (CLC) and team performance. The results showed that self-reported team leader stress and team performance are negatively related, whereas no connection between a leader's physiological stress signals (SCR) and team performance could be found. These findings are relevant for CPR training, as they imply that a focus on learning how to cope with feelings of stress could benefit CPR quality and teamwork more than trying to prevent SCR's from occurring. Moreover, the finding that the duration of the session correlated with self-reported stress as well as team performance can be of use to the ECTM. Instructors can reflect on why these results arose, and use this as a tool to further improve their courses. On a side note, it must be taken into account that the present study focused on a simulated setting, with the goal of improving CPR training. Therefore, the results of this study are not generalizable to real-life emergency situations.

4.4 Conclusion

In closing, the t-tests within the present study did not provide any statistical proof for a significant relation between team leader stress, team leader behaviour, CLC, and team performance in a simulated CPR situation. However, correlation showed a moderate positive relation between physiological stress and closed-loop communication, and a moderate negative relation was observed between psychological stress and team performance. Additional exploratory analysis showed a strong significant positive correlation between team leader behaviour (focused on task distribution and information gathering) and closed-loop communication. Also, it became clear that the duration of the CPR-session was negatively related to team performance and positively related to self-reported stress during CPR. A link between team leader behaviour or CLC with team performance was non-existent, despite the underlying links between team leader physiological stress and team leader behaviour, and self-reported team leader stress and team performance. Because correlational testing did show significant results, more research is needed on a larger scale in order to study these underlying relations.

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APPENDIX I:
ALS – LEARNING GOALS AND COURSE CONTENT

Goal

The course Advanced Life Support enables students to adequately assess and treat a patient in resuscitation setting according to protocolled guidelines by making use of a systematic clinical approach and medical technology.

The following learning objectives are pursued:

1. The student can describe the underlying principles of therapies that are commonly used in a resuscitation setting
2. The student can describe the possibilities and limitations of diagnostic technologies that are commonly used in a resuscitation setting
3. The student is able to relate information derived from the anamnesis, physical examination, arterial blood gas values, venous laboratory values, echography, X-thorax and the patient monitor to an individual patient case.
4. The student can perform resuscitation in a team according to the protocol of shockable and non-shockable rhythms in a simulated resuscitation setting.
5. The student can adequately perform chest compressions, non-invasive ventilation techniques, medication administration, and electrical therapies that are part of the resuscitation protocol in a simulated resuscitation setting.
6. The student can adequately communicate and collaborate in a team in a simulated resuscitation setting.
7. The student can handover patients in a structured way according to the SBAR methodology.
8. The student can analyze a patient in a structured way according to the ABCDE methodology.
9. The student can propose an adequate diagnostic and therapeutic strategy based on the available clinical and contextual information of a patient case.

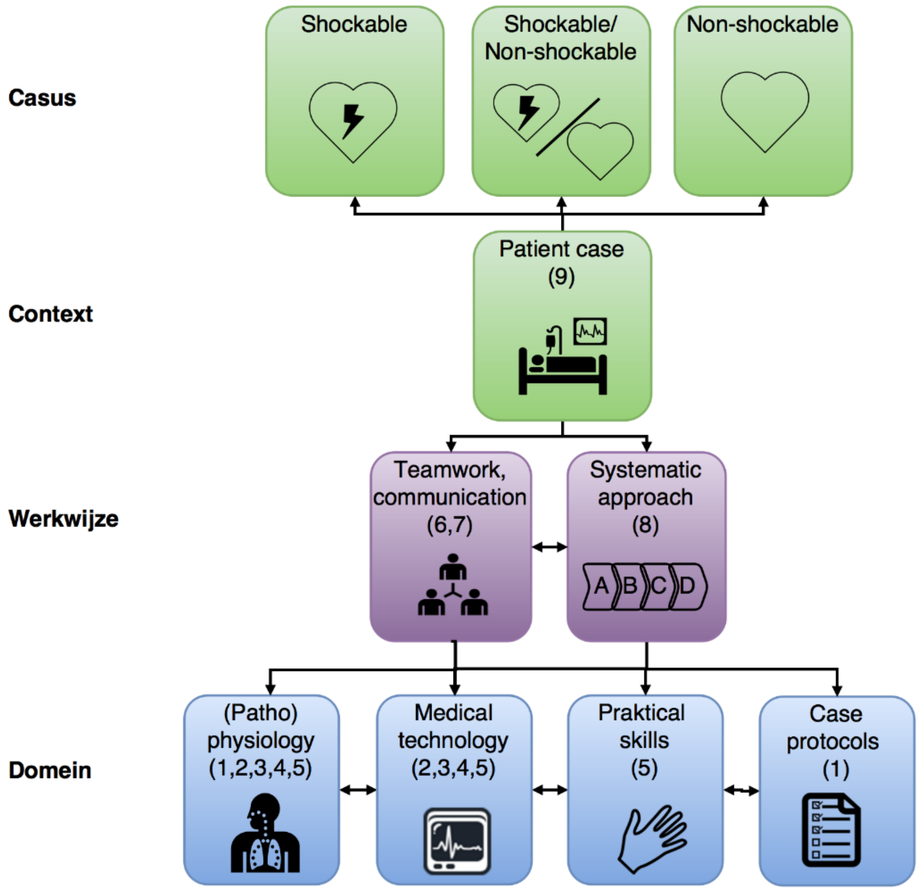
Content

In the course Advanced Life Support, we will follow the guidelines provided by the European Resuscitation Council. Yet, we do not intend to train resuscitation teams or to provide any certifications, but to create insight in medical technologies and procedures that are relevant in the management of patients witch a circulatory arrest.

During the course, students will practice and become acquainted with medical technologies and skills, in which the underlying therapeutic and diagnostic principles are underlined. Next, specific attention is given to the clinical approach of patient assessment and the interpretation of critical body functions. 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 resuscitation setting.

	Cognitieve vaardigheden **(kennis)**	**Praktische vaardigheden** **(handelingen)**	**Interactieve vaardigheden (samenwerking, communicatie)**	**Intellectuele vaardigheden** **(Integratie)**
Leerdoelen	1, 2, 3, 4	5	6,7	3, 5, 8, 9
Voorkennis	Basis kennis	BLS Injecteren	N.v.t.	N.v.t.

Onderwijs	Hoorcollege, Zelfstudie, Groepsopdracht	Skills practicum	Werkgroep	Groepspracticum
Toetsing individu	Theorietoets	BLS toets	N.v.t.	Theorietoets
Toetsing groep	Casus assessment (geïntegreerd in context)			



APPENDIX II:
APPROVED RESEARCH REQUEST ETHICAL COMMITTEE

UNIVERSITEIT TWENTE. Gedragswetenschappen

COMMISSIE ETHIEK (CE) FACULTEIT GEDRAGSWETENSCHAPPEN

AANVRAAGFORMULIER BEOORDELING
VOORGENOMEN ONDERZOEK DOOR CE, VERSIE 2

1. Achtergrond proefpersonen

1. Betreft het een medisch-wetenschappelijk onderzoek?

NB: Medisch-wetenschappelijk onderzoek wordt in deze context gedefinieerd als 'onderzoek dat als doel heeft het beantwoorden van een vraag op het gebied van ziekte en gezondheid (etiologie, pathogenese, verschijnselen/symptomen, diagnose, preventie, uitkomst of behandeling van ziekte), door het op systematische wijze vergaren en bestuderen van gegevens. Het onderzoek beoogt bij te dragen aan medische kennis die ook geldend is voor populaties buiten de directe onderzoekspopulatie.'

Nee

2. Titel

2b. Datum van de aanvraag

16-02-2017

2a. Wat is de titel van het onderzoek (max. 50 tekens)?

LET OP: Als u van het SONA systeem gebruik gaat maken, moet hier dezelfde titel worden vermeld als de titel die in SONA zal worden gebruikt. Deze titel zal ook zichtbaar zijn voor de proefpersonen (bij gebruik SONA).

Onderwijskundig onderzoek Advanced Life Support

3. Contactgegevens onderzoekers/uitvoerders

3a. Voorletters

J.

3b. Achternaam

van Sas

3c. Vakgroep (indien van toepassing)

0

3d. Studentnummer

1804529

3e. E-mailadres

j.vansas@student.utwente.nl

3f. Telefoonnummer (tijdens het onderzoek):

06-81882017

3g. Indien er meer dan één uitvoerder is, dan graag in het onderstaande invulblok de gegevens (voorletters/achternaam/e-mailadres/telefoonnummers) van alle uitvoerders van het onderzoek invullen.

T. Swinkels, t.swinkels@student.utwente.nl, 06-20938834
M. I. A. Baas, m.i.a.baas@student.utwente.nl, 06-46268308
S. Rijsemus, s.rijsemus@student.utwente.nl, 06-30488402

4. Contactgegevens hoofdonderzoeker/begeleidend docent

LET OP: De eerst verantwoordelijke onderzoeker/begeleidend docent is verantwoordelijk voor de bij deze aanvraag verstrekte gegevens en het onderzoek als geheel en verleent (indien van toepassing) met de aanvraag in dit formulier toestemming aan ANDERE PERSO(O)N(EN) (zie vraag 3) om voornoemde onderzoek met proefpersonen uit te voeren.

Deze eerst verantwoordelijke onderzoeker is een gepromoveerde onderzoeker.

4a. Voorletters

M.D.

4b. Achternaam

Endedijk

4c. Vakgroep

OWK

4d. E-mailadres

m.d.endedijk@utwente.nl

4e. Telefoonnummer tijdens het onderzoek

+31534893608

5. Beoogde begin- en einddatum onderzoek

5a. Wat is de beoogde begindatum van het onderzoek?

28-02-2017

5b. Wat is de beoogde einddatum van het onderzoek?

07-07-2017

6. Doel en vraagstelling onderzoek

Geef een duidelijke en voldoende uitgebreide omschrijving van het onderzoek, waarmee een voldoende ethische beoordeling mogelijk is.

6a. Wat is het doel van het onderzoek?

Het vak Advanced Life Support wordt aan de eerstejaars marterstudenten van Technische Geneeskunde aangeboden. Hierbij leren de studenten klinische skills in te zetten binnen een gesimuleerde in-ziekenhuis reanimatie, maar ook wordt aandacht besteed aan team-training en de rol als leider, omloop en BLS (basic life support). Hierbij speelt communicatie een belangrijke rol.
Het doel van het onderzoek is meer te weten te komen over de invloed van stress, communicatiepatronen en de rol van de teamleider op team effectiviteit binnen een gesimuleerd reanimatie-scenario met de Human Patient Simulator, met als einddoel om meer inzicht te krijgen in de gedragsmatige en fysiologische aspecten die invloed kunnen hebben op de team performance in deze context alsmede om input te geven aan hoe de opleiding Technische Geneeskunde de training/module voor studenten kan optimaliseren
Er zal data verzameld worden gedurende de periode dat het vak gegeven wordt (kwartaal 2a).

6b. Wat is de vraagstelling van het onderzoek?

Wat is de invloed van stress, communicatiepatronen en persoonlijkheidskenmerken op team effectiviteit binnen een gesimuleerd reanimatie-scenario voor master-studenten van Technische Geneeskunde?

7. Binnen welk kader wordt het onderzoek uitgevoerd?

7. Het onderzoek wordt uitgevoerd in het kader van een studie. Het gaat specifiek om een:

Anders, te weten:

mastertheses (2) en bachelortheses (2)

8. Aard van het onderzoek

8. Wat is de aard van het onderzoek?

(Online) survey onderzoek

Observatieonderzoek

9. Gebruik Proefpersonen uit SONA

9. Wilt u voor uw onderzoek met proefpersonen gebruik maken van SONA?

Nee

10. Omvang aantal sessies

Probeer een zo goed mogelijke schatting te geven van de benodigde duur van het onderzoek.

LET OP: Het onderzoek moet worden aangevraagd in eenheden van 15 minuten. Proefpersooncredits worden toegekend per standaard eenheid van 15 minuten.

10a. Zal een proefpersoon zijn/haar deelname afronden in één of meerdere sessie(s)?

In meer dan een sessies

10b. Hoeveel sessies zijn in totaal nodig?

7 (1x pre-survey (indiv.), 4x practicum (team), 1x proefassessment (team), 1x assessment (team))

10c. Wat is de duur (in minuten) van de afzonderlijke sessies?

20

10d. Wat is de totale duur van de sessie(s) in minuten?

140

11. Beoogde aantal proefpersonen, verdeling, inclusie en exclusie criteria

11a. Wat is het beoogde aantal proefpersonen?

80

11b. Wat is de beoogde verdeling man/vrouw onder de proefpersonen?

40/60 (volgens onderwijskundig onderzoeker binnen TG)

11c. Wat zijn de beoogde inclusiecriteria?

- De respondenten zijn ingeschreven voor de cursus ALS
- De studenten zitten in jaar 1 van de master-opleiding Technical Medicine

11d. Wat zijn de beoogde exclusiecriteria?

- Het nemen van angstremmers: dit kan namelijk invloed hebben op fysieke stress-signalen, de perceptie van stress en omgaan met stressvolle situaties
- Studenten die al eerder deelnamen aan de cursus

Indien een student niet mee wil doen aan het onderzoek, wordt het team waarin hij/zij zit ge-excludeerd van het onderzoek. De andere teamleden die wel deelnemen aan het onderzoek, kunnen enkel nog betrokken worden indien ze meedraaien bij een ander team (bijvoorbeeld wanneer ze invallen, of wanneer teamleden geruild worden).

12. Procedure van het onderzoek

12. Wat moet een proefpersoon die aan dit onderzoek deelneemt doen?

Een duidelijke beschrijving van de procedure van het onderzoek (instructies aan de proefpersonen, te meten variabelen, condities, manipulaties, meetinstrumenten) is vereist.

Op 28 februari 2017 zal er aan het begin van een werkcollege de studenten gevraagd worden of ze mee willen doen aan het onderzoek (d.m.v. informed consent). Hierbij krijgen ze uitleg over de doelen, procedure en vertrouwelijkheid van het onderzoek. Aansluitend volgt een vragenlijst waarin gevraagd wordt naar demografische informatie, team samenstelling, gebruik van medicatie gerelateerd aan stress (meer specifiek: of de student angstremmers neemt, zie punt 11d) en wordt afgesloten met de HEXACO persoonlijkheidsvragenlijst. Dit zal 20 min. van het werkcollege in beslag nemen.

Op 7/3, 14/3, 21/3 en 28/3 vinden de practicumlessen plaats, waarin er naast de reguliere lesplanning enkele metingen worden verricht. Alle studenten krijgen bij binnenkomst een sociometric badge om. De teamleiders worden verzocht daarnaast een Empatica E4 om hun pols te dragen. Vervolgens volgen de studenten de normale planning van het practicum. Na elke simulatie-oefening zal aan de student-teamleider gevraagd worden in welke mate ze stress hebben ervaren (met een visual analog scale). De docenten zullen op dat moment 9 items over team effectiviteit en ALS performance invullen. Dit zal maximaal 2 min. van hun tijd innemen. Er zijn 4 simulatie-oefeningen per practicum, en er zullen 6 practica per dag plaatsvinden. Volgens de reguliere lesplanning, worden alle simulatie-oefeningen voor de studenten opgenomen. De onderzoekers krijgen inzage in deze opnames, die zullen gecodeerd worden in de analyse-fase van het onderzoek.

Op 11/3 en 18/3 vindt respectievelijk het proefassessment en het assessment van de studenten plaats. De procedure wordt zoals hierboven beschreven doorlopen, met het verschil dat elke groep slechts 1 keer een simulatie-oefening zal doorlopen. Tijdens het assessment zal de beoordeling door de docenten uitgebreider zijn.

Al het bovenstaande is in overeenstemming met de docenten van de desbetreffende cursus.

13. Is een van de onderstaande situaties van toepassing?

n.v.t.

14. Mogelijke gevolgen van het onderzoek voor de proefpersonen.

14a. Kan het onderzoek mogelijk ongemak en/of risico's opleveren voor de proefpersonen?

Nee

14b. Toelichting

Indien Nee: Graag toelichten.
Indien Ja: Leg uit op welke wijze het ongemak en/of de risico's voor de deelnemende proefpersonen gerechtvaardigd worden in het licht van mogelijke opbrengsten van het onderzoek (voor de proefpersonen en/of andere groepen). Leg ook uit welke maatregelen worden getroffen om ongemak en risico's zoveel mogelijk op te vangen of te beperken.

Tijdens de sessies beoordelen de docenten team performance, maar ze krijgen tijdens de duur van het onderzoek geen inzicht in de resultaten van alle andere metingen die worden verricht. Het onderzoek zal dan ook geen invloed hebben op het eindcijfer van de student. Persoonsgegevens worden versleuteld zodat data niet te herleiden in tot een individu (zie ook punten 23 en 24).
De materialen die gebruikt worden om data te verzamelen vormen geen bewegingsbeperking voor de studenten en zijn niet schadelijk voor hun gezondheid.

15. Wilsbekwaamheid proefpersonen

Wilsbekwaamheid houdt in dat de proefpersonen beschikken over het individuele vermogen om zelfstandig beslissingen te nemen.

Proefpersonen zijn wilsbekwaam als zij:
•18 jaar of ouder (meerderjarig) zijn, en
•ieder voor zich in staat zijn tot een redelijke beoordeling van het eigen belang ter zake.
Volwassenen die daartoe niet in staat zijn, zijn wilsonbekwaam.(zie ook www.ccmo.nl/nl/onderzoek-bij-wilsonbekwame-volwassenen)

15a. Zijn de proefpersonen wilsbekwaam?

Ja

16. Leeftijdscategorie

16. In welke leeftijdscategorie vallen de proefpersonen?

- [x] Meerderjarig: 18 jaar en ouder (alleen toestemming proefpersoon nodig)

17. Volledige voorlichting vooraf

17a. Worden proefpersonen (en/of ouders/verzorgers) alvorens zij meedoen aan het onderzoek volledig over doel en inhoud van het onderzoek voorgelicht, bijvoorbeeld door middel van een brochure?

Ja

17b. Toelichting

Indien Ja: op welke wijze?
Indien Nee: waarom niet?

mondelinge en schriftelijke toelichting tijdens het eerste werkcollege (28/02).

17c. Welke informatie ontvangen proefpersonen (en/of ouders/verzorgers) vooraf over het doel en de inhoud van het onderzoek?

Ze onvangen informatie over het volgende:
- Welke ruwe data zal worden verzameld
- de vertrouwelijkheid van het onderzoek
- Het einddoel van het onderzoek ("Dit onderzoek is bedoeld om belangrijke aspecten zoals de groepscommunicatie, de rol van de teamleider en de ervaring van stress beter te integreren en controleren tijdens de reanimatie simulaties met de Human Patient Simulator")
- Beknopte informatie over de procedure

18. Informed Consent

18a. Verlenen proefpersonen (en in geval van niet-wilsbekwame proefpersonen: de voogd of ouders/verzorgers) vooraf schriftelijk toestemming voor het onderzoek door middel van een 'Informed Consent' formulier met daarin informatie over doel, aard en duur, risico's en bezwaren?

Het gebruik van een Informed Consent formulier heeft sterk de voorkeur! Een standaard Informed Consent formulier is te vinden op de website van de Commissie Ethiek.

Ja

19. Volledige voorlichting achteraf

19. Op welke manier vindt de debriefing plaats? Kunnen proefpersonen (en/of hun ouders/verzorgers) bijvoorbeeld naderhand nog in contact treden met de onderzoeker over het onderzoek?

Indien Ja: op welke wijze?
Indien Nee: waarom niet?

Ja, de studenten kunnen naderhand informatie ophalen over de geaggregeerde eindresultaten van het onderzoek (nb. de resultaten zullen nooit herleidbaar zijn naar individuele studenten).

20. Afhankelijkheid proefpersonen

20a. Beschrijf de relatie tussen de hoofdonderzoeker/onderzoekers enerzijds en de proefpersonen anderzijds.

De onderzoekers kunnen op geen enkele manier invloed uitoefenen op de respondenten. Tijdens de simulatie-oefeningen zijn de onderzoekers enkele aanwezig omwille van facilitaire redenen, zoals het overhandigen van een vragenlijst of sociometric badge.
De onderzoekers bespreken buiten de context van het onderzoek geen resultaten met de respondenten.
Nadien kunnen proefpersonen contact opnemen met de onderzoeker indien er eventuele vragen zijn (zie tevens punt 19).

20b. Zijn de proefpersonen, buiten de context van het onderzoek, in een afhankelijke of ondergeschikte positie t.o.v. de onderzoeker?

Nee

20c. Toelichting

Indien Ja: op welke wijze?

-

21. Duidelijkheid t.a.v. terugtrekken

21a. Wordt proefpersonen duidelijk gemaakt dat zij zich te allen tijde zonder verklaring/rechtvaardiging kunnen terugtrekken?

Ja

22. Beloning proefpersonen

LET OP: Alleen voor onderzoek waarbij alleen proefpersoon credits worden gegeven, kan gebruik gemaakt worden maken van het SONA systeem.

22. Welke beloning(en) kunnen proefpersonen ontvangen voor hun deelname aan het onderzoek.

- [x] Geen

23. Opslag en verwerking gegevens

23a. Worden gegevens van het onderzoek vertrouwelijk behandeld en anoniem opgeslagen en verwerkt?

Nee

23b. Indien Nee: Waarom niet?

-

24. Inzage gegevens

24a. Hebben proefpersonen achteraf inzage in hun eigen gegevens?

Nee

24b. Worden de mogelijkheden tot inzage vooraf bekend gemaakt aan de proefpersonen? Op welke wijze?

Ja, dit zal bij de mondelinge uitleg over het onderzoek vermeld worden. Studenten krijgen geen inzage in hun eigen gegevens, tenzij ze na afronding van het onderzoek een afspraak maken met de hoofdonderzoeker die via de versleuteling gegevens van die persoon kan laten inzien. Een proefpersoon kan enkel zijn/haar eigen gegevens inzien. Deze mogen niet gekopieerd of digitaal verzonden worden.

Opmerkingen

Uw reactie

Dag Maaike,
- het is belangrijk te weten of studenten angstremmers nemen. Het is namelijk een exclusiecriterium omdat het het gemeten stress-niveau en omgaan met stress beïnvloedt. Dit heb ik nu verduidelijkt in het formulier. Mocht je het er toch uit willen, kan dat, maar dan beïnvloedt het mogelijk wel de betrouwbaarheid van het onderzoek.
- Punten 23 en 24 zijn geherformuleerd. Er bestaat nog twijfel over wie de sleutel zal bijhouden en wie de persoonsgegevens zal versleutelen. We kunnen ons inbeelden dat het voor jou veel werk zou zijn. Wat is jouw mening hierover?
- De theorietoets wordt niet meegenomen, omdat het om een kennistoets gaat die sterk beïnvloed kan zijn door ervaring of leerstijl van de student. De data is voor geen van ons bruikbaar.
- Indien een student niet mee wil doen, valt het team inderdaad af (omdat effectiviteit van het hele team gemeten moet worden). Ik heb het aangepast bij punt 11d.
- Bedankt, is aangepast.
- Er was een woord verdwenen uit vraag 12, heb het nu weer toegevoegd.

Vragen/opmerkingen van onderzoeker, begeleidend docent en commissie

2017-02-16 20:01:37 - Endedijk, M.D. :
Hoi Jolien,

Een paar kleine vragen:
- de vragen over medicijngebruik: is dat noodzakelijk? Is erg persoonlijk en daar gaat denk ik de commissie over vallen. Ik vraag mij zelf ook af of dit heel veel zal uitmaken in het onderzoek
- je kunt niet de data WEL anoniem opslaan, maar ook inzicht geven in persoonlijke data (onderdeel gegevensverwerking). Als het anoniem is opgeslagen, dan is het niet meer herleidbaar. Sowieso kan het niet helemaal anoniem verzameld worden, want we moeten data koppelen.
- ik dacht dat we ook data zouden verzamelen van de eindtoets? Die staat nu niet genoemd. Daar moet de student ook toestemming voor geven
- wat doe je met de teams waarvan 1 student niet mee wil doen? Doet dan het hele team niet mee?
- Het is niet HEXAGO, maar HEXACO
- vraag 12 breekt nu abrupt af.

Ik hoop dat je dit snel kunt verwerken, dan zal ik meteen accorderen.

APPENDIX III:
ENCRYPTION RESEARCH DATA

Plan versleuteling data onderwijskundig onderzoek ALS (febr – aug 2017)

De data zou verzameld worden op basis van studentnummer. Dit valt onder de categorie persoonsgegevens, en wordt alleen toegestaan indien er geen andere mogelijkheid is om de data beschermd te verzamelen. We geloven dat dit inderdaad bij ons onderzoek van toepassing is, om de volgende redenen:

1. Het videomateriaal is gekoppeld aan studentnummer binnen een beschermde omgeving.
2. Indien elke student een ander nummer zou krijgen, zou
    a. Elke student zijn eigen nummer moeten onthouden: hier bestaat het risico dat studenten het nummer vergeten. Mogelijke gevolgen: De procedure wordt vertraagd of studententeams worden ge-excludeerd.
    b. De persoon met de versleuteling telkens aanwezig moeten zijn om de juiste nummers aan de juiste studenten te geven, onder andere tijdens snelle groepswissels. De studenten, noch de onderzoekers kunnen de nummers checken. Mogelijke gevolgen: studentnummers worden verwisseld (data is dan niet meer betrouwbaar), de procedure loopt vertraging op.

   Hierdoor moeten we concluderen dat dataverzameling op basis van geanonimiseerde nummers de betrouwbaarheid van het onderzoek in het gedrang kunnen brengen. Daarnaast beschikken de onderzoekers niet over de tijd, noch de middelen om data volledig geanonimiseerd te kunnen verzamelen.

Om deze reden stellen we het volgende voor, zoals te zien in het verzoek voor de Ethische Commissie:

Met alle data zal vertrouwelijk worden omgegaan. Omdat het videomateriaal en teams gekoppeld zijn aan studentennummers, zal initieel alle data verzameld worden op basis van dit studentennummer. Wanneer data binnenkomt, wordt elk studentnummer zo snel mogelijk omgezet naar een nieuw nummer door middel van een versleuteling. Dit document zal zich gescheiden van de onderzoeksgegevens, op een fysiek andere plek bevinden. Enkel de hoofdonderzoeker krijgt inzage in de sleutel. Onderzoekers kunnen de data pas analyseren wanneer deze versleuteld is, met uitzondering van het videomateriaal. Deze kan namelijk niet losgekoppeld worden van het studentnummer, omdat de onderzoekers slechts inzage krijgen in de video's die gedeeld werden aan de betreffende studententeams op een beschermd platform. Alle informatie blijft binnen het onderzoeksteam, en derden zullen geen informatie over individuele respondenten kunnen ophalen.

Enkel het geel gemarkeerde zal anders geïnterpreteerd/aangepast moeten worden:

Onder hoofdonderzoekers zal moeten worden verstaan: Jolien van Sas en Tom Swinkels. Onderzoekers zijn Simon Rijsemus en Maschja Baas.

Toegang tot de versleuteling zal vergrendeld worden door middel van een paswoord die alleen Tom en Jolien kennen. Daarnaast zal –indien mogelijk- een verbod voor printen in het document worden gezet. Na afronding van het onderzoek krijgt de coördinator van het onderzoek (Maaike Endedijk?) toegang tot het document, en wordt de toegang voor Tom en Jolien verboden.

In de praktijk

Alle analoge data zal de studentnummers bevatten, de respondenten vullen deze zelf in.
Op digitale data (met uitzondering van het videomateriaal) zullen geen persoonsgegevens (naam of studentnummer) terug te vinden zijn. Het omzetten van studentnummer naar een geanonimiseerd nummer zal gebeuren tijdens het handmatig invoeren van analoge data in een digitaal bestand. Hiervoor zal een beschermde sleutellijst aangemaakt worden, waar enkel de hoofdonderzoekers toegang tot zullen hebben.

We zijn ons ervan bewust dat deze manier van data verzamelen risico's met zich meebrengt. Wegens tijdgebrek en gebrek aan middelen was het niet mogelijk data volledig geanonimiseerd te verzamelen. Echter zal erg voorzichtig met de data worden omgegaan, en zal alles achter slot en grendel (digitaal en analoog) bewaard worden.

	Categorie:	**Locatie:**	**Inzicht door:**
Studentnummers	Persoonsgegevens	Analoog	T. Swinkels & J. van Sas
Nieuwe nummers	Geanonimiseerd	Digitaal	Onderzoekers team ALS

Uit het goedgekeurde verzoek Ethische Commissie BMS:

23. OPSLAG EN VERWERKING GEGEVENS

23a. Worden gegevens van het onderzoek vertrouwelijk behandeld en anoniem opgeslagen en verwerkt?

Nee

23b. Indien Nee: Waarom niet?

Met alle data zal vertrouwelijk worden omgegaan. Omdat het videomateriaal en teams gekoppeld zijn aan studentennummers, zal initieel alle data verzameld worden op basis van dit studentennummer. Wanneer data binnenkomt, wordt elk studentnummer zo snel mogelijk omgezet naar een nieuw nummer door middel van een versleuteling. Dit document zal zich gescheiden van de onderzoeksgegevens, op een fysiek andere plek bevinden. Enkel de hoofdonderzoeker krijgt inzage in de sleutel. Onderzoekers kunnen de data pas analyseren wanneer deze versleuteld is, met uitzondering van het videomateriaal. Deze kan namelijk niet losgekoppeld worden van het studentnummer, omdat de onderzoekers slechts inzage krijgen in de video's die gedeeld werden aan de betreffende studententeams op een beschermd platform. Alle informatie blijft binnen het onderzoeksteam, en derden zullen geen informatie over individuele respondenten kunnen ophalen.

24. INZAGE GEGEVENS

24a. Hebben proefpersonen achteraf inzage in hun eigen gegevens?

Nee

24b. Worden de mogelijkheden tot inzage vooraf bekend gemaakt aan de proefpersonen? Op welke wijze?

Ja, dit zal bij de mondelinge uitleg over het onderzoek vermeld worden. Studenten krijgen geen inzage in hun eigen gegevens, tenzij ze na afronding van het onderzoek een afspraak maken met de hoofdonderzoeker die via de versleuteling gegevens van die persoon kan laten inzien. Een proefpersoon kan enkel zijn/haar eigen gegevens inzien. Deze mogen niet gekopieerd of digitaal verzonden worden.

APPENDIX IV:
TEAM PERFORMANCE SCALE AND EXPLANATION

Team effectiveness and performance scales

Groep: ______
Datum: __/__
Practicum: ______
Rater: ______

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)	○	○	○	○	○

Handleiding en uitleg
effectiveness & performance scales

Team performance (Vertaald uit Gibson, Cooper, & Conger, 2009)

1. Met een consistent goed presterend team wordt bedoeld: Een team dat gedurende het hele reanimatie-scenario goed presteert.
2. Een effectief team wordt gedefinieerd als team dat doeltreffend werkt, zijn doelen behaalt, in de algemene zin. Een doel kan bijvoorbeeld zijn: het komen tot de juiste diagnose. De nadruk wordt hierbij gelegd op het behalen van het doel, en in mindere mate op het proces.
4. Met kwalitatief werk doelt men zowel op de technische als de niet-technische aspecten van het werk.

Origineel:
1 = very inaccurate, 7 = very accurate

1. *"This team is consistently a high performing team."*
2. *"This team is effective."*
3. *"This team makes few mistakes."*
4. *"This team does high quality work."*

ALS performance (ALS scorelijst, TG)

5. ALS protocol
   Weging: 20%
   Onder ALS protocol wordt verstaan:
   a. primaire diagnose: De patiënt aanspreken, schudden, respons afwachten, in mond kijken en/of voelen, chinlift, look/listen/feel (≥ 7 sec.), en pols voelen (≥ 4 sec) voor start compressies.
   b. Reanimatie cyclus: directe start na primaire diagnose, minimale interruptie, 30:2 ratio compressies: beademingen
   c. Snelle ritmecheck: vroeg en juiste interpretatie
   d. Indicatie defillibratie: shock vs. non-shock
   e. Opvolging handelingen protocol: aanhouden 2 min. cycli
6. Uitvoering handelingen
   Weging: 20%
   Onder uitvoeringen handelingen wordt verstaan:
   a. Compressie techniek: juiste handplaatsing, frequentie (100/min)
   b. Kap beademing techniek: correcte mayo tube maat selectie + plaatsing, en correcte handpositie + teugtoediening.
   c. Ritmecheck methodiek: onderbreken compressies, pols voelen, en gezamelijke interpretative ritme.
   d. Defillibratie techniek: correct gebruiken defillibrator, waarschuwing omgeving ("*bed vrij*").
   e. Intubatie techniek: material selectie en controle, juiste intubatie techniek (max. 12 sec), en controle via look/listen/feel techniek.
   f. Medicatie toedieningswijze en dosis: juiste concentratie en juiste toegangsroute.
7. Diagnostiek en klinisch redeneren
   Weging: 40%
   Onder diagnostiek en klinisch redeneren wordt verstaan:
   a. ABCDE systematiek: volgorde en compleetheid
   b. Inzet anamneses: relevantie en compleetheid (algemene, speciële, aanvullende anamnese)
   c. Inzet lichamelijk onderzoek: relevantie en compleetheid (volgens ABCDE)
   d. Inzet diagnostische technieken: relevantie en compleetheid (monitor, lab, ECG, echo, X-thorax)
   e. Interpretatie diagnostische informatie: juiste interpretatie diagnostische uitslagen (anamnese, lichamelijk onderzoek, monitor, lab, ECG, echo, X-thorax)
   f. Diagnostische conclusie: correcte diagnose stelling
   g. Reassessment: herevaluatie bij verandering status
8. Therapeutisch plan

Weging: 10%

Onder dit item wordt verstaan:

a. Behandeling onderliggende oorzaak: passende behandeling
b. Post-resuscitation care: overdracht naar passende afdeling/specialist, en adequate follow-up strategie

9. Werkwijze

Weging: 20%

Onder werkwijze wordt verstaan:

a. Closed loop communicatie: naam benoemen, bevestigen, heldere communicatie
b. Onderling overleg en samenwerking: overleg en samen besluit nemen, en elkaar helpen bij onzekerheid.
c. Overdracht volgens SBAR: SBAR componenten aanwezig

Leadership effectiveness (adapted from Hooijberg, 1996)

10. Met efficiënt wordt bedoeld: de doelen worden op de meest economische manier behaald. In deze context betekent het dat de leidinggevende handelt en zijn/haar doelen bereikt op de meest zuinige/nuttige/verstandige manier wat betreft tijd, inspanning en middelen.
11. Hier wordt gevraagd of de leidinggevende als een rolmodel voor zijn teamleden functioneert, zodat zij er in de toekomst een voorbeeld aan kunnen nemen wanneer zij in een leidersrol moeten staan.
12. Onder doelen wordt verstaan: de doelen die een leidinggevende moet behalen, zoals op een correcte manier communiceren, het protocol volgen, etc.
13. Met succes wordt bedoeld zowel op sociaal/emotioneel vlak, als succes in het redeneren, actie ondernemen etc.
14. Voor een definitie van effectiviteit: zie punt 2.

APPENDIX V:
STRESS SCALE

Studentnr. _______________

Taak* TL / OML / BLS

Groep _______

Datum ___/___

Practicum _______

Stress scale

Omcirkel het passende antwoord op een schaal van 1 tot 10.
Vul ook rechtsboven deze bladzijde je studentnummer, taak en groepsnummer in.

<u>VOORAF HET SCENARIO</u>

1. Hoe stressvol verwacht je dat het komende scenario zal zijn?

1	2	3	4	5	6	7	8	9	10
Helemaal niet stressvol									Extreem stressvol

2. In hoeverre ben je in staat om goed om te gaan met het komende scenario?

1	2	3	4	5	6	7	8	9	10
Slecht									Perfect

<u>ACHTERAF HET SCENARIO</u>

3. Hoe stressvol vond je het uitvoeren van het scenario?

1	2	3	4	5	6	7	8	9	10
Helemaal niet stressvol									Extreem stressvol

4. In hoeverre was je in staat om goed om te gaan met het zonet uitgevoerde scenario?

1	2	3	4	5	6	7	8	9	10
Slecht									Perfect

* TL = teamleider, OML = omloop, BLS = basic life support

APPENDIX VI:
DESCRIPTIVE STATISTICS AND DETAILED INFORMATION CODED BEHAVIOURS

			Relative frequency[a]				RPM[b]			
Category	*Who*[c]	*Total*	*Min.*	*Max.*	*M*	*SD*	*Min.*	*Max.*	*M*	*SD*
Command (CLC1)	TL	392.50	7.50	34.00	17.84	7.58	.33	3.51	1.61	.85
Observe	TL	108.50	.00	12.00	4.93	2.98	.00	.92	.44	.26
Suggest (CLC1)	TL	323.00	5.00	27.50	14.68	6.29	.15	2.54	1.40	.73
Inquiry (CLC1)	TL	76.50	.00	8.50	3.48	2.67	.00	.85	.34	.27
Question (CLC1)	TL	69.50	1.00	8.50	3.16	1.84	.06	.60	.30	.16
Confirmation	TL	242.50	3.00	26.00	11.02	5.50	.19	2.68	1.03	.55
Opinion	TL	18.50	.00	2.50	.84	.75	.00	.20	.08	.07
Summary	TL	95.00	1.50	6.50	4.32	1.64	.05	.87	.41	.22
Laugh	TL	6.00	.00	2.50	.27	.63	.00	.25	.03	.08
Sorry	TL	6.00	.00	1.50	.27	.53	.00	.26	.03	.07
Social	TL	4.00	.00	1.00	.18	.29	.00	.11	.02	.03
Incomprehensible	TL	131.50	.00	14.00	5.98	4.08	.00	1.34	.51	.32
Other	F	1437.00	30.00	106.50	65.32	22.90	.84	10.27	6.25	2.77
Check back (CLC2)	F	386.00	7.50	33.00	17.55	7.45	.33	3.40	1.63	.76
Closing the loop (CLC1)	TL	119.50	1.00	14.50	5.43	3.34	.04	1.31	.49	.30
External communication	TL	366.00	2.50	40.50	16.64	9.04	.16	3.68	1.64	1.05
Intervention	B	428.00	3.00	43.00	19.45	9.55	.20	3.69	1.92	1.14

Note. N = 22. [a]Relative frequency = amount of coded specific behaviours / total amount of coded behaviours. [b]RPM = rate per minute. [c]TL = Team leader, F = Follower, B = Bystander

APPENDIX VII:
CORRELATION TABLE BEHAVIOUR AND CLC

		1	2	3	4	5	6	7	8	9	10	11	12
Kendall's tau_b	1. Command	-											
	2. Suggest	,758**	-										
	3. Question	0,295	0,295	-									
	4. Inquiry	,368*	,455**	,443**	-								
	5. Summarizing	,451**	,451**	0,186957	0,286	-							
	6. Confirmation	,316*	,385*	,312*	0,065	0,278	-						
	7. Opinion	-0,054	0,027	0,267	0,036	-0,014	,380*	-					
	8. Observe	,364*	,330*	0,239	0,200	0,248	0,243	-0,005	-				
	9. Check-back	,654**	,567**	,486**	,455**	,399**	,506**	0,199	0,269	-			
	10. Closing the loop	,455**	,385*	,451**	,567**	,408**	0,186	0,054	,304*	,506**	-		
	11. External communication	0,000	0,052	0,152	0,113	0,096	-0,121	-0,122	-0,083	-0,069	0,095	-	
	12. Incomprehensible	0,239	,343*	0,122	0,004	0,131	0,283	-0,054	,357*	0,126	0,126	-0,174	-
Spearman's rho	1. Command	-											
	2. Suggest	,857**	-										
	3. Question	0,398	0,391	-									
	4. Inquiry	,522*	,595**	,548**	-								
	5. Summarizing	,595**	,628**	0,278	,425*	-							
	6. Confirmation	,426*	,563**	,429*	0,106	0,371	-						
	7. Opinion	-0,045	-0,017	0,345	0,021	-0,016	,549**	-					
	8. Observe	,494*	,433*	0,336	0,252	0,306	0,382	-0,034	-				
	9. Check-back	,823**	,745**	,666**	,612**	,533*	,656**	0,320	0,400	-			
	10. Closing the loop	,679**	,607**	,567**	,774**	,523*	0,267	0,062	,440*	,667**	-		
	11. External communication	0,023	0,090	0,211	0,166	0,118	-0,214	-0,148	-0,134	-0,090	0,115	-	
	12. Incomprehensible	0,341	,447*	0,196	0,011	0,198	,444*	-0,079	,534*	0,176	0,187	-0,227	-

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed). c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples