MASTER THESIS

EXPLICIT AND IMPLICIT COORDINATION PATTERNS IN STUDENT TEAMS PERFORMING ADVANCED LIFE SUPPORT IN A SIMULATION-BASED SETTING

An observational study about the occurrence of explicit and implicit coordination patterns in high and low performing teams and the relationship of these patterns during the simulation.

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Title

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Acknowledgement

I dedicate this scientific work to my father, a man who taught me to think critically, weight pros and cons and take conscious decisions.

A very intense and diverse experience at the University of Twente, Enschede and the Netherlands ends with the completion of this master project. I had the privilege to study at a university with an extraordinary learning environment and I am taking a lot of learnings out of this time that will shape my future self.
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Joscha Friedrich
Enschede, August 2018

Abstract

Little is known about temporal dynamics in team coordination and their impact on team performance in medical emergency situations. In this observational study, we investigate when and how sequences of explicit and implicit coordination affect team performance in student teams performing advanced life support in a simulated setting. We exhaustively coded video-recordings of 17 student teams to capture temporal occurrences of coordination micro-behaviors, differentiated in two temporal phases of the practice. Team performance was measured with expert ratings by medical teachers. Lag sequential analyses revealed significant differences in explicit and implicit coordination sequences between high and low performing teams. During the setup of cardiovascular support (Phase 1), high performing teams were characterized by patterns where information upon request was followed by further information upon request and summary was followed by a command. During the assessment of the underlying cause of cardiac arrest (Phase 2), high performing teams showed patterns in which action-related talking to the room was followed by further action-related talking to the room. The development of implicit coordination sequences in Phase 2 through explicit coordination sequences in Phase 1 did not find enough empirical support.

This study emphasizes the need to take a temporal view on team coordination while considering task requirements. Future research should embed additional measures to understand the establishment and development of team mental models through explicit and implicit coordination patterns in medical emergencies.

Keywords: interaction patterns, action teams, team performance, team coordination, explicit and implicit coordination, lag sequential analysis

1. Introduction

Nowadays, teams are a ubiquitous element in organizations. Research on teamwork and related outcomes in different team types has been increasing in the last decades (Vangrieken, Boon, Dochy, & Kyndt, 2017). Action teams are a specific type of teams that need to perform necessary actions at the right time, in a correct way, under high pressure, uncertainty and in continuously evolving situations (Doumouras, Keshet, Nathens, Ahmed, & Hicks, 2012). Especially in health care emergency situations, effective coordination in action teams is essential to save the patient's life (Fernandez Castelao, Russo, Riethmüller, & Boos, 2013). Poor team coordination frequently results in failure and miscommunication. In such settings the stakes are high as this may compromise patient safety (Manser, 2009). Therefore, training such teams to effectively coordinate complex situations with various task requirements is crucial. Realistic settings like simulated environments are an excellent possibility for teams to learn and improve technical and coordination skills (Hunziker et al., 2011).

Teams can use both explicit and implicit coordination to coordinate information and action. These two mechanisms have been shown to affect team performance (Kolbe, Burtscher, & Manser, 2013). Explicit coordination behavior is an intentional use of overt communication and characterized by directly addressing people concerning a specific request, whereas implicit coordination is described as dynamic and anticipated adjustment behavior without addressing specific team members (Espinosa, Lerch, Kraut, Salas, & Fiore, 2004; Kolbe, Burtscher, Manser, Künzle, & Grote, 2011). Research shows opposing results concerning the impact of explicit and implicit coordination on team performance.

To better understand the coordination processes that affect team performance during medical emergency situations, such as a cardiac arrest, we need to capture a fine-grained look at the temporal dynamics of explicit and implicit coordination that affect patient safety (Gorman, Amazeen, & Cooke, 2010). Taking a temporal lens is advocated because of the growing evidence that the use of micro-level interaction patterns of coordination instead of aggregated frequency counts is suitable to compare low and high performing teams (Bowers, Jentsch, Salas, & Braun, 1998; Kolbe et al., 2014; Stachowski, Kaplan, & Waller, 2009; Zijlstra, Waller, & Phillips, 2012). From a perspective of team functioning, medical emergency tasks are too complex to be fulfilled by a compilation of medical experts. The specific order, combination and change of coordination activities over time are a crucial part of the behavioral dynamics in team coordination that affect team performance (Gorman et al., 2010). In addition, the joint impact of explicit and implicit coordination mechanisms on team performance is hardly investigated (Espinosa et al., 2004). Herndon and Lewis (2005) emphasize that the methodological limitations of traditional approaches (i.e. mean comparisons) can be overcome with the usage of sequence methods that enable the investigation of research questions related to the temporal nature of teamwork and the emergence and effects of patterns. The analysis of sequences enables the consideration of behavioral events across time and "in their continuity" (Aisenbrey & Fasang, 2010, p. 441).

However, so far, research on temporal coordination patterns and their impact on team performance is scarce, especially in the health care context (Burtscher, Ritz, Kolbe, 2018; Rico, Sánchez-Manzanares, Gill, & Gibson, 2008). A micro-approach to team coordination in high-risk and dynamic environments, such as medical emergencies, enables a better understanding of the antecedents of team performance and offers solutions for effective training and educational measures.

This study contributes to team research and theories about team coordination by focusing on temporal patterns of explicit and implicit coordination within the same practice (Riethmüller, Fernandez Castelao, Eberhardt, Timmermann, & Boos, 2012). The consideration of the team type and task requirements will allow a detailed analysis of the occurrence of coordination patterns, as researchers have called for (Burtscher et al., 2018). This advances our knowledge about health care action teams, the emergent character of explicit and implicit coordination and why some teams perform more effectively than others. In addition, we will analyze the frequencies of explicit coordination sequences and how these affect the occurrence of implicit coordination sequences during the practice. This enables deeper knowledge about team cognitive processes to fully understand team coordination (Marks, Zaccaro, & Mathieu, 2000; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000). Practically, an in-depth understanding of these interaction processes provides the opportunity to design more effective training scenarios and enable better learning transfer in real situations. The key research question of this study is:

How and when do sequences of explicit and implicit coordination affect team performance in student teams performing cardiopulmonary resuscitation in a simulated setting?

First, an in-depth literature review about the relevant constructs in team coordination literature provides a theoretical framework in which three hypotheses and the research model are derived from. Subsequently, details about the research design, respondents, procedure, operationalization of the variables and the data analysis of exhaustive behavioral coding can be found in the section "Methods". Afterwards, the results of lag sequential analyses are presented, and their theoretical implications are discussed. The limitations of this study are mentioned, propositions for future research and practical implications are presented. Last, the conclusion offers a concise summary of the main aspects of this study.

2. Theoretical Framework

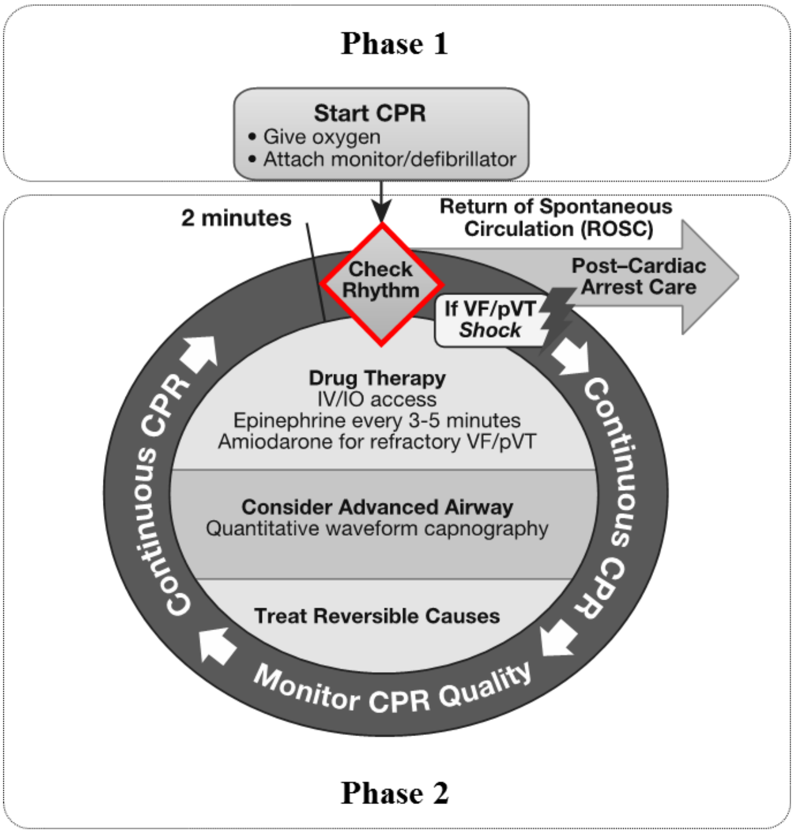
Action Teams

Action teams are specialized teams that "respond to unexpected events in a coordinated way, often requiring a free and open transfer of information to enable real-time, reciprocal coordination of action" (Edmondson, 2003, p.1421; Thompson, 1967; Sundstrom, De Meuse, & Futrell, 1990). These teams often face unpredictable performance situations and unknown circumstances that "require them to quickly and dynamically respond to multiple task inputs" (Vashdi, Bamberger, & Erez, 2013, p.946; Klein, Ziegert, Knight, & Xiao, 2006). Therefore, task coordination between team members needs to be adapted to the requirements of the situation and cannot be planned beforehand (Edmondson, 2003). In health care, coordination is found to be an important factor that influences patient safety, especially in dynamic settings like operating rooms, intensive care or emergency medicine (Manser, 2009; Klein et al., 2006). Situations that require Advanced Life Support (ALS), a medical emergency treatment after cardiac arrest of a patient, entail such a dynamic and emergency setting. In ALS team coordination is essential for the patient's survival because cardiopulmonary resuscitation (CPR) subtasks need to be synchronized among team members in an accurate way. Teams performing ALS can be considered as action teams because they have to perform effectively under complex, high-pressure and unpredictable conditions due to a cardiac arrest of a patient (Klein et al., 2006). The consequences of their actions impact the life of the patient at risk and they work "under conditions that change frequently" (Manser, 2009, p. 143).
Research found that teamwork is the most impactful factor in explaining malpractices and adverse events in dynamic health care settings (Manser, 2009). It is also known that performance in medical setting is directly influenced by the interaction and coordination processes between the team members (Hackman & Morris, 1975; Marks, Mathieu, & Zaccaro, 2001; Wittenbaum et al., 2004) rather than by the clinical skill level. Consequently, the dynamic and unstable context is an important condition to consider while investigating how interaction processes of coordination behaviors influence medical team performance and patient safety.

Two Phases in an Advanced Life Support Practice

Advanced Life Support situations require teams to perform cardiopulmonary resuscitation (CPR), follow a set protocol, conduct diagnostics, perform a systematic clinical approach and ensure good teamwork and communication (Nolan, Deakin, Soar, Böttiger, & Smith, 2005). This means, teams need to fulfill different task requirements depending on the current state and progress of the patient's medical situation. The distinction of ALS into two phases is based on the theoretical considerations that different coordination requirements are relevant in the beginning of a cardiac arrest situation compared to the phase where the underlying cause of the cardiac arrest is assessed. The basis for this distinction is the American Heart Association's (2015) "Adult Cardiac Arrest Circular Algorithm" in which the beginning of cardiopulmonary resuscitation is explicitly and visually separated from a subsequent cycle of activities that involves drug therapy, advanced airway consideration and the treatment of the underlying cause and continuous CPR activities (see Figure 1). The beginning of cardiopulmonary resuscitation requires a quick and error free distribution and coordination of tasks such as giving oxygen and attaching the patient to the monitor and defibrillator (Phase 1). The subsequent cycle of activities requires teams to find out the cause of the cardiac arrest among ten different reversible causes, administer and perform the most appropriate drug therapy and continuously perform and monitor CPR in temporal cycles (Phase 2). An accurate diagnosis is an important part in this phase as teams are required to use their knowledge and collected information about the patient to take the right decisions and coordinate the right actions that lead to the patient's survival. To sum up, Phase 1 is defined as the beginning of cardiopulmonary resuscitation and Phase 2 as the subsequent cycle of ALS activities.

Figure 1. The Adult Cardiac Arrest Circular Algorithm (American Heart Association, 2015), *adjusted*



Team coordination

Team coordination is an essential element of teamwork and is defined as "orchestrating the sequence and the timing of interdependent actions" (Marks et al., 2001, p. 363). More specifically, this encompasses the coordination of interdependent subtasks by managing the flow of actions and information among team members to reach a common goal (Brannick, Salas, & Prince, 1997; Fernandez Castelao et al., 2013). Research on team coordination in the medical field has shown that it is an important explanatory factor for high team performance (Arrow et al., 2000; Bogner, 1994; Cooper, 2001; Gaba, 1994; Helmreich & Merrit, 2000; Helmreich & Schaefer, 1994; Manser, 2009; Tschan et al., 2011). Team performance in medical teams is mostly an outcome of team coordinating processes in a complex system (Kolbe et al., 2011). The way teams coordinate their actions and communicate with each other influences the team's performance and consequently the patient's safety. Thus, communication failures and misunderstandings can be detrimental for a patient's health.

A commonly used and important distinction regarding coordination processes is between action-related and information-related coordination (e.g. Boos, Kolbe, & Strack, 2011; Burtscher et al., 2010; Kolbe et al., 2013; Riethmüller et al., 2012; Tschan et al., 2009). Information-related coordination supports collective sense-making in crisis situations. Thus, it is especially important in the health care setting where unshared information has to be collected from various sources, "including the patient, other team members, written notes, and the different monitors in the operating room" (Kolbe et al. 2011, p. 80; Waller & Uitdewilligen, 2008). Action-related coordination is an important process to regulate tasks-oriented behaviors, such as the division of tasks, instructions about medical treatments or the

coordination of diagnostic actions. In the situation of a sudden cardiac arrest, this entails the timing and sequencing of subtasks that need to be coordinated quickly, for example the decision who will lead the resuscitation, who monitors the process, which drug(s) are administered by whom and when (Clark, 1999). Effective teams synchronize the flow of information and action among team members (Kolbe et al., 2011). Thus, both information-related and action-related coordination are simultaneous processes as they ensure a common understanding of the patient's situation and effective task execution leading to higher team performance in medicine (Arrow et al., 2000; Rousseau, Aubé, & Savoie, 2006).
Information- and action-related coordination are two processes that are distinguished by the basis of content. To effectively coordinate information and action, teams use two basic mechanisms: explicit and implicit coordination. This distinction is important and often made in teamwork literature as it characterizes the nature of coordination and type of mechanism (Kolbe et al., 2013).

Explicit and Implicit Coordination

Explicit coordination is characterized as overt communication that is "usually plain and easy to understand" (Kolbe et al., 2011, p. 81; Espinosa et al., 2004; Wittenbaum et al., 1998; Zala-Mezö et al., 2009). Explicit coordination is displayed when team members communicate explicitly and purposely to achieve a certain goal. Most research conducted in CPR settings focus on explicit coordination behaviors, such as speaking up, planning, leadership behaviors such as giving instructions, the request for information and closed-loop communication (Edmondson, 2003; Künzle, Kolbe, & Grote, 2010; Fernandez Castelao et al., 2013).
Although explicit coordination is indicated as being intensive in resources (Kolbe et al., 2014), it can also ensure effective task distribution through clear communication. Tschan and her colleagues (2006) found that clear instructions correlate with cardiovascular support. Cardiac arrest is a life-endangering situation that needs to be met with flawless and accurate synchronization of CPR subtasks to stabilize the patient from the beginning on (Fernandez Castelao et al., 2013). After recognizing cardiac arrest, immediate distribution of tasks and an accurate setup of CPR activities, such as chest compressions and ventilations, are crucial for a patient's survival (Nolan et al., 2005). Explicit coordination prevents misunderstandings among team members, which could be fatal for patient safety, especially in the beginning of CPR. This is supported by Fernandez Castelao and colleagues (2013) who have reviewed the effects of team coordination during CPR and conclude that comprehensible and clear communication are key mechanisms of coordination in emergency situations.
As opposed to explicit coordination, implicit coordination refers to the tacit character of coordination in a team. Implicit coordination effort is not addressed to a specific team member because it is more natural and sometimes unconscious form of team coordination. Teams implicitly retrieve shared information regarding the requirements of a task and rely "on anticipation of the information and resource needs of the other team members" (Butchibabu, Sparano-Huiban, Sonenberg, & Shah, 2016, p.596; Grote, Zala-Mezö, & Grommes, 2003; Wittenbaum et al. 1996). Researchers argue that the usage of implicit coordination is possible through a shared mental model – "a shared and organized understanding and mental representation" of the situation and the required tasks among team members (Mohammed, Ferzandi, & Hamilton, 2010, p.4; Cannon-Bowers & Salas, 1990). An example of implicit coordination is talking to the room which is a proactive way of sharing task-relevant information without a previous request (Kolbe et al., 2014; Rico et al., 2008).
Implicit coordination is argued to be detrimental for team performance if misunderstandings occur due to missing clarity about task allocation. On the contrary, implicit coordination can ensure the effective usage of everyone's knowledge and information in the room. Butchibabu and his colleagues (2016) investigated implicit communication strategies in varying degrees of complexity. They found that during highly complex tasks high performing teams were significantly more engaged in anticipatory information sharing through a proactive way of communication. In addition, high performing teams reduce the coordination overhead through implicit coordination strategies which positively influence team performance (Entin & Serfaty, 1999). In the medical setting of a cardiac arrest, a crucial component besides CPR is post-cardiac arrest treatment which requires accurate diagnosis of reversible causes and deriving the correct actions from existing information to restore the patient's quality of life (Nolan et al., 2005). Tschan et al. (2009) found that accurate diagnosis is facilitated by the implicit coordination behavior of talking to the room. Team members get invited to participate in "a mutual diagnostic

process" which increases the chances for active engagement with additional suggestions and detections of problems in the team (Tschan et al., 2009, p. 276).

A Micro View on Team Coordination with Interaction Patterns

Although extant research on aggregates of explicit and implicit coordination behaviors provides an understanding of the antecedents of medical team performance, it fails to capture the complete picture of team coordination (e.g. Gorman et al., 2010; Thomas et al., 2006). Research found no differences in the frequency counts of coordination behaviors between high and low performing teams (Stachowski et al., 2009; Kolbe et al., 2014). Scholars have argued that we need to extend the investigation beyond the quantitative occurrence of coordination behaviors and instead include non-random interaction patterns of behaviors and their emergence over time (Becker-Beck, 2001; Kozlowski & Ilgen, 2006; Marks et al., 2001). Lei and her colleagues (2016) define interaction patterns as "regular sets of coordinated behavior in teams, repeated over time, occurring above and beyond chance" (p. 495). A growing amount of research focuses on interaction patterns to investigate team coordination (e.g. Jeong, 2003; Kauffeld & Meyers, 2009; Meinecke, Lehmann-Willenbrock, & Kauffeld, 2017). This would provide us with a more in-depth understanding of effective coordination and its relation to team performance.

Considering the context of a medical emergency, research on both the content and timing of effective interaction patterns of explicit and implicit coordination is still scarce. The analysis of interaction patterns through sequence methods enables to answer research questions related to the emergence and effects of explicit and implicit coordination patterns on team performance (Herndon & Lewis, 2005). Therefore, a micro view on sequences of explicit and implicit coordination provides information on how and when team coordination behaviors are triggered by each other, especially in the face of complex and changing task requirements.

The Importance of Temporal Sequences of Explicit Coordination

Through explicit coordination sequences "the non-directly involved team members remain updated about the current status of the process and are therefore able to adjust their own behavior to the given circumstances" (Fernandez Castelao et al., 2013, p. 518). This is important in medical emergency teams as they need to establish a quick and correct setup of cardiovascular support by following clear task hierarchy and distribution of actions according to a set procedure (Tschan et al., 2011). The European Resuscitation Council Guidelines presets a maximum of ten seconds for teams to diagnose cardiac arrest before starting CPR (Nolan et al., 2005). Teams need to switch quickly from the actions where they diagnose and communicate a cardiac arrest into actions of intervention, e.g. with chest compressions to oxygenate the brain, to ensure the highest chances for patient survival. The time-pressure of the diagnose of cardiac arrest and the shift to intervention in which CPR activities are executed, require effective explicit coordination of actions and information. Therefore, sequences of explicit coordination can ensure a fluent exchange of information about the patient and actions that need to be decided and distributed among team members. In addition, new information about the patient might emerge which triggers further actions in the process of saving the patient's life. Therefore, the beginning of a cardiac arrest situation (Phase 1) requires effective coordination of information and actions which are closely interrelated. The explicit character of interaction patterns serves as a double-check and prevents misunderstandings which is necessary for an accurate setup of cardiovascular support (Kolbe et al., 2011). As the error free exchange of information and actions is crucial during this phase, we do not differentiate between solely action-related and information-related interaction patterns of explicit coordination.

We hypothesize that in the beginning of a cardiac arrest situation (Phase 1) explicit coordination behaviors are followed by further explicit coordination behaviors in high performing teams. In such situations, team members explicitly confirm or negate any explicit information sharing. For instance, a leader who asks for the pulse of the patient in the form of an information request or an instruction receives the clear response "no pulse" by the team member who is responsible for basic life support. These sequences of explicit coordination in the beginning of a cardiac arrest situations (Phase 1) support the establishment of a clear understanding of everyone's tasks and minimizes room for interpretation or differing, tacit understandings of the situation. Communication failure is avoided and team performance increases which enhances the chances of patient survival. This leads us to our first hypothesis:

Hypothesis 1: *High performing teams show more sequences of explicit coordination behaviors that are followed by further explicit coordination behaviors in the beginning of a cardiac arrest situation (Phase 1).*

The Importance of Temporal Sequences of Implicit Coordination

Interaction patterns of implicit coordination are mainly operationalized with the behavior of talking to the room. Several studies indicate that team failure can be prevented by talking to the room (Brodbeck, Kerschreiter, Mojzisch, & Schulz-Hardt, 2007; Stasser & Titus, 1985) which was also found to contribute to better situational awareness (Kolbe et al., 2013).

Kolbe and her colleagues (2014) investigated the relationship of coordination patterns on team performance in anesthesia teams. Their lag sequential analyses revealed that high performance is associated with autochthonous patterns of action-related talking to the room and information-related talking to the room. This means that in high performing teams information-related talking to the room was followed by further information-related talking to the room and action-related talking to the room was followed by further action-related talking to the room above chance level. This study supports the assumption that failures to share information can be avoided by implicit coordination (e.g. Larson et al., 1998; Stasser & Titus, 1985). Through sequences of information-related talking to the room behavior, the explicit gathering and sharing of information becomes obsolete as all relevant knowledge has already been shared. Team members can focus on different aspects to reach the team's goal as clarity about patient information is established. The results also confirmed that in high performing teams action-related talking to the room is followed by giving instruction below chance level. Through sequences of action-related talking to the room, teams constantly update each other about their actions which substitutes explicit forms of coordination. The finding of autochthonous patterns of information-related and action-related talking to the room strengthens their theoretical consideration that these are two distinct facets of implicit coordination patterns that serve different purposes during team coordination. They make teams more effective through enabling a clear understanding of the situation (information) and through executing medical activities (action) which are both processes that prevent breakdowns in coordination which are associated with failures in health care (Gawande, Zinner, Studdert, & Brennan, 2003).

As Tschan and her colleagues (2009) indicate, talking to the room facilitates medical assessment as existing information is shared effectively with the team members. Information-related talking to the room invites other team members to further talking to the room and keeps them engaged in information sharing. The occurrence of sequential patterns of implicit information-related coordination ensures that all relevant information for accurate diagnosis is communicated in an effective way. It is assumed that when high performing teams are searching for the underlying cause of the cardiac arrest, team members proactively share observations, which invites other team members to do the same. By doing so, unnecessary explicit forms of coordination are avoided and the team mental model about the patient's state is automatically updated.

In addition, coordination sequences of implicit action-related coordination ensure effective execution of tasks because they "render specific instructions unnecessary and can contribute to team performance" (Kolbe et al., 2014, p.4). When teams are investigating the cause of a patient's cardiac arrest, they derive future actions from their conclusions to successfully treat the patient. In high performing teams sequences of action-related talking to the room open the space for other team members to proactively suggest further actions which ultimately saves time and effectively coordinates actions to reach the goal, the patient's survival.

In the context of the present study, the assessment of the underlying cause of a patient's cardiac arrest (Phase 2) requires teams to coordinate actions and information as they need to interpret diagnostics, process information and derive accurate actions for post-CPR treatment. Therefore, implicit information-related and action-related coordination sequences play a pivotal role in Phase 2 in ALS situations. The derived hypothesis builds upon the theoretical assumptions by Kolbe and her colleagues (2014) which assume a positive influence of autochthonous patterns of information-related and action-related implicit coordination on team performance and investigate this relationship in a new task context and situational requirements of a high-risk and dynamic environment. This leads us to the second hypothesis:

H2: *High performing teams show more sequences of information-related implicit coordination that are followed by further information-related implicit coordination (H2a), and action-related implicit coordination that are followed by further action-related implicit coordination (H2b), during the assessment of the underlying cause of a patient's cardiac arrest (Phase 2)*.

The Development of Explicit and Implicit Coordination Patterns During One Practice

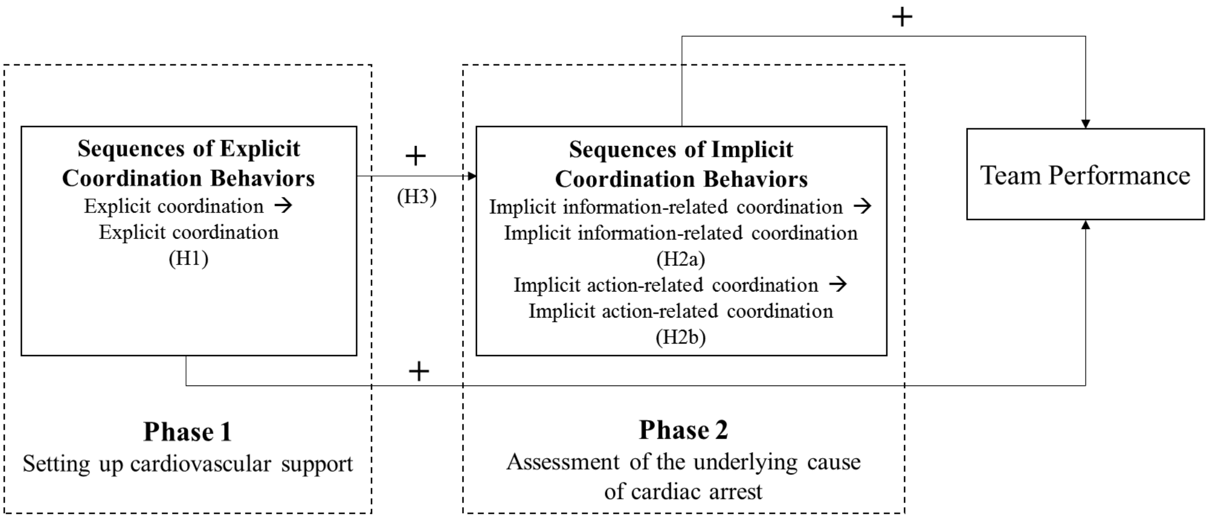
The context of Advanced Life Support requires teams to adapt to the conditions of a specific situation. Medical teams are facing changing circumstances such as the altering information situation about the patient's current state or several types of distractions and interruptions. In addition, the ALS process itself requires teams to switch between tasks such as the quick setup of CPR tasks, the physical examination and anamnesis of the patient and the treatment of the underlying cause of cardiac arrest. Such adaption entails a change in tasks and communication to ensure patient safety. Several researchers define team adaption as the ability to adapt the coordination strategy to changing task requirements of the situation (e.g. Burtscher et al., 2010; Xiao, Seagull, Mackenzie, & Klein, 2004). Especially in action teams, the adjustment of actions and information exchange to fit the task and the switch between explicit and implicit coordination triggered by situational changes ensures teams perform effectively (Grote, Zala-Mezö, & Grommes, 2004). In an experimental study, Entin and Serfaty (1999) designed a team training procedure for six teams of naval officers to understand the development of explicit and implicit coordination strategies in a changing task environment. They conclude that adaptive training reduces coordination overhead and improves stress resilience due to better teamwork skills. Riethmüller and his colleagues (2012) investigated the development of explicit and implicit coordination in 24 medical student teams during four medical simulation-based training scenarios. The results confirmed the assumption that the amount of explicit coordination in routine situations decreased over time whereas implicit coordination increased. They explain that through the usage of explicit coordination a shared mental model was developed. Shared experiences in team coordination enable teams to rely more on implicit coordination. This is supported by Rico, Sánchez-Manzanares and Gibson (2008) who point out that answering questions, an explicit form of coordination, improves the similarity and accuracy of mental models. The results of this study answer the question about the overall development of explicit and implicit frequency counts, but they do not offer insights about the temporal dynamics and emergence of explicit and implicit coordination within a medical practice.

In the context of our research study, we want to understand how explicit and implicit coordination sequences interrelate, specifically within the same situation of cardiac arrest. We extend the results by Riethmüller and his colleagues (2012) with a temporal view on team dynamics by assuming that in the beginning of an ALS practice (Phase 1) explicit coordination sequences enable teams to build a mental model on which they can rely on later through implicit coordination sequences that are important for an accurate diagnosis (Phase 2). We state the following hypothesis:

Hypothesis 3: *Sequences of implicit coordination behaviors during the assessment of the underlying cause of a patient's cardiac arrest (Phase 2) are elicited more often in teams that show more sequences of explicit coordination behaviors in the beginning of a cardiac arrest situation (Phase 1).*

Figure 2 presents the research model that summarizes the theoretical assumptions of this study.

Figure 2. Research Model



3. Methods

3.1. Research Design & Context

The quantitative research is designed as an observational study with 20 medical student teams performing CPR in a simulation-based environment in the context of the "Advanced Life Support" course for master students at the University of Twente. Within this educational program, data is gathered at the assessment day of the course and used to answer the research question. Two different data sources were used: (1) video-recordings to code coordination behaviors among the teams, and (2) technical and non-technical performance scores evaluated by medical teachers. The collected video data allows a micro-investigation about the way teams coordinate among themselves during an ALS situation and offers insights into the relationship between team coordination and team performance.

The research study is a project by the faculty of Behavioral, Management and Social Sciences (BMS) and the Experimental Centre for Technical Medicine (ECTM) at the University of Twente. All data was collected at the ECTM which enables research, development and education with highly modern simulation technologies and medical devices. It provides a high-tech and safe learning space for Technical Medicine students and professionals within several courses. The ECTM offers two simulation rooms, namely simulated Intensive Care Unit (ICU) and simulated operation room (OR), which were used during the ALS-course. The ICU room is equipped with a Human Patient Simulator (CAE iStan/CAE HPS) and the OR room is equipped with the mobile METIman simulator (ECTM, 2016a; ECTM, 2016b). Both rooms have a patient monitor (Infinity, Dreager) and defibrillator (Philips). The recordings were captured with the METIvision system. With the use of three ceiling mounted cameras and microphones, the audio-visual material was collected.

During the course, students learn about the methods, mechanisms and processes in a resuscitation setting. They learn about it theoretically, i.e. the goals and mechanism of certain therapies, the interpretation of results of anamnesis, physical examination, or blood-gas. Additionally, they practice the execution of an ALS protocol for shockable and non-shockable rhythms and communication in a team, learn to analyze a patient case according to the ABCDE method (i.e. **A**irway, **B**reathing, **C**irculation, **D**isability, **E**xposure & environment) and properly execute chest compressions or non-invasive manual respiration techniques. A detailed description of the course curriculum can be found in Appendix 1.

3.2. Respondents and Sampling

The respondents are master students of the three-year master program in Technical Medicine. The participation in the course "Advanced Life Support" is compulsory. The students specialize in their master program in "Medical Imaging & Interventions" or "Medical Sensing & Stimulation". Based on the curriculum, students from the latter-mentioned study program are expected to have more prior knowledge in diagnostics but not in the technical performance in ALS situations. Therefore, the distribution of master specializations within teams could influence team performance. The section "Data Analysis" will address this issue. 81 respondents participated in the ALS course. All students who confirmed their voluntary participation were considered respondents of the study. Two students dropped out of the course and two did not give informed consent. That is why 77 students agreed to participate in the study. As the study is conducted at the team-level, 17 out of 20 teams remain in the study sample. In the remaining three teams, one of the team members did not give informed consent[1].

*Table 1***.** Respondents Statistics

		Frequency	Percent
Gender	Male	25	26.8
	Female	42	63.2
	Total	67	100.0
Master Program	Medical Imaging & Intervention	37	54.4
	Medical Sensing & Stimulation	30	45.6
	Total	67	100.0
ALS experience[a]	Yes	2	4.5
	No	65	95.5
	Total	67	100.0

Notes.
[a] "Did you previously follow ALS or a similar course?"
The age ranged from 20 to 26.
Team 4 consisted of 3 instead of 4 people.

3.3. Procedure

The Ethical Committee of the Behavioral, Management and Social Science (BMS) Faculty of the University of Twente approved the ethical request for the study sufficiently early prior to data collection (see Appendix 2). The students were informed about the details of the study and informed consent in the introduction lecture. One week later, the students filled in the informed consent and a preliminary test with questions about their demographics, team cohesion and personality. In the subsequent four weeks the students followed the theoretical lectures, refreshed their knowledge about basic life support, received a technical introduction to the simulation room and practiced ALS. During a final assessment day, the students were tested and graded on their team performance. All practices at the final assessment day were video-recorded and selected as study sample. This represents realistic ALS circumstances because of the high-pressure. Students were graded under situations of stress and uncertainty, as they were not briefed about the content of the cardiac arrest scenarios that did not differ in difficulty level. The teams performed ALS in shockable and non-shockable situations. The practices were conducted in two rooms simultaneously. One teacher and one medical expert for resuscitations were present in each simulation room. The team leader was randomly selected prior to the start of the session. The teachers explained the case to the team leader in a transition talk and afterwards the practice started. The practice ended when the patient was successfully resuscitated or when the teachers indicated the end of the scenario. The collected data was analyzed anonymously and was not accessible to the medical teacher to ensure a fair and unbiased grading process for every team (see Appendix 3)

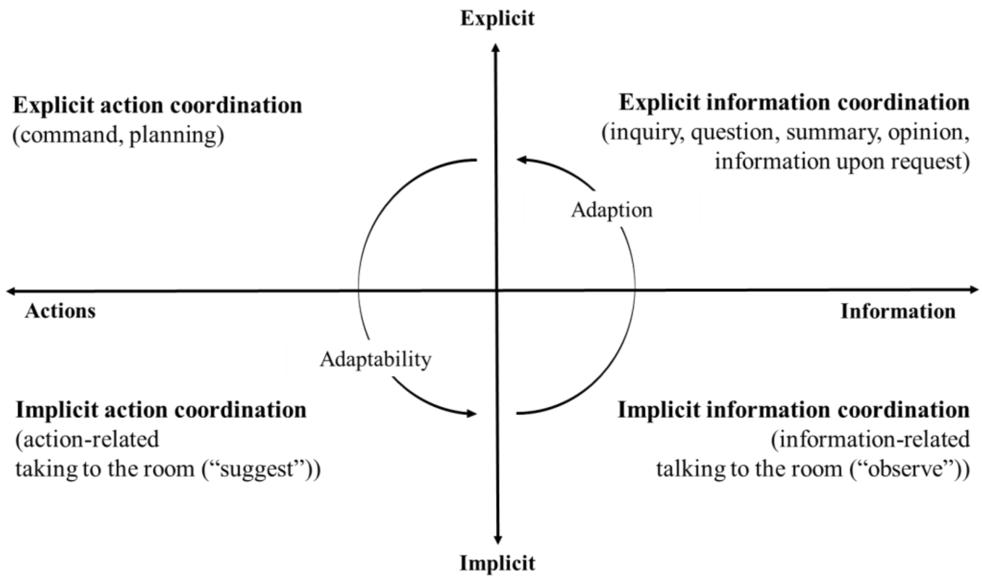
[1] One participant that did not give informed consent was part in two different teams to fill up an incomplete team. That is why both teams were omitted from the study sample in which he or she was part of.

3.4. Variables

Exhaustive Coding of Explicit and Implicit Coordination Behaviors

The videos were coded according to a pre-developed codebook. By assigning codes to each behavioral event, this enabled the extensive investigation of coordination behaviors during team member interaction. The coding scheme is based on the “Framework for Observing Coordination Behavior in Acute Care Teams” by Kolbe and her colleagues (2013) that is differentiated in two dimensions (explicit vs. implicit coordination; action vs. information coordination) and presented in Figure 3. The behavioral category explicit coordination consists of seven micro behaviors and implicit coordination consists of two micro behaviors (see Table 2). This framework is based on teamwork theory and empirical evidence. The focus on the situational and task characteristics in team coordination suits to the research interest. “Planning”, “command”, “inquiry”, “question”, “summary”, “opinion” and “information upon request” are the behaviors measured to analyze explicit coordination. The two first-mentioned are categorized as action-related and the five latter-mentioned as information-related coordination behaviors. Implicit coordination is coded with the behaviors “observe” (information-related) and “suggest” (action-related). Any behavior that did not fit to the coordination categories was coded as “other”, “social” or “incomprehensible”.

Figure 3. Integrated model of coordination in health care (Kolbe et al., 2011; *adjusted*)



The codes are mutually exclusive, meaning they exclude each other at any time, which is an important prerequisite for investigating temporal interaction sequences between team members (e.g. Chiu & Lehmann-Willenbrock, 2016; Klonek, Quera, Burba, & Kauffeld, 2016; Meinecke et al., 2017). The unit of analysis is a sentence or word that is “meaningful in itself, regardless of the meaning of the coding categories” (Strijbos, Martens, Prins, & Jochems, 2006, p.37). The data was coded in state event format to enable an analysis of the frequency counts (Noldus, 2009; Bakeman & Quera, 2011). The average duration of the 17 recorded videos was 24 minutes, ranging from 18-34 minutes (M = 24.33, SD = 5.06). The recordings of each ALS practice have been systematically analyzed by two Dutch-speaking coders with the use of “The Observer XT”, a video-observation software from Noldus Information Technologies.
Interrater reliability is an indicator of the degree of agreement among coders and can be measured with Cohen’s kappa. In Bakeman, Deckner and Quera (2005), it is recommended to independently code at least 15-20% of the total video data to calculate the interrater reliability. To ensure high quality data, we coded more than 80% of the data and 18% of the whole amount of coded data was analyzed by both coders to calculate the interrater agreement.

Table 2. Coding Scheme

Category	Subcategory	Content	Definition	Example
Explicit Coordination	Planning	Action-related	A statement about the planned procedure (decisions about what to do, how to do it, and when it will be done)	#1: First, we are going to prepare the medication, and then we do the treatment.
	Command		The team leader or team member gives an individual a specific assignment of responsibility (addressed call-out). It includes directives, commands, or assignment of subtasks	#1: Can you turn on the ECG? ; #2 You can administer it directly.
	Inquiry	Information-related	Request for factual information, statement, or analysis from one or more individuals	#1: Is the patient breathing? ; #2: Is the airway unobstructed?
	Question		Request for confirmation or rejection of statement from one or more individuals	#1: Shall we both have a look at the screen?
	Summary		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 expect something like hyperaemia…; #2: We will evaluate the patient on visible symptoms.
	Opinion		The team leader or team member makes a statement to express personal view	#1: It think it is hyperaemia. ; #2: I agree.
	Information upon request		Coded when a team member answers on an information request(inquiry or question), in the form of an answer or observation.	#1: Yes, the airway is unobstructed #2: I can see on the screen that…
Implicit coordination	Observe (Talking to the room)	Information-related	The team leader or team member recognizes or notices a fact or occurrence	#1: I can see a heartbeat. ; #2: I can see an asystole.
	Suggest (Talking to the room)	Action-related	The team leader or team member suggests a future action without delegating it to a specific team member (call-out not addressed)	#1: Maybe we can ask for an ultrasound of the abdomen. ; #2: In 30 seconds, we need to do a heart rhythm check
Other	External communication	n/a	Any communication directed at someone outside the CPR-team. 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 a family member present? ; #2: Did the patient have complaints before he was brought in?
	Confirmation		The team leader or team member answers to a question, command, inquiry, opinion by giving a confirmation.	#1: yes
	Other		Any verbal communication of the team leader or team members that does not fit to any of the defined categories.	
Social	Laugh	n/a	Laughter or clearly humorous remark	#1: Haha.
	Sorry		A team member excuses himself or apology remark	#1: Oh, sorry
	Social		Social, non-task communication.	#1: Shit.
Incomprehensible			a team member says something, but the content is not understandable or not relevant. Code only when the verbal behavior 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: Guys; #2: Robert, do you eh..

After coding the first video recording, the reliability score of 0.63 led to a discussion amongst coders about the disagreement in coded behaviors. Afterwards, a coder agreement of more than 90% was established during the subsequent two recordings (Cohen's kappa = .91) which demonstrates a reliable, pre-developed codebook. According to Landis and Koch (1977), the reliability score of 0.792 is sufficient.

Team Performance was measured with the scale by Gibson, Cooper and Conger (2009). The 4-item scale is a valid instrument to measure the general performance of a team by focusing on the consistency of performance, effectiveness, error rates and quality of teamwork. Performance is assessed on a 7-point Likert scale (1=very inaccurate; 7=very accurate). A sample item is "This team makes few mistakes". The measure is highly consistent with a Cronbach's alpha of 0.97. The ALS performance score list is the second instrument which captures the technical and non-technical skills of the teams assessing the following competencies: (1) following the ALS-protocol, (2) execution of technical skills, (3) diagnostics and clinical reasoning, (4) therapeutic plan, and (5) method. The 5-item scale is a measure that is self-made and adjusted to the reality of the course. It is scored on a 5-point Likert scale ranging from insufficient to excellent. The measure is highly consistent with a Cronbach's alpha of 0.88. The combination of the team performance scale by Gibson, Cooper and Conger (2009) and the ALS performance scale ensures a holistic assessment of team performance tailored to the student team's task context. The teachers evaluated the team performance of each team on scoring sheets and handed it back to the researchers. Each teacher assessed half of the teams during the assessment as the practices took place simultaneously. That is why it was not possible to calculate interrater agreement of this variable. Details about the scoring sheet and the two variables can be found in Appendices 4 and 5.
For the data analysis, the validated team performance scale by Gibson and her colleagues (2009) is used as a measurement for team performance. This scale indicates a higher internal consistency than the ALS performance scale (Cronbach's Alpha: .97 compared to .88) and both scales correlate with each other at a high level (Spearman Rho: .89, $p = .01$). That is why the ALS performance measure is omitted for the statistical analyses.

3.5. Data Analysis

The hypothesized model aims to test the relationship of the dependent variable team performance with explicit and implicit coordination sequences as well as the relationship among the latter two variables during the two phases of an ALS practice. All investigated variables are measured at the team-level. Normality tests were performed for the team performance scale by using the Shapiro-Wilk test and by looking at skewness and kurtosis values and z-scores. The results show that the scale does not violate the assumption of homogeneity of variance[2]. The low sample size and nature of this study suggests dividing them in low and high performing teams instead of using a regression model. This allows us to illustrate behavioral contingencies between the two groups. High and low performing teams were categorized using the median split of the team performance variable. Eleven teams were classified as high performing and six teams as low performing (see Appendix 6). The two clusters showed a significant difference in the means (at a 99.99% level) which strengthens our decision to use the median split instead of extreme group comparisons or regression analyses that require a larger sample size (Iacobucci, Posavac, Kardes, Schneider, & Popovich, 2014). We cannot reject that the students' study program influences our dependent variable. A t-test showed that the variation of master specializations in teams does not significantly differ in low and high performing teams ($t = .98$, $p = .33$). That is why for further analyses, we do not account for the study program as control variable.
In "Observer XT", the research team separated ALS practices in two phases by coding the transition moment from Phase 1 to Phase 2. This is based on the theoretical distinction visible in Figure 1. The transition moment appeared when a team member communicated the need for a "rhythm check" for the first time. The analysis was conducted with behavioral based data selection where Phase 1 contains all coordination behaviors from the beginning of the practice until the transition from Phase 1 and 2. The subsequent coordination behaviors until the end of the simulation are accounted to Phase 2. A total

[2] Shapiro-Wilk test: $W(20) = 0.97$; $p = 0.66$; skewness: $p = 0.51$; kurtosis: $p = 0.99$

amount of 7,852 behavioral events was coded based on the codebook (Phase 1: 459; Phase 2: 7,393). The three hypotheses are tested by means of lag sequential analyses which enable to point out temporal patterns of coded behavioral sequences that occur below or above chance level (Bakeman & Quera, 2011). Running sequential analyses separately within the two performance groups allows us to relate occurring coordination patterns with team performance. Lag 1 analyses are performed, which means that behavioral events that directly follow each other are considered as a sequential pattern. The first behavior is called "criterion behavior" and the following is called "target behavior". In "The Observer XT", lag sequential analyses are performed in order to generate frequency counts of behavioral patterns separated by teams and modified time intervals. This allows a differentiated analysis between the teams and Phase 1 and 2. Transition frequencies were calculated for each sequence of occurring behaviors and z-statistics were calculated that test "whether the transitional probabilities differed significantly from the unconditional probability for the code that followed" (Kolbe et al., 2014, p. 7; Jeong, 2003). A z-value larger than 1.96 (2.58) or smaller than -1.96 (-2.58) indicates that a behavioral sequence occurred above or below 95% (99%) chance level. As an example, a z-score of 2.0 indicates that a behavioral sequence (target behavior following the criterion behavior) occurs significantly above 95% chance level. Hypothesis H1a and H1b are tested by calculating the z-scores of behavioral sequences in Phase 2. Hypothesis 2 is tested by calculating the z-scores of behavioral sequences in Phase 1. All results are separately analyzed for low and high performing teams. Hypothesis 3 is tested by calculating the median split for teams that show high and low explicit coordination sequences in Phase 1 (see Appendix 7). Afterwards, a lag sequential analysis was performed to investigate whether teams with high explicit coordination in Phase 1 show more implicit coordination sequences in Phase 2.

4. Results

Table 3 presents the absolute frequency (N), minimum (Min), maximum (Max), mean (Mean) and standard deviation (SD) of the team performance measures and all coded behaviors, separately for low and high performing teams and the two ALS phases.

High performing teams showed 17% implicit coordination behaviors and 29% explicit coordination behaviors which is similar to low performing teams that showed 17% implicit coordination behaviors and 28% explicit coordination behaviors. Two-tailed t-tests for all coded behaviors indicate no significant differences concerning how often high and low performing teams exhibit the coded behaviors. Lag sequential analyses were performed for each subset to examine temporal patterns of explicit and implicit coordination and test our hypotheses. Hypothesis 1 stated that high performing teams exhibit more sequences of explicit coordination behaviors (i.e. sequences that only include "command", "planning", "inquiry", "question", "opinion", "summary" or "information upon request") in the beginning of a cardiac arrest situation (Phase 1). Tables 4 and 5 present the z-scores for high and low performing teams in Phase 1. In high performing teams, three explicit coordination sequences occurred above chance level ($p < .1$).

"Command" was followed by further "command" ($z = 4.04$), "summary" was followed by "command" ($z = 4.24$) and information upon request was followed by further "information upon request" ($z = 3.05$) more often. In low performing teams, the explicit coordination sequences "command" triggered by "command" and "planning" triggered by "planning" ($z = 4.24$, $z = 3.61$, respectively) occurred above chance level. Technically, more sequences of explicit coordination occur in high performing teams. Yet, the results indicate that one of the sequences occurred above chance level in both clusters and the difference in the frequencies of significant explicit coordination sequences is just 1. Therefore, we cannot find enough empirical support for hypothesis 1.

Hypotheses H2a and H2b assume that in high performing teams in Phase 2, the implicit coordination behaviors "observe" and "suggest" are followed by further implicit coordination "observe" (information-related) and "suggest" (action-related) above chance level. Tables 6 (high performing teams) and 7 (low performing teams) present the z-scores for the implicit coordination sequences in bold. The z-scores for information-related coordination sequences are significant for high and low performing teams ($z = 2.39$, $z = 2.46$, respectively). Consequently, hypothesis H2a is rejected as "observe" followed by further "observe" does not occur significantly more in high performing teams. Hypothesis H2b can be confirmed as action-related implicit coordination sequences occur significantly above chance level in high performing teams (i.e. a suggestion is followed by a suggestion, $z = 2.37$), and not in low performing teams ($z = 0.64$, respectively).

Table 3. Descriptive Statistics of Team Performance Variables and Coded Behaviours

		High Performing Teams (N=11)						**Low Performing Teams (N=6)**						**Phase 1**						**Phase 2**					
		N	%	Min	Max	Mean	SD	N	%	Min	Max	Mean	SD	N	%	Min	Max	Mean	SD	N	%	Min	Max	Mean	SD
Team Performance[a]		11		5.75	7	6.2	0.44	6		4.25	5.5	5.21	0.49												
ALS Performance[b]		11		3.6	5	4.36	0.43	6		3.8	4.4	4.1	0.25												
Implicit Coordination	Observe	532	10%	1	63	24.18	24.27	270	10%	0	68	22.50	23.68	30	7%	0	4	1.76	1.09	772	10%	29	68	45.41	12.11
	Suggest	326	6%	0	40	14.82	15.59	179	7%	0	40	14.92	14.98	21	5%	0	11	1.24	2.70	484	7%	13	40	28.47	8.47
Explicit Coordiation	Command	409	8%	4	47	18.59	14.46	259	10%	5	46	21.58	15.84	111	24%	4	12	6.53	2.45	557	8%	19	47	32.76	8.92
	Planning	118	2%	0	18	5.36	5.96	56	2%	0	14	4.67	4.91	6	1%	0	2	0.35	0.70	168	2%	5	18	9.88	3.84
	Inquiry	121	2%	0	19	5.50	6.57	57	2%	0	19	4.75	6.06	2	0%	0	1	0.12	0.33	176	2%	4	19	10.35	5.15
	Question	320	6%	0	45	14.55	16.37	137	5%	0	31	11.42	11.74	19	4%	0	4	1.12	1.32	438	6%	14	45	25.76	11.26
	Opinion	199	4%	0	33	9.05	10.76	106	4%	0	24	8.83	9.89	0	0%	0	0	0.00	0.00	305	4%	8	33	17.94	6.94
	Summary	58	1%	1	11	2.64	2.61	27	1%	1	4	2.25	1.36	17	4%	1	1	1.00	0.00	68	1%	2	11	4.00	2.35
	Infom. up. request	233	4%	1	29	10.59	9.48	127	5%	2	26	10.58	9.03	45	10%	1	4	2.65	1.06	315	4%	7	29	18.53	6.24
Other	Ext. Comm.	760	15%	0	89	15.86	12.02	372	14%	0	101	19.33	17.90	9	2%	0	5	0.53	1.28	1123	15%	36	101	66.06	16.96
	Confirmation	1367	26%	1	191	62.14	63.85	653	25%	0	151	54.42	57.54	79	17%	0	12	4.65	3.79	1941	26%	55	191	114.18	35.61
	Other	349	7%	3	40	34.55	36.14	232	9%	2	60	31.00	35.16	98	21%	2	15	5.76	3.42	483	7%	14	60	28.41	11.47
Social	Laugh	58	1%	0	19	2.64	5.86	19	1%	0	7	1.58	2.68	1	0%	0	1	0.06	0.24	76	1%	0	19	4.47	6.34
	Sorry	11	0.2%	0	4	0.50	1.06	3	0.1%	0	1	0.25	0.45	0	0.0%	0	0	0.00	0.00	14	0.2%	0	4	0.82	1.13
	Social	27	1%	0	6	1.23	1.69	7	0.3%	0	3	0.58	0.90	6	1%	0	2	0.35	0.70	28	0.4%	0	6	1.65	1.77
	Incomprehensible	311	6%	0	42	14.14	15.09	149	6%	0	50	12.42	16.36	15	3%	0	2	0.88	0.78	445	6%	11	50	26.18	11.99
	Total	5199	100%					2653	100%					459	100%					7393	100%				

Notes.
Two-tailed t-tests were performed with all variables to indicate differences in the means. Differences in the variable "Team Performance" were on a significant level (p-value: = 0.0001). All other variables did not show significant differences in the means.
[a] 7-point Likert scale by Gibson et al. (2009)
[b] 5-point Likert scale

Hypothesis 3 assumes that sequences of implicit coordination behaviors in Phase 2 are elicited more often in teams that show more sequences of explicit coordination in Phase 1. Tables 8 and 9 show the results of lag sequential analyses for Phase 2 separated by teams with high (Table 8) and low (Table 9) usage of explicit coordination sequences in Phase 1[3]. The results indicate that two implicit coordination sequences occur significantly more often in teams that show high usage of explicit coordination in Phase 1: "observe" triggered by "observe" ($z = 2.17$) and "observed" triggered by "suggest" ($z = 2.37$). Observation followed by further observation occurs significantly in teams with low exhibition of explicit coordination in Phase 1 ($z = 2.51$). Similar to the results of hypothesis 1, we therefore conclude that not enough support for hypothesis 3 can be found, as teams with high explicit coordination in Phase 1 only show one implicit coordination sequence above chance level in Phase 2 that does not occur in the low performing cluster.

Further analysis indicates that the behavior "external communication" occurs in 30% of all behavioral sequences across phases. Clear differences can be investigated between high performing (35%) and low performing teams (20%).

[3] Additionally, Appendix 8 shows lag sequential analyses for Phase 1 which offer insights into the types of sequences occurring in teams with high and low amount of explicit coordination sequence

Table 4. Results of Sequential Analyses for all Coded Behaviors at Lag 1 for Phase 1 (Z-Values)

High Performing Teams (N=11) Target Behaviours

Criterion behaviors		Observe	Suggest	Command	Planning	Inquiry	Question	Opinion	Summary	Infom. up. request	Ext. Comm.	Confirmation	Other	Laugh	Sorry	Social	Incompreh.
Implicit Coordination	Observe	-0.07 (1)	**2.17** (2)	-0.73 (2)	-0.34 (0)	. (0)	0.62 (1)	. (0)	. (0)	-1.10 (0)	1.06 (1)	0.18 (3)	0.54 (4)	. (0)	. (0)	. (0)	-0.68 (0)
	Suggest	-0.65 (0)	-0.44 (0)	0.36 (2)	4.18 (1)	. (0)	-0.47 (0)	. (0)	. (0)	-0.72 (0)	-0.39 (0)	0.73 (2)	-0.22 (1)	. (0)	. (0)	. (0)	-0.44 (0)
Explicit Coordination	Command	0.50 (5)	-0.57 (1)	**4.04** (29)	0.84 (1)	. (1)	-0.69 (1)	. (0)	. (0)	**-2.13** (0)	-0.28 (1)	-0.58 (8)	-2.80 (1)	. (0)	. (0)	. (2)	0.17 (2)
	Planning	-0.27 (0)	-0.18 (0)	1.34 (1)	-0.09 (0)	. (0)	-0.19 (0)	. (0)	. (0)	-0.29 (0)	-0.16 (0)	-0.40 (0)	-0.42 (0)	. (0)	. (0)	. (0)	-0.18 (0)
	Inquiry	. (0)	. (0)	. (1)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (1)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)
	Question	1.52 (2)	-0.54 (0)	-0.15 (2)	-0.28 (0)	. (0)	-0.58 (0)	. (0)	. (0)	-0.88 (0)	-0.47 (0)	0.89 (3)	-1.26 (0)	. (0)	. (0)	. (1)	1.23 (1)
	Opinion	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)
	Summary	-0.84 (0)	-0.57 (0)	**4.24** (10)	-0.29 (0)	. (0)	-0.61 (0)	. (0)	. (0)	-0.93 (0)	-0.50 (0)	-1.27 (0)	-1.33 (0)	. (0)	. (0)	. (0)	-0.57 (0)
	Infom. up. request	0.12 (2)	-0.89 (0)	-2.22 (0)	-0.45 (0)	. (0)	-0.94 (0)	. (0)	. (0)	**3.05** (7)	-0.77 (0)	1.47 (8)	0.36 (6)	. (0)	. (0)	. (1)	-0.89 (0)
Other	Ext. Comm.	-0.60 (0)	1.98 (1)	-1.00 (0)	-0.21 (0)	. (1)	-0.43 (0)	. (0)	. (0)	0.74 (1)	2.41 (1)	-0.90 (0)	-0.06 (1)	. (0)	. (0)	. (0)	-0.41 (0)
	Confirmation	0.67 (5)	1.05 (3)	-1.07 (8)	-0.64 (0)	. (0)	1.57 (4)	. (0)	. (0)	0.23 (5)	-0.20 (1)	0.56 (11)	-0.93 (7)	. (0)	. (0)	. (1)	1.05 (3)
	Other	-0.91 (2)	-1.29 (0)	-2.98 (1)	-0.65 (0)	. (0)	-0.65 (1)	. (0)	. (0)	1.93 (9)	-1.12 (0)	-1.08 (6)	4.93 (28)	. (0)	. (0)	. (1)	0.23 (2)
Social	Laugh	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)
	Sorry	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)
	Social	. (0)	. (1)	. (0)	. (0)	. (0)	. (1)	. (0)	. (0)	. (0)	. (0)	. (2)	. (1)	. (0)	. (0)	. (0)	. (0)
	Incomprehensible	0.36 (1)	-0.54 (0)	0.44 (3)	-0.28 (0)	. (0)	1.10 (1)	. (0)	. (0)	-0.88 (0)	1.59 (1)	0.19 (2)	-0.60 (1)	. (0)	. (0)	. (0)	-0.54 (0)

Notes.
N=235.
A z-value larger than 1.96 or smaller than -1.96 indicates that a behavioral sequence occurred above or below chance (p < .05).
A z-value larger than 2.58 or smaller than -2.58 indicates that a behavioral sequence occurred above or below chance (p < .01).
Frequencies of behavioral sequences are presented in parentheses.
Z-values related to the hypotheses are framed. Significant z-values for implicit and explicit coordination sequences are displayed in bold.

Table 5. Results of Sequential Analyses for all Coded Behaviors at Lag 1 for Phase 1 (Z-Values)

Low Performing Teams (N=6) Target Behaviours

Criterion behaviors		Observe	Suggest	Command	Planning	Inquiry	Question	Opinion	Summary	Infom. up. request	Ext. Comm.	Confirmation	Other	Laugh	Sorry	Social	Incompreh.
Implicit Coordination	Observe	**2.40** (2)	0.25 (1)	-0.93 (1)	-0.48 (0)	. (0)	1.06 (1)	. (0)	. (0)	-0.71 (0)	-0.34 (0)	-0.84 (0)	0.89 (3)	-0.24 (0)	. (0)	. (0)	-0.48 (0)
	Suggest	0.65 (1)	**2.97** (4)	-0.69 (2)	-0.54 (0)	. (0)	-0.65 (0)	. (0)	. (0)	0.40 (1)	-0.38 (0)	1.01 (2)	-1.34 (0)	-0.27 (0)	. (0)	. (0)	-0.54 (0)
Explicit Coordination	Command	-0.78 (1)	-1.95 (0)	**3.61** (30)	0.67 (2)	. (0)	0.82 (3)	. (0)	. (0)	-1.64 (0)	-0.78 (0)	-0.02 (4)	-2.49 (1)	-0.56 (0)	. (0)	. (0)	-0.22 (1)
	Planning	-0.38 (0)	-0.51 (0)	0.81 (2)	**3.01** (1)	. (0)	-0.36 (0)	. (0)	. (0)	-0.43 (0)	-0.21 (0)	-0.51 (0)	-0.73 (0)	-0.15 (0)	. (0)	. (0)	-0.29 (0)
	Inquiry	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)
	Question	-0.54 (0)	0.53 (1)	-0.65 (1)	-0.42 (0)	. (0)	1.39 (1)	. (0)	. (0)	-0.61 (0)	-0.30 (0)	3.05 (3)	-1.03 (0)	-0.21 (0)	. (0)	. (0)	-0.42 (0)
	Opinion	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)
	Summary	-0.54 (0)	-0.73 (0)	1.74 (5)	-0.42 (0)	. (0)	1.39 (1)	. (0)	. (0)	-0.61 (0)	-0.30 (0)	-0.73 (0)	-1.03 (0)	-0.21 (0)	. (0)	. (0)	-0.42 (0)
	Infom. up. request	1.46 (2)	0.54 (2)	-1.53 (1)	-0.64 (0)	. (0)	-0.77 (0)	. (0)	. (0)	1.07 (2)	1.73 (1)	-0.29 (1)	1.05 (5)	-0.32 (0)	. (0)	. (0)	-0.64 (0)
Other	Ext. Comm.	-0.31 (0)	-0.42 (0)	-0.72 (0)	-0.24 (0)	. (0)	-0.29 (0)	. (0)	. (0)	-0.35 (0)	-0.17 (0)	-0.42 (0)	0.79 (1)	-0.12 (0)	. (0)	. (0)	3.81 (1)
	Confirmation	-0.89 (0)	1.90 (4)	-0.95 (3)	0.75 (1)	. (0)	-0.83 (0)	. (0)	. (0)	-0.06 (1)	-0.48 (0)	-0.42 (1)	-0.22 (3)	2.55 (1)	. (0)	. (0)	2.19 (2)
	Other	-0.29 (1)	-0.92 (1)	-2.07 (2)	-0.87 (0)	. (0)	-1.06 (0)	. (0)	. (0)	2.42 (5)	-0.62 (0)	-0.31 (2)	3.68 (15)	-0.44 (0)	. (0)	. (0)	-0.87 (0)
Social	Laugh	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)
	Sorry	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)
	Social	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)
	Incomprehensible	-0.31 (0)	-0.42 (0)	-0.72 (0)	-0.24 (0)	. (0)	-0.29 (0)	. (0)	. (0)	-0.35 (0)	5.60 (1)	-0.42 (0)	0.79 (1)	-0.12 (0)	. (0)	. (0)	-0.24 (0)

Notes.
N=135.
A z-value larger than 1.96 or smaller than -1.96 indicates that a behavioral sequence occurred above or below chance (p < .05).
A z-value larger than 2.58 or smaller than -2.58 indicates that a behavioral sequence occurred above or below chance (p < .01).
Frequencies of behavioral sequences are presented in parentheses.
Z-values related to the hypotheses are framed. Significant z-values for implicit and explicit coordination sequences are displayed in bold.

Table 6. Results of Sequential Analyses for all Coded Behaviors at Lag 1 for Phase 2 (Z-Values)

High Performing Teams (N=11)		Target Behaviours															
Criterion behaviors		Observe	Suggest	Command	Planning	Inquiry	Question	Opinion	Summary	Infom. up. request	Ext. Comm.	Confirmation	Other	Laugh	Sorry	Social	Incompreh.
Implicit Coordination	Observe	**2.39** (63)	**1.97** (40)	1.83 (42)	-0.67 (8)	0.33 (12)	0.95 (32)	0.52 (21)	-0.75 (3)	0.14 (19)	-5.07 (24)	0.54 (128)	-2.47 (13)	-0.80 (4)	-1.01 (0)	-0.50 (1)	2.06 (38)
	Suggest	1.54 (38)	**2.37** (29)	0.87 (24)	0.21 (7)	1.15 (10)	0.44 (19)	0.31 (13)	0.03 (3)	-1.35 (7)	-1.67 (32)	0.18 (79)	-1.31 (11)	-1.42 (1)	-0.81 (0)	-1.02 (0)	-1.22 (12)
Explicit Coordiation	Command	4.69 (60)	-0.93 (16)	6.62 (54)	0.33 (8)	-1.29 (4)	0.27 (20)	-3.00 (2)	0.98 (5)	-1.05 (9)	-3.25 (24)	-0.47 (80)	-0.71 (15)	-1.05 (2)	0.33 (1)	0.79 (2)	-1.76 (11)
	Planning	-1.27 (6)	-0.57 (5)	2.55 (14)	1.79 (5)	0.99 (4)	-0.80 (4)	-0.08 (4)	-1.01 (0)	-1.02 (2)	-0.80 (12)	-0.70 (23)	4.14 (16)	-1.15 (0)	1.61 (1)	-0.60 (0)	-0.80 (4)
	Inquiry	-2.84 (1)	0.81 (9)	-1.56 (3)	0.39 (3)	3.37 (8)	1.82 (11)	0.76 (6)	-1.04 (0)	0.80 (6)	-1.42 (10)	1.59 (38)	-1.61 (2)	-1.17 (0)	-0.49 (0)	-0.62 (0)	0.64 (8)
	Question	1.10 (33)	-0.02 (17)	-0.10 (18)	-1.61 (2)	-1.33 (3)	1.76 (23)	-1.47 (6)	0.78 (4)	0.66 (13)	-2.56 (23)	1.56 (86)	-0.80 (12)	-0.26 (3)	4.37 (4)	-0.98 (0)	0.03 (16)
	Opinion	-1.02 (14)	2.34 (20)	-2.91 (2)	-1.52 (1)	0.28 (5)	1.51 (16)	4.80 (21)	-1.36 (0)	-1.23 (4)	-1.91 (17)	1.26 (59)	-2.55 (2)	2.94 (7)	-0.64 (0)	-0.81 (0)	0.61 (13)
	Summary	-0.68 (3)	2.95 (8)	-1.70 (0)	-0.99 (0)	-0.07 (1)	2.01 (6)	0.12 (2)	11.14 (8)	-0.59 (1)	-1.35 (3)	-0.24 (11)	-1.55 (0)	-0.76 (0)	-0.32 (0)	-0.40 (0)	-0.99 (1)
	Infom. up. request	0.80 (22)	-0.18 (11)	-2.61 (3)	0.95 (6)	-0.64 (3)	-1.71 (5)	0.91 (10)	-0.62 (1)	2.05 (13)	-1.16 (21)	2.62 (69)	-1.31 (6)	-0.89 (1)	-0.64 (0)	0.42 (1)	-1.12 (7)
Other	Ext. Comm.	-4.02 (33)	-3.22 (21)	-5.16 (10)	1.05 (19)	-1.97 (8)	-2.55 (23)	-2.51 (14)	-0.29 (6)	-3.21 (10)	24.85 (366)	-5.80 (92)	-4.11 (12)	1.78 (14)	-0.41 (1)	-0.26 (2)	-2.26 (25)
	Confirmation	-1.17 (108)	0.82 (84)	0.66 (89)	0.61 (30)	1.16 (35)	0.35 (74)	0.94 (56)	-0.05 (12)	2.76 (68)	-6.58 (88)	1.99 (359)	0.21 (70)	-0.93 (12)	0.18 (3)	1.28 (7)	1.71 (86)
	Other	0.02 (27)	-2.35 (7)	1.27 (24)	-1.60 (2)	-0.14 (6)	-1.65 (9)	-1.46 (6)	-1.64 (0)	0.67 (13)	-2.98 (20)	-1.59 (56)	14.98 (75)	0.27 (4)	-0.77 (0)	0.04 (1)	-0.93 (12)
Social	Laugh	-0.34 (5)	-0.86 (2)	-0.97 (2)	-1.12 (0)	-1.16 (0)	-0.22 (3)	1.67 (5)	-0.76 (0)	-0.86 (1)	0.08 (9)	-0.55 (13)	0.91 (5)	5.98 (6)	-0.36 (0)	1.73 (1)	0.82 (5)
	Sorry	1.85 (3)	-0.78 (0)	0.34 (1)	-0.47 (0)	-0.49 (0)	-0.75 (0)	-0.63 (0)	-0.32 (0)	-0.63 (0)	1.10 (3)	0.16 (3)	-0.74 (0)	-0.36 (0)	-0.15 (0)	-0.19 (0)	-0.75 (0)
	Social	-0.54 (1)	-1.02 (0)	0.71 (2)	-0.61 (0)	0.90 (1)	-0.02 (1)	0.34 (1)	1.96 (1)	-0.82 (0)	-0.35 (2)	0.99 (7)	-0.96 (0)	-0.47 (0)	-0.20 (0)	3.75 (1)	-0.98 (0)
	Incomprehensible	0.79 (31)	-0.68 (14)	-0.06 (18)	0.85 (8)	-0.13 (6)	0.09 (16)	1.24 (15)	-0.41 (2)	0.70 (13)	-3.54 (16)	0.91 (79)	-0.51 (13)	0.29 (4)	-0.77 (0)	-0.98 (0)	2.29 (25)

Notes.
N=4361.
A z-value larger than 1.96 or smaller than -1.96 indicates that a behavioral sequence occurred above or below chance (p < .05).
A z-value larger than 2.58 or smaller than -2.58 indicates that a behavioral sequence occurred above or below chance (p < .01).
Frequencies of behavioral sequences are presented in parentheses.
Z-values related to the hypotheses are framed.

Table 7. Results of Sequential Analyses for all Coded Behaviors at Lag 1 for Phase 2 (Z-Values)

Low Performing Teams (N=6)		Target Behaviours															
Criterion behaviors		Observe	Suggest	Command	Planning	Inquiry	Question	Opinion	Summary	Infom. up. request	Ext. Comm.	Confirmatio	Other	Laugh	Sorry	Social	Incompreh.
Implicit Coordination	Observe	**2.46** (39)	0.74 (20)	-0.30 (21)	0.30 (6)	2.53 (12)	3.60 (27)	0.54 (13)	-1.57 (0)	-0.95 (8)	-3.62 (16)	0.38 (67)	-2.75 (7)	0.82 (3)	0.47 (1)	-0.85 (0)	0.50 (17)
	Suggest	1.20 (21)	**0.64** (13)	0.63 (16)	0.32 (4)	-1.40 (1)	0.45 (11)	1.41 (11)	-0.48 (1)	-1.54 (3)	-1.29 (19)	0.16 (42)	-0.43 (11)	-1.90 (0)	2.52 (2)	0.78 (1)	-0.20 (9)
Explicit Coordiation	Command	3.88 (40)	0.40 (14)	5.10 (39)	0.30 (5)	-0.36 (4)	-1.18 (8)	-1.67 (4)	2.50 (5)	-1.37 (5)	-3.94 (9)	-1.30 (44)	0.70 (19)	-1.24 (0)	-0.72 (0)	1.81 (2)	0.19 (13)
	Planning	0.73 (7)	-0.22 (3)	2.66 (10)	1.84 (3)	-0.16 (1)	1.67 (6)	-1.47 (0)	-0.71 (0)	0.47 (3)	-2.20 (2)	-0.22 (12)	-0.95 (2)	-0.61 (0)	-0.36 (0)	2.22 (1)	-0.58 (2)
	Inquiry	0.10 (6)	-0.37 (3)	-1.20 (2)	-0.16 (1)	3.22 (5)	0.37 (4)	-0.92 (1)	-0.74 (0)	0.93 (4)	-0.62 (7)	0.21 (15)	-0.62 (3)	0.90 (1)	-0.37 (0)	-0.40 (0)	0.89 (5)
	Question	0.76 (16)	-0.18 (8)	-1.38 (6)	-1.20 (1)	-1.12 (1)	1.94 (13)	-0.26 (5)	-1.12 (0)	0.95 (8)	-1.76 (12)	1.40 (41)	-0.59 (8)	1.80 (2)	1.21 (1)	-0.61 (0)	0.15 (8)
	Opinion	0.74 (13)	1.55 (11)	-2.16 (2)	-0.78 (1)	2.34 (6)	0.78 (8)	2.70 (9)	-1.00 (0)	0.21 (5)	-0.79 (13)	-0.31 (24)	-0.66 (6)	-0.87 (0)	-0.50 (0)	-0.54 (0)	-0.30 (6)
	Summary	-0.73 (1)	0.51 (2)	-0.53 (1)	0.85 (1)	0.75 (1)	2.45 (4)	0.90 (1)	1.75 (1)	-0.94 (0)	-1.69 (0)	1.10 (8)	-1.22 (0)	-0.39 (0)	-0.23 (0)	-0.24 (0)	-0.20 (1)
	Infom. up. request	-0.94 (8)	0.95 (10)	-1.20 (6)	-0.86 (1)	0.28 (3)	-0.19 (6)	0.51 (6)	-1.40 (0)	4.47 (15)	-2.37 (7)	0.73 (32)	0.48 (10)	1.30 (2)	-0.52 (0)	-0.56 (0)	-0.20 (6)
Other	Ext. Comm.	-3.28 (16)	-2.97 (9)	-3.35 (11)	-0.19 (7)	-1.47 (4)	-2.15 (11)	-1.18 (11)	-0.82 (2)	-2.94 (4)	2.85 (226)	-4.51 (43)	-4.37 (4)	0.82 (4)	-0.94 (0)	-0.30 (1)	-2.17 (11)
	Confirmation	-0.85 (56)	1.68 (52)	0.49 (55)	-0.52 (11)	-0.31 (13)	-1.49 (27)	1.12 (33)	1.99 (11)	0.51 (30)	-4.16 (55)	3.36 (200)	-1.49 (37)	-0.73 (3)	0.39 (2)	0.17 (2)	0.90 (37)
	Other	-1.71 (12)	-2.16 (5)	1.12 (21)	-1.20 (2)	-1.16 (2)	-1.29 (7)	-2.20 (2)	-1.38 (0)	2.44 (16)	-3.22 (12)	-1.29 (39)	14.16 (72)	0.46 (2)	-0.69 (0)	-0.75 (0)	-1.59 (6)
Social	Laugh	-0.58 (1)	-0.16 (1)	-0.38 (1)	-0.60 (0)	-0.63 (0)	-0.99 (0)	0.24 (1)	1.96 (1)	-0.87 (0)	0.64 (4)	1.80 (7)	-1.13 (0)	-0.36 (0)	-0.21 (0)	-0.23 (0)	0.90 (2)
	Sorry	1.21 (1)	-0.43 (0)	-0.48 (0)	-0.25 (0)	-0.26 (0)	-0.41 (0)	-0.35 (0)	-0.17 (0)	-0.35 (0)	-0.64 (0)	0.27 (1)	1.56 (1)	-0.15 (0)	-0.90 (0)	-0.90 (0)	-0.41 (0)
	Social	-0.80 (0)	2.20 (2)	3.70 (3)	-0.38 (0)	-0.39 (0)	-0.62 (0)	-0.54 (0)	-0.26 (0)	1.23 (1)	-0.98 (0)	-0.50 (1)	-0.70 (0)	-0.23 (0)	-0.13 (0)	-0.14 (0)	-0.62 (0)
	Incomprehensible	-0.64 (12)	-0.14 (9)	-0.80 (9)	2.88 (8)	-0.15 (3)	0.89 (11)	1.47 (10)	1.34 (3)	-0.12 (6)	-2.89 (8)	-0.10 (35)	-0.87 (8)	-0.50 (1)	-0.59 (0)	-0.64 (0)	4.23 (21)

Notes.
N=2467.
A z-value larger than 1.96 or smaller than -1.96 indicates that a behavioral sequence occurred above or below chance (p < .05).
A z-value larger than 2.58 or smaller than -2.58 indicates that a behavioral sequence occurred above or below chance (p < .01).
Frequencies of behavioral sequences are presented in parentheses.
Z-values related to the hypotheses are framed.

Table 8. Results of Sequential Analyses for all Coded Behaviors at Lag 1 for Phase 2 (Z-Values)

Teams with High Explicit Coordination Sequences in Phase 1 (N=8)[a]

Criterion behaviors		Observe	Suggest	Command	Planning	Inquiry	Question	Opinion	Summary	Infom. up. request	Ext. Comm.	Confirmation	Other	Laugh	Sorry	Social	Incompreh.
Implicit Coordination	Observe	**2.17** (24)	0.94 (5)	1.48 (26)	-1.58 (3)	1.78 (5)	3.35 (5)	0.86 (4)	-0.54 (0)	-2.11 (19)	-4.73 (14)	0.98 (45)	-2.73 (82)	-0.12 (2)	-0.81 (0)	-1.15 (1)	1.42 (9)
	Suggest	**2.37** (30)	1.19 (16)	-0.11 (16)	-0.35 (3)	0.69 (6)	0.86 (16)	-0.03 (8)	-0.62 (1)	-1.60 (4)	-2.17 (19)	0.97 (60)	-1.56 (8)	-1.16 (0)	0.91 (1)	0.18 (1)	-0.22 (12)
Explicit Coordiation	Command	3.83 (3)	0.06 (6)	5.93 (3)	0.77 (1)	-1.72 (8)	-0.27 (6)	-1.87 (4)	1.47 (0)	-1.26 (7)	-3.96 (8)	-0.94 (17)	0.46 (4)	-1.39 (1)	0.53 (0)	1.67 (0)	-0.73 (8)
	Planning	-0.39 (5)	0.15 (4)	2.90 (12)	1.70 (3)	2.15 (4)	0.47 (5)	-1.56 (0)	-0.76 (0)	0.13 (3)	-1.49 (5)	-0.74 (13)	0.28 (5)	-0.65 (0)	2.41 (1)	-0.51 (0)	-0.49 (3)
	Inquiry	-1.51 (43)	0.71 (23)	-1.24 (34)	-0.33 (2)	4.77 (12)	0.51 (36)	0.53 (16)	-0.83 (2)	1.96 (6)	-1.11 (15)	-0.55 (93)	-0.55 (9)	0.67 (2)	-0.40 (0)	-0.56 (0)	1.39 (27)
	Question	0.88 (25)	0.60 (15)	-0.65 (15)	-1.48 (1)	-1.74 (1)	2.11 (22)	-0.25 (8)	0.71 (3)	0.13 (10)	-2.51 (19)	1.24 (67)	-0.79 (12)	1.24 (3)	2.31 (2)	-0.95 (0)	0.28 (15)
	Opinion	-0.21 (75)	1.43 (58)	-2.61 (80)	-1.55 (18)	1.71 (17)	1.15 (49)	3.22 (43)	-1.10 (9)	-1.57 (51)	-1.90 (66)	1.70 (283)	-0.42 (54)	-0.95 (5)	-0.53 (2)	-0.74 (5)	0.15 (62)
	Summary	0.02 (3)	0.85 (3)	-0.93 (1)	0.57 (1)	0.36 (1)	3.46 (7)	-0.22 (1)	5.08 (3)	-1.14 (0)	-0.82 (3)	-0.33 (7)	-1.42 (0)	-0.46 (0)	-0.25 (0)	-0.36 (0)	-0.67 (1)
	Infom. up. request	-1.81 (21)	0.43 (15)	-1.97 (11)	0.17 (12)	0.37 (8)	-0.46 (17)	0.02 (12)	-1.16 (4)	4.41 (12)	-1.85 (2)	2.11 (55)	0.21 (9)	0.99 (6)	-0.55 (0)	-0.78 (2)	-0.77 (19)
Other	Ext. Comm.	-3.99 (2)	-2.82 (0)	-4.75 (0)	0.74 (0)	-1.11 (0)	-2.81 (0)	-1.97 (0)	-0.38 (0)	-2.30 (0)	24.62 (326)	-6.36 (2)	-4.46 (1)	1.27 (0)	-1.04 (0)	-0.13 (0)	-2.47 (0)
	Confirmation	-0.91 (2)	0.88 (1)	0.95 (1)	0.48 (0)	-0.60 (0)	-0.91 (0)	1.29 (2)	0.34 (1)	1.97 (0)	-5.94 (4)	3.36 (9	-0.89 (0)	-0.39 (0)	0.14 (0)	0.72 (1)	0.79 (3)
	Other	0.14 (12)	-2.40 (12)	1.30 (2)	-0.69 (0)	-0.20 (6)	-2.60 (12)	-1.82 (13)	-1.49 (0)	2.47 (2)	-3.74 (12)	-2.07 (46)	15.27 (8)	0.27 (0)	-0.71 (0)	-0.01 (0)	-1.62 (9)
Social	Laugh	-0.18 (48)	-0.34 (17)	-0.66 (53)	-0.66 (7)	-0.73 (2)	-1.20 (17)	1.03 (5)	1.66 (5)	-1.01 (8)	0.08 (17)	0.99 (65)	-1.25 (22)	-0.40 (0)	-0.22 (1)	2.85 (3)	1.15 (15)
	Sorry	1.56 (7)	-0.62 (10)	-0.73 (5)	-0.35 (3)	-0.39 (4)	-0.65 (8)	-0.52 (6)	-0.25 (0)	-0.54 (18)	0.77 (14)	0.12 (53)	0.71 (11)	-0.22 (2)	-0.12 (0)	-0.17 (0)	-0.65 (7)
	Social	-0.28 (1)	0.19 (1)	2.57 (4)	-0.50 (0)	1.21 (1)	0.11 (1)	-0.74 (0)	-0.36 (0)	-0.77 (0)	-0.15 (2)	-0.30 (3)	-0.96 (0)	-0.31 (0)	-0.17 (0)	3.91 (1)	-0.92 (0)
	Incomprehensible	0.32 (22)	0.10 (13)	-0.82 (14)	2.03 (8)	-1.72 (1)	0.34 (15)	1.79 (14)	0.73 (3)	-0.15 (9)	-2.93 (16)	0.62 (61)	-1.00 (11)	0.45 (2)	-0.67 (0)	-0.94 (0)	3.22 (26)

Target Behaviours: Observe through Incompreh.

Notes.
N=3386.
[a]New groups of teams are formed based on a median split of the amount of explicit coordination sequences in Phase 1 (see Appendix 7).
A z-value larger than 1.96 or smaller than -1.96 indicates that a behavioral sequence occurred above or below chance (p < .05).
A z-value larger than 2.58 or smaller than -2.58 indicates that a behavioral sequence occurred above or below chance (p < .01).
Frequencies of behavioral sequences are presented in parentheses.

Table 9. Results of Sequential Analyses for all Coded Behaviors at Lag 1 for Phase 2 (Z-Values)

Teams with Low Explicit Coordination Sequences in Phase 1 (N=9)[a]

Criterion behaviors		Observe	Suggest	Command	Planning	Inquiry	Question	Opinion	Summary	Infom. up. request	Ext. Comm.	Confirmation	Other	Laugh	Sorry	Social	Incompreh.
Implicit Coordination	Observe	**2.51** (59)	1.74 (37)	0.58 (29)	0.68 (12)	0.76 (12)	0.39 (23)	0.21 (18)	-1.57 (1)	1.39 (21)	-4.02 (25)	-0.02 (102)	-2.40 (11)	-0.38 (5)	-0.01 (1)	-0.01 (1)	1.39 (28)
	Suggest	0.35 (29)	1.87 (26)	1.70 (24)	0.64 (8)	-0.48 (5)	0.09 (14)	1.45 (16)	0.15 (3)	-1.23 (6)	-0.83 (32)	-0.55 (61)	-0.19 (14)	-1.43 (1)	0.43 (1)	-0.81 (0)	-1.26 (9)
Explicit Coordiation	Command	4.90 (52)	-0.96 (13)	5.80 (40)	-0.04 (6)	0.01 (6)	-0.57 (11)	-2.90 (1)	1.45 (5)	-1.14 (6)	-3.15 (16)	-0.51 (59)	-0.56 (12)	-0.87 (2)	-0.79 (0)	0.47 (1)	-1.15 (9)
	Planning	-0.50 (8)	-0.89 (4)	2.34 (12)	1.78 (5)	-0.81 (1)	0.05 (5)	0.02 (4)	-0.98 (0)	-0.81 (2)	-1.09 (9)	-0.29 (22)	3.23 (13)	-1.16 (0)	-0.48 (0)	1.59 (1)	-0.84 (3)
	Innquiry	-1.65 (4)	-0.06 (6)	-1.52 (2)	0.53 (3)	1.92 (5)	1.91 (9)	-0.41 (3)	-0.97 (0)	-0.24 (3)	-1.01 (9)	2.42 (36)	-1.76 (1)	-1.14 (0)	-0.47 (0)	-0.47 (0)	0.10 (5)
	Question	1.10 (24)	-0.69 (10)	-0.79 (9)	-1.16 (2)	-0.65 (3)	1.39 (14)	-1.69 (3)	-0.67 (1)	1.48 (11)	-1.91 (16)	1.81 (60)	-0.72 (8)	-0.42 (2)	3.75 (3)	-0.68 (0)	-0.22 (9)
	Opinion	-0.33 (15)	2.41 (19)	-2.48 (2)	-0.93 (2)	0.62 (5)	1.25 (12)	3.88 (17)	-1.28 (0)	0.38 (7)	-0.92 (18)	-0.43 (37)	-2.90 (0)	3.04 (7)	-0.63 (0)	-0.63 (0)	0.54 (10)
	Summary	-1.33 (1)	2.82 (7)	-1.46 (0)	-0.92 (0)	0.16 (1)	0.81 (3)	0.39 (2)	9.13 (6)	-0.30 (1)	-2.10 (0)	0.87 (12)	-1.38 (0)	-0.72 (0)	-0.30 (0)	-0.30 (0)	-0.63 (1)
	Infom. up. request	1.80 (23)	0.24 (11)	-1.76 (4)	0.18 (4)	-0.82 (2)	-1.69 (3)	1.42 (10)	-0.46 (1)	1.75 (10)	-1.52 (14)	1.46 (48)	-1.16 (5)	-0.80 (1)	-0.61 (0)	1.02 (1)	-0.67 (6)
Other	Ext. Comm.	-3.33 (28)	-3.30 (15)	-3.91 (10)	0.40 (14)	-2.34 (4)	-1.88 (17)	-1.86 (13)	-0.61 (4)	-3.92 (2)	21.12 (266)	-4.01 (80)	-4.00 (7)	1.60 (12)	-0.25 (1)	-0.25 (1)	-1.92 (17)
	Confirmation	-1.13 (89)	1.40 (78)	0.18 (64)	-0.15 (23)	1.61 (31)	0.14 (52)	0.73 (46)	1.17 (14)	1.58 (47)	-5.02 (77)	1.72 (276)	-0.26 (53)	-1.13 (10)	0.37 (3)	1.01 (4)	1.30 (61)
	Other	-1.67 (15)	-2.09 (7)	1.13 (19)	-1.90 (1)	-1.02 (3)	-0.24 (11)	-1.78 (4)	-1.54 (0)	0.45 (10)	-2.40 (18)	-0.88 (50)	14.24 (65)	0.37 (4)	-0.75 (0)	-0.75 (0)	-0.84 (9)
Social	Laugh	-0.59 (4)	-0.80 (2)	-0.73 (2)	-1.11 (0)	-1.10 (0)	0.11 (3)	1.10 (4)	-0.74 (0)	-0.70 (1)	0.42 (9)	-0.55 (11)	1.07 (5)	5.79 (6)	-0.36 (0)	-0.36 (0)	0.66 (4)
	Sorry	1.60 (2)	-0.64 (0)	0.91 (1)	-0.39 (0)	-0.38 (0)	-0.56 (0)	-0.51 (0)	-0.26 (0)	-0.48 (0)	0.10 (1)	0.29 (2)	-0.58 (0)	-0.30 (0)	-0.13 (0)	-0.13 (0)	-0.56 (0)
	Social	-1.00 (0)	0.33 (1)	0.39 (1)	-0.50 (0)	-0.50 (0)	-0.73 (0)	0.82 (1)	2.67 (1)	0.93 (1)	-1.17 (0)	1.32 (5)	-0.75 (0)	-0.39 (0)	-0.16 (0)	-0.16 (0)	-0.73 (0)
	Incomprehensible	0.10 (21)	-0.93 (10)	0.07 (13)	1.43 (8)	1.49 (8)	0.49 (12)	0.88 (11)	-0.06 (2)	0.87 (10)	-3.61 (8)	0.36 (53)	-0.35 (10)	0.05 (3)	-0.70 (0)	-0.70 (0)	2.87 (20)

Target Behaviours: Observe through Incompreh.

Notes.
N=3442.
[a]New groups of teams are formed based on a median split of the amount of explicit coordination sequences in Phase 1 (see Appendix 7).
A z-value larger than 1.96 or smaller than -1.96 indicates that a behavioral sequence occurred above or below chance (p < .05).
A z-value larger than 2.58 or smaller than -2.58 indicates that a behavioral sequence occurred above or below chance (p < .01).
Frequencies of behavioral sequences are presented in parentheses.

5. Discussion

Research found no differences in the frequency counts of explicit and implicit coordination behaviors between high and low performing teams (Stachowski et al., 2009; Kolbe et al., 2014). That is why researchers postulate a micro-investigation of coordination patterns to understand these differences. However, an understanding of the content and the sequential character of effective coordination patterns is still scarce. That is why this study investigates the occurrence of temporal sequences of explicit and implicit coordination in medical emergency and aims to answer the research question when and how these patterns affect team performance. The performances of 17 student teams in simulated ALS settings were video-recorded and analyzed with an exhaustive coding approach. Table 10 presents the main results of the lag sequential analyses that test our three hypotheses.

Table 10. Main Results of the Hypotheses Testing (Z-Values)

Hypothesis	High performing teams	Low performing teams	Phase
1	Inform. upon request ⇨ Inform. upon request (+3.05) Command ⇨ Inform. upon request (-2.41) Summary ⇨ Command (+4.24) Command ⇨ Command (+4.04)	Planning ⇨ Planning (+3.01) Command ⇨ Command (+3.61)	1
2a	Observe ⇨ Observe (+2.39) Observe ⇨ Suggest (+1.97)	Observe ⇨ Observe (+2.46)	2
2b	Suggest ⇨ Suggest (+2.37)	-	
	High explicit coordination teams in Phase 1	Low explicit coordination teams in Phase 1	
3	Observe ⇨ Observe (+2.17) Observe ⇨ Suggest (+2.37)	Observe ⇨ Observe (+2.51)	2

Notes.
The first behavior indicates the criterion behavior and the second behavior indicates the target behavior of a behavioral sequence.
Only significant z-values (+/- 1.96) that are related to our hypotheses are displayed.

5.1. Theoretical Implications

Explicit Coordination Sequences *(Hypothesis 1)*

In the beginning of a cardiac arrest situation (Phase 1), high performing teams show four explicit coordination sequences and low performing teams show two above chance level. Both clusters overlap in the sequence “command” followed by another “command”. In general, high performing teams do not significantly stand out in the amount of explicit coordination sequences. Consequently, we cannot confirm our theoretical assumption that effective teams communicate clearer, distribute tasks and minimize communication failure. One explanation could be the low amount of explicit coordination sequences in Phase 1 which weakens the expressiveness of the results for H1. Nevertheless, an in-depth analysis of the results can explain the existing differences in coordination patterns and offer a deeper understanding of effective micro-behavioral team processes.

The occurring autochthonous patterns of giving information upon request could be an indicator that high performing teams effectively aggregate information which ensures that everyone knows what is happening and what needs to be done. Several team members participate in information sharing through the aggregation of information upon a certain request which ensures effective coordination and time efficiency in such a high-pressure situation. This result contributes to a better understanding of a temporal view on information sharing in action teams. The importance of participative patterns for effective information sharing and team performance was already advocated by Cotton (1993), but this result offers a micro view on how mutual participation in sharing requested information can enhance team performance in a CPR context.

Moreover, high performing teams exhibit behavioral sequences where a summary of the current situation is followed by an instruction. This can be an indication for effective derivation of tasks after establishing a common understanding about the situation. In team learning research, creating a mutual understanding of the current state is an important behavioral marker for team learning that contributes to team

performance (Edmondson, 1999; Raes, Boon, Kyndt, & Dochy, 2015).
Next, low performing teams showed autochthonous "planning" sequences. Considering the task requirements of a fast and error free setup of cardiovascular support (Phase 1), this can be an indicator for missing clarity about future actions or inaccurate planning that needs to be corrected or complemented by further planning behavior. Although planning is seen as a key performance mechanism that affects team coordination in CPR environments (Fernandez Castelao et al., 2013), our result on planning sequences alludes to the possible negative effects on team performance. This underlines the importance to take a temporal look into team coordination. Whereas planning generally supports team performance, it can also be detrimental if teams plan at the wrong time or in inefficient sequences as suggested by our results.
Although high performing teams exhibit more explicit coordination sequences (3) above chance level, the average amount of sequences per team is lower compared to low performing teams (high performing teams: 4.8; low performing teams: 7.6). This is an interesting finding that could underline the relevance to differentiate between specific explicit coordination sequences. Some explicit coordination sequences could be more positive than others. Moreover, it can be an indicator that high performing teams practiced more how to work together and therefore need less overt communication to coordinate each other (Zala-Mezö et al., 2009; Grote et al., 2003; Rico et al., 2008; Wittenbaum et al., 1996).

Implicit Coordination Sequences *(Hypotheses H2a and H2b)*

First, testing hypothesis 2a, we found out that information-related talking to the room patterns in Phase 2 (observation followed by further observation) occur significantly above chance level in high and low performing teams. Although no differences can be investigated in information-related coordination patterns, only low performing teams show sequences where an observation is followed by further explicit coordination behaviors, like "inquiry" ($z = 2.53$) or "question" ($z = 3.6$), above chance level (see Table 7). This could mean that in high performing teams, information-related coordination sequences made further explicit gathering of information unnecessary. These two insights are important findings that are contradictory to the results of Kolbe et al. (2014). They found significant support for information-related coordination sequences only in high performing teams but could not indicate that explicit information gathering is substituted through implicit coordination. Whereas Kolbe and her colleagues (2014) investigated coordination patterns among medical experts in real anesthesia induction, the present research design involved medical student teams in simulated ALS situations. Because of high time pressure in ALS situations, first, the coordination of actions to save the patient's life could be more critical than coordination of information, and second, it could be harmful for team performance when information is implicitly coordinated and followed by explicit coordination.
Testing hypothesis H2b confirmed the assumption that in high performing teams sequences of action-related implicit coordination (talking to the room behavior operationalized as "suggest") occur significantly more often than in low performing teams. A possible explanation can be that a suggestion about further actions without addressing a specific team member keeps the team engaged in coordinating with further suggestions. This prevents communication breakdowns, which are a critical source of health care error (Gawande et al., 2003).
The micro-view on team coordination addresses calls for further investigation about the construct talking to the room (Lumley, 1997). Therefore, this study contributes to the literature by extending our knowledge about implicit coordination sequences in two phases of a CPR task. Our findings for hypothesis H2b replicate the findings by Kolbe et al. (2014) in a different task context which underlines its relevance. Knowledge about the temporal occurrence of implicit coordination sequences in an ALS setting can help us to find appropriate measurement methods which are necessary to understand how shared mental models are built and developed (Mohammed et al., 2001). A general approach on the measurement of team mental models is not existing (DeChurch & Mesmer-Magnus, 2010). A starting point are behavioral makers like "summary" or a combination of "summary" with information sharing that could approximate for the establishment of a shared mental model.
Our results also indicate that specific implicit coordination patterns are only advantageous for team performance in different temporal phases. In Phase 1, only high performing teams show patterns in which implicit information-related coordination is followed by implicit action-related coordination, which means that an observation is followed by a suggestion above chance level. An explanation could be that high performing teams are able to implicitly transfer information into actions under high pressure,

which is required to set up cardiovascular support. This can be an indication for an effective anticipatory behavior. On the contrary, low performing teams show significant autochthonous patterns of implicit information-related and action-related coordination. This could hinder teams to perform in Phase 1. A possible explanation is that it requires more effort to combine separately shared information and action to perform during high time pressure. This extends our initial assumption that only explicit coordination sequences are important for team performance in Phase 1. Different sequential combinations of implicit coordination behaviors contribute differently to team performance in high pressure situations. This contributes to a more fine-grained understanding of implicit coordination.

The Relationship of Explicit and Implicit Coordination Sequences *(Hypothesis 3)*

Teams that exhibit a higher amount of explicit coordination sequences in Phase 1, show one more significant implicit coordination sequence in Phase 2. This result does not provide enough support to conclude that explicit coordination sequences clearly influence the development of implicit coordination sequences.

Rather, this result should be interpreted as a trend that needs further investigation. The two clusters differ in the type of significant explicit coordination sequences in Phase 1, which could be an explanation for the different amount of implicit coordination sequences in Phase 2 (see Appendix 8). In addition, a possible explanation in favor of this trend could be that specific explicit coordination sequences in Phase 1 trigger the establishment of a shared mental model which enabled the usage of more implicit coordination strategies in Phase 2.

A model that supports the latter explanation is developed by Nonaka and Takeuchi (1995) who outline several stages of knowledge management in teams. Knowledge is spread in teams through the explication and combination of individual knowledge that at a later stage enables the conversion into implicit knowledge through a process of routinization. Based on this theoretical explanation, the explicit communication of individuals in the beginning creates a common understanding of the team's tasks and enables clarity about the patient's initial situation. At a later stage, high performing teams can coordinate themselves implicitly based on the acquired knowledge in the team. The finding contributes to a better understanding of the temporal development of coordination mechanisms in teams. Moreover, the development of coordination mechanisms and a shift from explicit and implicit coordination was solely studied over the course of several practices without considering team coordination developments within one practice.

Marks and her colleagues (2001) developed a model that explains how team performance is affected by several team processes within reoccurring transition and action phases. Coordination is seen as an important process that affects team performance in the action phase of team interaction. Our results advance this model with the insight that explicit and implicit coordination sequences can influence each other over the course of action phases. Therefore, our results give a temporal perspective on how teams change in patterns of explicit and implicit coordination when they move through two phases of CPR goal accomplishment.

External Communication with the Environment

The ratio of coordination-related coded behaviors in both clusters was 45%, which is quite low. In comparison, Riethmüller and his colleagues (2012) found ratios of 60-80% depending on the scenario and phase in anesthesia simulations. This raises the question whether other factors impacted team performance that are not coordination-related.

One explanation could be the cluster differences in the amount of behavioral sequences that include "external communication" (high performing: 35%; low performing: 20%). The high amount of sequences with "external communication" in high performing teams could have an impact on team performance. "External communication" is related to a (simulated) intervention by the medical teachers in which the student teams needed to be able to extract all relevant information to save the patient's life. High performing teams could be more effective in collecting accurate information from the intervention or more proactive in demanding additional insights into the patient's current state, for example by requesting x-ray information from a simulated radiologist. In short, these teams were interacting more frequently with their environment, which probably affected their team performance.

Several medical technologies allow real-time monitoring of the patient's current state, which is crucial for the quality of resuscitation (Meaney et al., 2013). In simulated ALS settings, this means that through the communication with the environment and the collection of all existing information, teams accurately examine the patient's state to decide for post-cardiac arrest treatment methods. This increases the chances for patient's survival and consequently team performance. This finding broadens our understanding of effective team coordination beyond team boundaries. This raises questions about the conditions for effective communication and interaction with the environment to save patient life in highly dynamic situations. How do effective interaction patterns with the environment look like? Which coordination patterns can be investigated with the environment and how do they influence team performance? This finding contributes to the literature by extending the perspective on team coordination beyond aspects of intra-team interaction that could have an influence on team performance.

5.2. Limitations and Future Research

Despite a careful design of the research study, several methodological limitations should be mentioned. First, the sample size consists of 17 student teams which is a small and homogenous study group. This raises the question how generalizable the findings are. Further research about temporal development of team coordination should examine larger sample sizes and a more realistic compilation of teams that represent emergency teams in cardiac arrest situations. One possibility would be to combine students from different backgrounds (nursing, physician, technical medicine etc.) or experts with different medical expertise. In addition, the study sample consists of medical students which limits the generalizability of the results to professional CPR teams. Due to differences in medical experience and knowledge, they potentially show differences in the way how they coordinate themselves (Riethmüller et al., 2012).

Second, the cross-sectional study design does not allow an explanation of causal relationships between the variables. As emphasized by Kolbe and her colleagues (2014), a longitudinal study combined with an exhaustive coding approach on micro-behaviors would enable more generalizable statements about the emergence of explicit and implicit coordination patterns and their relationship to team performance over time and within practices. This contributes to a better understanding concerning how curriculums need to be organized over the course of a semester and how student team performance is increased through the exhibition of coordination mechanisms.

Third, explicit and implicit coordination sequences are investigated separately by temporal phases, but team performance is measured as aggregated assessment. As Tschan and her colleagues (2011) emphasize, certain CPR tasks call for different coordination requirements. Therefore, the inclusion of other measures, such as the content and structure of medical knowledge of individual team members (DeChurch & Mesmer-Magnus, 2010), would build the basis to acquire more insights about the development of shared mental models in medical emergency teams. Consequently, cognitive processes are accounted more accurately in the analysis, which are two major aspects in research about team cognition (Mohammed, Klimoski, & Rentsch, 2000). As researchers suggest, team mental models are built on shared team experiences and trust, which are influencing factors that could be additionally investigated over time for a better understanding of the antecedents of explicit and implicit coordination and how they shape team cognition in medical emergency situations (Burtscher, Kolbe, Wacker, & Manser, 2011; Grote et al., 2003; Rico et al., 2008; Stout, Cannon-Bowers, Salas, & Milanovich, 1999).

Fourth, this research study did not consider a task analysis of the coordination requirements in ALS situations. Researchers call for conducting task analyses to understand temporal coordination requirements that affect team performance (Bowers, Baker, & Salas, 1994; Marks et al., 2001; Tschan et al., 2011). A future investigation of these would enable us to build upon our empirical findings and find out when and which specific temporal sequences of explicit and implicit coordination influence team performance.

Fifth, the current study consists of a content analysis of coordination patterns but fails to capture the structural component. Lei, Waller, Hagen and Kaplan (2016) advocate using a temporal lens for the content and structure of team interaction to holistically explicate the dynamics in team behaviors. A structural analysis would enrich our study results by delineating explicit and implicit coordination patterns with structural characteristics like their homogeneity or complexity, which are influential factors of team performance (Kanki, Folk, & Irwin, 1991; Zijlstra et al., 2012). In the context of team coordination, we could see whether a more complex compilation of coordination behaviors or the degree of standardization of explicit and implicit coordination patterns affect team performance.

Sixth, the coding of our video observations was focused on verbal coordination behaviors. However, research in CPR and anesthesia stresses that non-verbal communication such as gestures, body movements and facial expressions and the work environment are part of team coordination processes (Husebø, Rystedt, & Friberg, 2011; Manser, 2009; Schyns & Mohr, 2004). Our observational method could be more fine-grained with the coding of non-verbal coordination behaviors or eye-tracking that point out eye gazing patterns. These newly collected data points could give insights into anticipative and adjustment behaviors which would enrich our understanding of implicit coordination in teams that perform ALS.

Lastly, there are possible confounders that could have affected the dependent variable team performance which were not included in the analysis. The data was collected during the assessment of the students which can be a stressful moment for all participants and possibly affect team performance, as supported by Hunziker and her colleagues (2011). Moreover, other interpersonal team processes could have affected team performance. An example is psychological safety, which could have affected whether team members felt safe enough to speak up and positively influence team performance during the practice (Edmondson, 1999). Future research should include stress measures and consider a way to measure the feeling of interpersonal risk taking within teams.

5.3. Practical Implications

This study explores how sequences of explicit and implicit coordination affect student team performance in simulated ALS situations. The usage of video analysis and exhaustive interaction coding provide important insights about the differences in coordination sequences between high and low performing teams. This can sensitize medical teachers for a more detailed feedback and debriefing about the execution of non-technical skills. During the setup of cardiovascular support, medical teachers can observe whether quick and error free coordination is conducted without unnecessary sequences of planning that indicate a lack of clarity about the next steps. Researchers emphasize the importance of task requirements in the process of team coordination (Burtscher et al., 2011; Tschan et al., 2011). Thus, teachers can give task-specific feedback on the way how teams coordinate each other, for example differentiated by phases, leading to a more nuanced understanding and learning for students about the antecedents of ALS performance.

Medical students should be encouraged to engage in the process of assessing the underlying cause of cardiac arrest through proactive sharing of their individual observations. The analysis showed that sequences of information-related talking to the room ("observe") occurred more often in high performing teams and are assumed to support the mutual process of diagnosis in which the perspective of every student is relevant. Teachers could address the (missing) proactivity in sharing observations during practices or use systemic-constructivist techniques, such as circular questions (e.g. "Joe, in the situation where Marie suggested to assume a hypothermia, what was your first guess about the reason of the cardiac arrest?"). This offers the possibility for teams to reflect on the quality of coordination (Kolbe et al., 2014). Moreover, students should use the interventions given by the medical teachers, as an opportunity to gather as much information as possible to solve the patient's case. The relevance of external communication emphasizes the necessity of a proactive attitude by the students to collect all relevant knowledge about the patient's state and therefore increases team performance.

6. Conclusion

Research about temporal patterns of explicit and implicit coordination and their impact on performance in medical emergency situations is scarce. The aim of this study was to answer the question of how and when explicit and implicit coordination sequences influence team performance in medical student teams performing Advanced Life Support in a simulated setting. The results of lag sequential analyses show that several patterns of implicit and explicit coordination occur significantly more often in high performing teams, differentiated by the two phases of an ALS practice.

We could not find enough support that during the setup of cardiovascular support (Phase 1), high performing teams show more sequences of explicit coordination. However, a detailed view indicates that high performing teams show explicit coordination patterns that could have enabled effective derivation of tasks after establishing a common understanding about the situation (i.e. a summary followed by a command). In contrast, low performing teams engage significantly more often in autochthonous patterns of planning behavior which is probably the result of unclarity about the required

tasks during Phase 1.
During the assessment of the underlying cause of cardiac arrest (Phase 2), sequences of action-related implicit coordination (suggestion followed by further suggestion) occur significantly more often in high performing teams. This emphasizes the importance of proactive engagement in coordination activities by every team member to save the patient’s life. The occurrence of implicit information-related sequences did not significantly differ between the two clusters. However, in high performing teams, the additional gathering of information was unnecessary as they did not show patterns of implicit information-related coordination followed by explicit coordination. In contrast to that, low performing teams show patterns of implicit information-related coordination followed by questions or inquiries. We could not find enough support for the assumption that explicit coordination sequences in Phase 1 influence the development of implicit coordination sequences in Phase 2. Yet, the two clusters differed in the types of explicit coordination sequences in Phase 1 and it is assumed that specific explicit coordination could be more positive for the development of implicit coordination than others.
In addition, high performing teams showed more behavioral sequences that include the communication with the external environment. An explanation could be that they are more proactive in collecting relevant information from the outside to save the patient’s life.
Our study results contribute to a more fine-grained understanding of when specific explicit and implicit coordination patterns occur in high and low performing teams. The temporal view on team interaction examined differences regarding how student teams coordinate information and action, which enables an improvement in the education of emergency medical care. Further research should investigate the temporal coordination requirements in ALS situations and embed additional measures into the analysis to understand the development of team mental models through specific coordination patterns. After all, every new insight into the temporal dynamics of effective coordination in emergency situations can affect an improvement in patient safety.

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Appendices

Appendix I. Detailed description of the course curriculum

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:

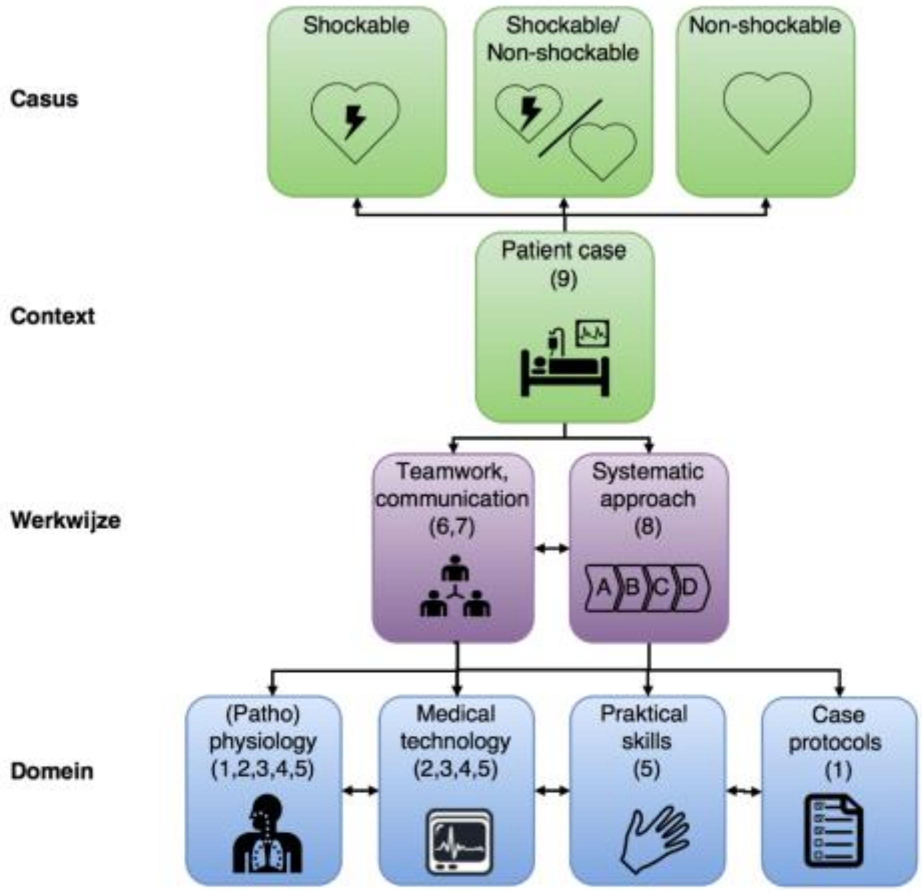
1. The student can describe the underlying principles of therapies that are commonly used in a resuscitation setting.
2. The student can describe the possibilities and limitations of diagnostic technologies that are commonly used in a resuscitation setting.
3. The student is able to relate information 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.

	Cognitive Skills (Knowlegde)	Practical Skills (Skills)	Interactive Skills (Collaboation, Communication)	Intellectual Skills (Integration)
Learning Goals	1,2,3,4	5	6,7	3,5,8,9
Foreknowlege	Basic knowledge	BLS injections	n/a	n/a
Educational Method	Lecture,	Skill practices	Working in Groups	Group Practice

	Self-Study Group Assignment			
Individual Testing	Theoretical Test	BLS test	n/a	Theoretical Test
Collective Testing	Case assessment (integrated into context)			



Appendix II. Ethical Research Request approved by the UT Ethical Committee

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

30-01-2018

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.B.

3b. Achternaam

Friedrich

3c. Vakgroep (indien van toepassing)

0

3d. Studentnummer

S2004852

3e. E-mailadres

j.b.friedrich@student.utwente.nl

3f. Telefoonnummer (tijdens het onderzoek):

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.

A. poort, a.poort@student.utwente.nl,

F.A. Lok, f.a.lok@student.utwente.nl,

B.T. Cherry, b.t.cherry@student.utwente.nl

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

A.M.G.M.

4b. Achternaam

Hoogeboom

4c. Vakgroep

OWK

4d. E-mailadres

4e. Telefoonnummer tijdens het onderzoek

5. Beoogde begin- en einddatum onderzoek

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

05-02-2018

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

30-06-2018

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 om meer te weten te komen over de invloed van groep cohesie, 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 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 groep cohesie, 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 (4)

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?

- 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 6 februari 2018 zal er aan het begin van een werkcollege de studenten gevraagd worden of ze mee willen doen aan het onderzoek. Hierbij krijgen ze uitleg over de doelen, procedure en vertrouwelijkheid van het onderzoek. Op 13 februari 2018 volgt een informed consent, gevolgd door een vragenlijst waarin gevraagd wordt naar demografische informatie, team samenstelling, en wordt afgesloten met de HEXACO persoonlijkheidsvragenlijst. Dit zal 20 min. van het werkcollege in beslag nemen.

Op 6/3, 13/3, 20/3 en 27/3 vinden de practicumlessen plaats, waarin er naast de reguliere lesplanning enkele metingen worden verricht. Alle studenten krijgen bij binnenkomst een sociometric badge om. Vervolgens volgen de studenten de normale planning van het practicum. Na elke simulatie-oefening zullen Docenten 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. Aan het einde van ieder practicum vullen studenten 5 items in over groep cohesie. 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 10/4 en 17/4 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

ilsbekwaamheid 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?

☑ 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 ontvangen 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 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 enkel 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.

☑ 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. Een proefpersoon kan enkel zijn/haar eigen gegevens inzien. Deze mogen niet gekopieerd of digitaal verzonden worden.

Appendix III. Encryption of Research Data

The data has been collected based on student numbers. That is why the data falls under the category personal data, which needs to be protected. We believe that this applies to our research of the following reasons:

1. The video material is linked to student number within a protected environment.

2. The student remembers his own student number. In case that a participant forgets an assigned number, this leads to process delay or whole student teams need to be excluded. Possible consequences: student numbers are exchanged (data is no longer available) reliable), the procedure is delayed.

The data is encrypted based on the student number and only accessible to one assigned person of the research team. Without this person, individual data and the encrypted data cannot be matched. With the aggregation of data on the team-level, it cannot be reproduced which participants with which student numbers belong to which group. With the encryption and aggregation of data, individual inferences are made impossible. Because of the mentioned measures, we conclude that data collection based on anonymized numbers can compromise the reliability of the research bring.

In practice

All physically collected data contained the student numbers, which was filled out by the respondents themselves. Personal data (name or student number) will be just available digitally to the principal investigator that created the protected key list.

We are aware that this way of collecting data entails risks but believe that this was the best possible solution as a full anonymization was not possible due to a lack of resources (time).The data will be handled very carefully, and everything is locked up latch (digital and analogue).

	Category	Location	Accessible by
Student Numbers	personal	Analog	Joscha Friedrich
New Number	anonymized	Digital	Research Team

Appendix IV. Performing Scoring List

Teameffectiviteit
en prestatieschalen
voor docenten

INSTRUCTIE
ZO INVULLEN: ●
NIET ZO: ⊗ ○

Groep: ______
Datum: ___ /___
Tijd blok _______
scenario nummer _______
Shock/non-shock: _______
beoordelaar: _______

Team effectiviteit

Erg inaccuraat Erg accuraat

	1	2	3	4	5	6	7
1. Dit team is steeds een goed presterend team.	○	○	○	○	○	○	○
2. Dit team is effectief.	○	○	○	○	○	○	○
3. Dit team maakt weinig fouten.	○	○	○	○	○	○	○
4. Dit team verzet kwalitatief hoog werk.	○	○	○	○	○	○	○

ALS effectiviteit

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	○	○	○	○	○

Leiderschapseffectiviteit

1 = volledig mee oneens, 5 = Volledig mee eens

Volledig mee oneens Volledig mee eens

	1	2	3	4	5
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 behalen.	○	○	○	○	○
13. Deze leidinggevende heeft succes binnen het team.	○	○	○	○	○

Zeer inefficiënt Zeer efficiënt

14. Ik vind deze leidinggevende: zeer inefficiënt (1) - zeer efficiënt (5)	○	○	○	○	○

Appendix V. Detailed Description of the Performing Scoring List (Dutch)

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 VI. Median Split Team Performance

Table 11. Median Split based on Team Performance (Gibson et al., 2009)

Teams	Team Performance[a]	Teams with Performance above Median	Teams with Performance below Median
2	6	2	3
3	4.25	4	6
4	6.25	5	9
5	6.25	7	10
6	5.5	8	11
7	6.75	12	16
8	6.75	14	
9	5.25	17	
10	5.5	18	
11	5.25	19	
12	7	20	
14	5.75		
16	5.5		
17	5.75		
18	5.75		
19	6		
20	6		
Median	**5.75**		

Note. [a] 7-point Likert scale

Appendix VII. Median Split Explicit Coordination Sequences

Table 12. Median Split based on the Amount of Explicit Coordination Sequences in Phase 1

Teams	# of Explicit Coordination Sequences	Teams with High # of Explicit Coordination Sequences	Teams with Low # of Explicit Coordination Sequences
2	17	2	4
3	13	3	6
4	9	5	7
5	19	8	11
6	9	9	12
7	7	10	14
8	12	16	18
9	12	17	19
10	14		20
11	8		
12	7		
14	11		
16	21		
17	12		
18	9		
19	11		
20	7		
Median	**11**		

Appendix VIII. Results of Sequential Analyses for all Coded Behaviors at Lag 1 for Phase 1 (Z-Values)

Table 13. Results of Sequential Analyses for all Coded Behaviors at Lag 1 for Phase 1 (Z-Values)

Teams with High Explicit Coordination Sequences in Phase 1 (N=8)[a]

Target Behaviours

Criterion behaviors		Observe	Suggest	Command	Planning	Inquiry	Question	Opinion	Summary	Infom. up. request	Ext. Comm.	Confirmation	Other	Laugh	Sorry	Social	Incompreh.
Implicit Coordination	Observe	0.91 (2)	1.53 (3)	-1.02 (2)	-0.51 (0)	-0.25 (0)	1.01 (2)	. (0)	. (0)	-1.05 (0)	0.80 (1)	-0.53 (2)	0.61 (5)	-0.25 (0)	. (0)	-0.44 (0)	-0.67 (0)
	Suggest	0.02 (1)	2.54 (4)	-0.05 (4)	1.51 (1)	-0.25 (0)	-0.93 (0)	. (0)	. (0)	-0.10 (1)	-0.65 (0)	0.65 (4)	-1.22 (1)	-0.25 (0)	. (0)	-0.43 (0)	-0.65 (0)
Explicit Coordiation	Command	0.20 (4)	-1.55 (1)	**4.43** (34)	0.10 (1)	-0.47 (0)	0.32 (4)	. (0)	. (0)	-1.97 (0)	-1.25 (0)	-0.12 (10)	-2.80 (2)	-0.47 (0)	. (0)	0.39 (1)	0.33 (2)
	Planning	-0.42 (0)	-0.45 (0)	1.25 (2)	**4.42** (1)	-0.11 (0)	-0.40 (0)	. (0)	. (0)	-0.44 (0)	-0.28 (0)	-0.67 (0)	-0.73 (0)	-0.11 (0)	. (0)	-0.18 (0)	-0.28 (0)
	Innquiry	-0.24 (0)	-0.26 (0)	-0.45 (0)	-0.12 (0)	-0.06 (0)	-0.23 (0)	. (0)	. (0)	-0.25 (0)	5.86 (1)	-0.39 (0)	-0.42 (0)	-0.06 (0)	. (0)	-0.11 (0)	-0.16 (0)
	Question	1.10 (2)	-0.09 (1)	-0.39 (3)	-0.48 (0)	-0.24 (0)	0.14 (1)	. (0)	. (0)	-0.99 (0)	-0.63 (0)	1.91 (6)	-1.65 (0)	-0.24 (0)	. (0)	1.98 (1)	0.93 (1)
	Opinion	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)
	Summary	-0.68 (0)	-0.74 (0)	**3.09** (7)	-0.35 (0)	-0.17 (0)	0.78 (1)	. (0)	. (0)	-0.72 (0)	-0.46 (0)	-1.10 (0)	-1.20 (0)	-0.17 (0)	. (0)	-0.30 (0)	-0.46 (0)
	Infom. up. request	0.48 (2)	-0.50 (1)	-1.82 (1)	-0.59 (0)	-0.30 (0)	-1.12 (0)	. (0)	. (0)	**2.63** (5)	0.48 (1)	1.36 (7)	0.40 (6)	-0.30 (0)	. (0)	-0.51 (0)	-0.78 (0)
Other	Ext. Comm.	-0.59 (0)	-0.64 (0)	-1.11 (0)	-0.30 (0)	6.43 (1)	-0.57 (0)	. (0)	. (0)	0.88 (1)	2.06 (1)	-0.95 (0)	0.55 (2)	-0.15 (0)	. (0)	-0.26 (0)	2.06 (1)
	Confirmation	-0.65 (2)	1.61 (7)	-0.83 (10)	0.23 (1)	-0.45 (0)	0.57 (4)	. (0)	. (0)	0.73 (5)	-0.33 (1)	0.57 (11)	-0.92 (8)	1.79 (1)	. (0)	-0.77 (0)	0.51 (2)
	Other	-0.10 (3)	-1.39 (1)	-2.58 (3)	-0.89 (0)	-0.45 (0)	-1.12 (1)	. (0)	. (0)	1.24 (6)	-1.17 (0)	-1.29 (5)	5.38 (31)	-0.45 (0)	. (0)	0.52 (1)	-0.33 (1)
Social	Laugh	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)
	Sorry	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)	. (0)
	Social	-0.42 (0)	1.62 (1)	-0.78 (0)	-0.21 (0)	-0.11 (0)	1.94 (1)	. (0)	. (0)	-0.44 (0)	-0.28 (0)	0.60 (1)	-0.73 (0)	-0.11 (0)	. (0)	-0.18 (0)	-0.28 (0)
	Incomprehensible	-0.59 (0)	-0.64 (0)	-0.39 (1)	-0.30 (0)	-0.15 (0)	1.09 (1)	. (0)	. (0)	-0.62 (0)	4.53 (2)	-0.95 (0)	0.55 (2)	-0.15 (0)	. (0)	-0.26 (0)	-0.40 (0)

Notes.
N=261.
[a]New groups of teams are formed based on a median split of the amount of explicit coordination sequences in Phase 1 (see Appendix 7).
A z-value larger than 1.96 or smaller than -1.96 indicates that a behavioral sequence occurred above or below chance ($p < .05$).
A z-value larger than 2.58 or smaller than -2.58 indicates that a behavioral sequence occurred above or below chance ($p < .01$).
Frequencies of behavioral sequences are presented in parentheses.

Table 14. Results of Sequential Analyses for all Coded Behaviors at Lag 1 for Phase 1 (Z-Values)

Teams with Low Explicit Coordination Sequences in Phase 1 (N=9)[a]

Target Behaviours

Criterion behaviors		Observe	Suggest	Command	Planning	Inquiry	Question	Opinion	Summary	Infom. up. request	Ext. Comm.	Confirmation	Other	Laugh	Sorry	Social	Incompreh.
Implicit Coordination	Observe	2.51 (1)	1.74 (0)	0.58 (1)	0.68 (0)	0.76 (0)	0.39 (0)	0.21 (0)	-1.57 (0)	1.39 (0)	-4.02 (0)	-0.02 (1)	-2.40 (2)	-0.38 (0)	-0.01 (0)	-0.01 (0)	1.39 (0)
	Suggest	0.35 (0)	1.87 (0)	1.70 (0)	0.64 (0)	-0.48 (0)	0.09 (0)	1.45 (0)	0.15 (0)	-1.23 (0)	-0.83 (0)	-0.55 (0)	-0.19 (0)	-1.43 (0)	0.43 (0)	-0.81 (0)	-1.26 (0)
Explicit Coordiation	Command	4.90 (2)	-0.96 (0)	**5.80** (25)	-0.04 (2)	0.01 (1)	-0.57 (0)	-2.90 (0)	1.45 (0)	-1.14 (0)	-3.15 (1)	-0.51 (2)	-0.56 (0)	-0.87 (0)	-0.79 (0)	0.47 (1)	-1.15 (1)
	Planning	-0.50 (0)	-0.89 (0)	**2.34** (1)	1.78 (0)	-0.81 (0)	0.05 (0)	0.02 (0)	-0.98 (0)	-0.81 (0)	-1.09 (0)	-0.29 (0)	3.23 (0)	-1.16 (0)	-0.48 (0)	1.59 (0)	-0.84 (0)
	Innquiry	-1.65 (0)	-0.06 (0)	-1.52 (1)	0.53 (0)	1.92 (0)	1.91 (0)	-0.41 (0)	-0.97 (0)	-0.24 (0)	-1.01 (0)	2.42 (0)	-1.76 (0)	-1.14 (0)	-0.47 (0)	-0.47 (0)	0.10 (0)
	Question	1.10 (0)	-0.69 (0)	-0.79 (0)	-1.16 (0)	-0.65 (0)	1.39 (0)	-1.69 (0)	-0.67 (0)	1.48 (0)	-1.91 (0)	1.81 (0)	-0.72 (0)	-0.42 (0)	3.75 (0)	-0.68 (0)	-0.22 (0)
	Opinion	-0.33 (0)	2.41 (0)	-2.48 (0)	-0.93 (0)	0.62 (0)	1.25 (0)	3.88 (0)	-1.28 (0)	0.38 (0)	-0.92 (0)	-0.43 (0)	-2.90 (0)	3.04 (0)	-0.63 (0)	-0.63 (0)	0.54 (0)
	Summary	-1.33 (0)	2.82 (0)	-1.46 (8)	-0.92 (0)	0.16 (0)	0.81 (0)	0.39 (0)	9.13 (0)	-0.30 (0)	-2.10 (0)	0.87 (0)	-1.38 (0)	-0.72 (0)	-0.30 (0)	-0.30 (0)	-0.63 (0)
	Infom. up. request	1.80 (2)	0.24 (1)	-1.76 (0)	0.18 (0)	-0.82 (0)	-1.69 (0)	1.42 (0)	-0.46 (0)	1.75 (4)	-1.52 (0)	1.46 (2)	-1.16 (5)	-0.80 (0)	-0.61 (0)	1.02 (1)	-0.67 (0)
Other	Ext. Comm.	-3.33 (0)	-3.30 (1)	-3.91 (0)	0.40 (0)	-2.34 (0)	-1.88 (0)	-1.86 (0)	-0.61 (0)	-3.92 (0)	21.12 (0)	-4.01 (0)	-4.00 (0)	1.60 (0)	-0.25 (0)	-0.25 (0)	-1.92 (0)
	Confirmation	-1.13 (3)	1.40 (0)	0.18 (1)	-0.15 (0)	1.61 (0)	0.14 (0)	0.73 (0)	1.17 (0)	1.58 (1)	-5.02 (0)	1.72 (1)	-0.26 (2)	-1.13 (0)	0.37 (0)	1.01 (1)	1.30 (3)
	Other	-1.67 (0)	-2.09 (0)	1.13 (0)	-1.90 (0)	-1.02 (0)	-0.24 (0)	-1.78 (0)	-1.54 (0)	0.45 (8)	-2.40 (0)	-0.88 (3)	14.24 (12)	0.37 (0)	-0.75 (0)	-0.75 (0)	-0.84 (1)
Social	Laugh	-0.59 (0)	-0.80 (0)	-0.73 (0)	-1.11 (0)	-1.10 (0)	0.11 (0)	1.10 (0)	-0.74 (0)	-0.70 (0)	0.42 (0)	-0.55 (0)	1.07 (0)	5.79 (0)	-0.36 (0)	-0.36 (0)	0.66 (0)
	Sorry	1.60 (0)	-0.64 (0)	0.91 (0)	-0.39 (0)	-0.38 (0)	-0.56 (0)	-0.51 (0)	-0.26 (0)	-0.48 (0)	0.10 (0)	0.29 (0)	-0.58 (0)	-0.30 (0)	-0.13 (0)	-0.13 (0)	-0.56 (0)
	Social	-1.00 (0)	0.33 (0)	0.39 (0)	-0.50 (0)	-0.50 (0)	-0.73 (0)	0.82 (0)	2.67 (0)	0.93 (0)	-1.17 (0)	1.32 (1)	-0.75 (1)	-0.39 (0)	-0.16 (0)	-0.16 (0)	-0.73 (0)
	Incomprehensible	0.10 (1)	-0.93 (0)	0.07 (2)	1.43 (0)	1.49 (0)	0.49 (0)	0.88 (0)	-0.06 (0)	0.87 (0)	-3.61 (0)	0.36 (2)	-0.35 (0)	0.05 (0)	-0.70 (0)	-0.70 (0)	2.87 (0)

Notes.
N=109.
[a]New groups of teams are formed based on a median split of the amount of explicit coordination sequences in Phase 1 (see Appendix 7).
A z-value larger than 1.96 or smaller than -1.96 indicates that a behavioral sequence occurred above or below chance ($p < .05$).
A z-value larger than 2.58 or smaller than -2.58 indicates that a behavioral sequence occurred above or below chance ($p < .01$).
Frequencies of behavioral sequences are presented in parentheses.