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Leader airtime management and team effectiveness in emergency management command and control (EMCC) teams

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ABSTRACT

We investigated the relation between leader airtime management and team effectiveness in Emergency Management Command and Control (EMCC) teams. Leader airtime management concerns leaders' interventions to structure who shares information when using opening and closing statements to respectively stimulate or reduce information sharing. We coded leaders' airtime management statements across different meeting phases (structuring, information sharing, decision making) using video-recordings of 12 EMCC exercises involving two consecutive meetings each. Experts rated two components of team effectiveness: Team Situation Awareness (TSA) and Team Decision Making (TDM). We found that closing statements were more frequently used in the decision-making phase than in any other meeting phase. Also, leaders of teams with lower TSA used more opening statements in the decision-making phase of the first team meeting than leaders of teams with higher TSA. These results confirm the importance of the timing of leader airtime management for EMCC team effectiveness.

Practitioner summary: We investigated leader airtime management and team effectiveness in EMCC teams. We video-coded 12 exercises; experts rated team effectiveness. In the decision-making phase, leaders use more closing statements, and leaders of less effective teams use more opening statements. Leaders are advised to adjust their airtime management to meeting phases.

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Leader airtime management; team leadership; team effectiveness; team phases; emergency management command and control teams

In nearly all sectors, teamwork is the rule rather than the exception in today's organisations (Kozlowski and Ilgen 2006). While there are many factors contributing to effective teamwork (Burke et al. 2006; Koeslag-Kreunen et al. 2018), prior research shows that it is important that all members in a team get the chance to share information and voice their opinion (Sherf et al. 2018). In team literature, this concept of voicing one's ideas and concerns is referred to as 'airtime' (Edmondson, Roberto, and Watkins 2003). Ensuring that the information held by different team members is shared and therefore available to the team makes teamwork effective and contributes to team member satisfaction (Sherf et al. 2018).

The concept of 'airtime' is especially important in meetings of emergency management command and control (EMCC) teams (e.g. Hoven et al. 2019). We

define EMCC teams in line with the definition of teams by Kozlowski and Ilgen as follows (2006, 79): 'A team can be defined as (a) two or more individuals who (b) socially interact (face-to-face or, increasingly, virtually); (c) possess one or more common goals; (d) are brought together to perform organisationally relevant tasks; (e) exhibit interdependencies with respect to workflow, goals, and outcomes; (f) have different roles and responsibilities; and (g) are together embedded in an encompassing organisational system, with boundaries and linkages to the broader system context and task environment'. EMCC teams have the task to coordinate action teams at an incident scene when facing major disasters and emergencies. They have characteristics that are similar to those of teams working in extreme contexts, meaning 'teams that (a) complete their tasks in performance environments with

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one or more contextual factors that are atypical in level (e.g. extreme time pressure) or kind (e.g. confinement, danger) and (b) for which ineffective performance has serious consequences (e.g. compromised health or well-being of the team or the team's clients)' (Bell et al. 2018, 2). First, in these multidisciplinary EMCC teams members of different disciplines hold pieces of unique information about an incident (van der Haar, Segers, and Jehn 2013b). It is necessary to share all available information within the team to be able to obtain a good overview of the situation and make adequate decisions (van der Haar et al. 2015; Uitdewilligen and Waller 2018). Second, EMCC teams operate in an environment where the situation or problem at hand is complex, little initial information is available, there is high time pressure, and decisions have a high impact, while the team itself is typically formed ad hoc (composed out of who is on duty when the crisis arises) with often unfamiliar team members (McMaster and Baber 2012; Salmon et al. 2011; Smith and Dowell 2000; van der Haar, Segers, and Jehn 2013b). These characteristics of EMCC teams make the proper distribution of airtime within teams very important. At the same time, precisely these characteristics, especially the distributed information and the high time pressure, jeopardise that team members take the floor to share their unique information. It has been shown that team members tend to withhold information because they do not want to disturb the meeting or subvert the hierarchical order or the social harmony within the team (e.g. Jones and Roelofsma 2000; Detert and Edmondson 2011; Morrison, Wheeler-Smith, and Kamdar 2011). Therefore, airtime management by the formal team leader is expected to be necessary for meetings of these teams. We define airtime management as the 'interventions of team leaders to structure which team member shares information when' (cf. Hoven et al. 2019, 10). With this concept, we point to the process control team leaders exhibit (Edmondson, Roberto, and Watkins 2003) to ensure that all relevant information is being shared (Farh and Chen 2018).

In the context of EMCC, scholars have stressed the importance of leader airtime management (Koeslag-Kreunen et al. 2018; van der Haar et al. 2017). Given the hierarchical structure of EMCC teams, leader airtime management is seen as necessary to facilitate and structure the information that team members share (Farh and Chen 2018). By steering which team member talks when, the team leader tries to achieve that all necessary information is shared such that the team can form an adequate overview of the situation

at hand and make adequate decisions and action plans for how to handle it (Hoven et al. 2018). Despite the clear argumentation for the role of airtime management in EMCC teams, to date empirical evidence is scarce. As one of the few studies conducted in this context, an interview study by Hoven et al. (2018) presents self-report evidence of leaders using airtime management behaviours in EMCC team meetings. Leaders of EMCC teams report to purposefully use airtime management behaviours in team meetings to guide the discussion and to follow the work structure. Additional observational research is necessary to confirm these self-reports and to further investigate the occurrence of leader airtime management and its relation with team effectiveness.

An important element to take into account when studying leader airtime management in EMCC teams is the timing of this behaviour. Typically, EMCC team meetings have three phases: an (initial) structuring phase, an information sharing phase, and a decision-making phase (Uitdewilligen and Waller 2018). While in the (initial) structuring phase roles, rules, and procedures are clarified, in the information sharing phase the team shares information about an incident, and in the decision-making phase decisions are made and actions are set out. As each phase has a different objective and therefore requires different forms of team interaction (Uitdewilligen and Waller 2018), requirements for leader airtime management may be different across the three phases. Farh and Chen (2018), for example, showed differential effects of team leader interventions on member voice across different phases in action teams. Their results underscore the idea that leadership functions may vary with time, as does a team's need for leader behaviour. However, so far, the role of leader airtime management in the three different phases of the EMCC team meeting is unknown. More substantially, evidence is missing of whether and how team leaders need to adjust their airtime management across the three different phases for the team to be effective in establishing a proper understanding of the situation and making decisions about the required actions.

To fill the gap, the aim of the current study is to investigate potential differences in leader airtime management across the three phases of the EMCC team meeting. Furthermore, we investigate to what extent the display of leader airtime management across these phases differs between teams with high vs. low team effectiveness. As such, this study contributes to theory about airtime in teams by studying how leaders of EMCC teams manage airtime and how this is related

to team effectiveness. By identifying specific leader airtime management behaviours and investigating their role in team effectiveness we contribute to literature about airtime management by team leaders and the relation to team effectiveness and help getting an understanding of the timing of these activities (Castillo and Trinh 2018). Thereby we extend the work of authors focussing on more general task-focussed behaviours (e.g. Burke et al. 2006). The extension of earlier studies is achieved by focussing on the specific and observable behaviour of the team leader in the EMCC context. This enables temporal analyses which provide insights into how the timing of leader behaviour influences team effectiveness (Meyer et al. 2016). The insights resulting from our study can be used for training of team leaders and thereby enhancing EMCC team effectiveness.

Theoretical framework

The role of leader airtime management in EMCC team meetings

Importance of airtime

There is an extensive body of research on information-processing and decision-making in teams (e.g. Burke et al. 2006; Hackman 2002) indicating its importance for the effectiveness of teams while also highlighting the undermining potential of process losses (Steiner 1972), for example, due to groupthink (Janis 1982). Groupthink involves 'poor decisions as a result of a strong concurrence-seeking tendency that suppresses critical inquiry'. Teams suffering from groupthink tend to arrive at a decision before realistically appraising all available courses of action; thus a faulty decision tends to result (Neck and Moorhead 1995, 537–538). Groupthink is particularly likely to occur when there is information asymmetry (Edmondson, Roberto, and Watkins 2003). Neck and Moorhead (1995) stress two more antecedent conditions of groupthink symptoms: highly consequential decisions to be taken by the team and pressures due to time constraints. Crisis management teams have to deal with each of these conditions and therefore are vulnerable to processes, such as groupthink.

To prevent process losses, such as groupthink, it is important for team members to get the chance to talk during a team meeting, to share their information, and express their opinions (Sherf et al. 2018), in other words, to get airtime. These ideas are also reflected in the concept of member voice (Farh and Chen 2018; Sherf et al. 2018). Prior airtime research has focussed on the effects of airtime. Team member airtime has

been shown to be important for team effectiveness (Sherf et al. 2018). Woolley et al. (2010) and Engel et al. (2014), for instance, show that equal speaking turns in teams lead to better team performance because all the potential and input of the group can be better used this way.

Airtime management: the role of the team leader

Given the potential for process losses in teams due to members not sharing and using all information at their disposal, research has pointed to the need for active management of information sharing. Neck and Moorhead (1995) already argued for the moderating role of methodical decision-making procedures in prior groupthink literature. More specifically, they stress the relevance of promoting 'constructive criticism, nonconformity and open-mindedness in the group' (549) and suggest that the team leader plays an important role in this. Leadership behaviours, such as encouraging diversity of viewpoints and promoting open inquiry into alternative courses of action protect teams against groupthink (Neck and Moorhead 1995). Cox, Zagelmeyer, and Marchington (2006) showed that involving team members in the discussion indicates that the team leader is interested in hearing the team member's view, which in turn, stimulates team members' willingness to participate in the discussion. This leads to more team member involvement and participation in team meetings (Cox, Zagelmeyer, and Marchington 2006). In the same vein, Hackman and Wageman (2004) argue for the role of the team leader to minimise process losses by facilitating and stimulating team members to contribute to the team interaction, by promoting utilisation of all team members' talents. In this respect, Cave et al. (2016) and Sherf et al. (2018) refer to the team leader's role of managing airtime of all team members by structuring which team member at which point in time takes an active role in the interaction process in the team to share or discuss information. In this way, the team leader facilitates the surfacing of diverse viewpoints, which are crucial for teams that are trying to make sense of a situation or task they have to deal with. In other words, by managing airtime, a team leader helps team members to organise their efforts as a team and prevent process losses (Mueller 2012).

These insights translate to EMCC teams. With the work context of EMCC teams being characterised by distributed information and high time pressure, it is very important to use the given time in the team meeting effectively and avoid process losses within the team. Therefore, EMCC teams use a standard

meeting structure and the formal team leader strictly guides the team meeting. At some points during the meeting, a team leader may invite team members to share relevant information, as to allow the team to come to a sufficient overview of the situation. At other points, the leader may want to discourage additional discussions. In consequence, a team leader that applies these airtime management behaviours ineffectively (i.e. in the wrong way or at the wrong time) in the team meeting may actually increase the risk of process losses (Neck and Moorhead 1995). As one of the few studies on airtime management, Farh and Chen (2018) indicate the necessity of managing the airtime in the context of surgical teams and the role of the formal team leader in this. The latter is confirmed in an interview study by Hoven et al. (2018), in which leaders of EMCC teams report to purposefully use airtime management behaviours in team meetings to guide the discussion and to follow the work structure. By managing the 'airtime' of team members within the team meeting, the leader also decides on which ideas and thoughts time is spent (Hoven et al. 2018).

Leader airtime management: opening and closing

Leader airtime management is conceptualised in two components: opening and closing (Hoven et al. 2019). Opening statements are defined as statements made by the team leader that allow or even invite team members to talk and expand on a task-relevant subject. Examples are requests to talk/questioning, testing for understanding, emphasising a remark, and asking for opinions or alternative views. Leader airtime management closing statements concern those statements made by the team leader that are aimed at reducing airtime or ending the information sharing process. Examples are to postponing (e.g. 'we can talk about that later'), rejecting, making decisions, and commanding (Edmondson, Roberto, and Watkins 2003; Hoven et al. 2018; Raes et al. 2015; van der Haar et al. 2017).

Figure 1 provides an overview of these two components of leader airtime management.

The notion of leader airtime management can be examined from different strands of (leadership) research. Leader airtime management compares to ambidextrous leadership in the sense that it is characterised by leaders' simultaneous use of opposing behavioural strategies (Rosing, Frese, and Bausch 2011; Kafetzopoulos 2022), i.e. opening and closing statements. Rosing, Frese, and Bausch (2011), in their literature review on leadership and innovation, place ambidextrous leadership within the general leadership literature and highlight the existence of opening and closing leader behaviour and the need for temporal flexibility in both behaviours due to situational requirements. In line with our reasoning, they stress that general leadership styles are too broad and that leader behaviour should match the requirements and needs of teams (Rosing, Frese, and Bausch 2011). As such, the notions of opening and closing statements are connected to the tasks of exploitation and exploration as used in the innovation context. Exploration, and the opening leader behaviour that is required, points to enhancing sharing of information within the teams while exploitation, and the matching closing leader behaviour, refers to stopping new information search and using the available information to come to decisions (Rosing, Frese, and Bausch 2011). As such, we conceptualise these leader behaviours in a similar fashion in the communication process of EMCC teams and the role of the team leader in this process.

In addition, the components of opening and closing leader airtime management behaviour can be compared to the concept of dynamic delegation of the team leader in medical emergency trauma teams (Klein et al. 2006). This concept describes team leaders balancing between directive leadership behaviour, which involves taking charge and providing directives for team members to follow, and empowering leadership behaviour, which means that the team leader



Figure 1. Conceptual model of leader airtime management for EMCC teams.

seeks input from the team members. The authors describe the balancing of these leadership behaviours as central to the reliable performance of these teams (Klein et al. 2006). In a similar fashion, Hoozeboom and Wilderom (2020) stress the necessity of team behaviour to adjust to the team context and the importance of information sharing in teams.

Leader airtime management also relates to the concept of process control which was coined by Edmondson, Roberto, and Watkins (2003) to describe 'an intervention in the discussion to encourage certain people to share information before or more often than others, to inquire into the views of silent members, or to emphasise particular remarks made by members' (Edmondson, Roberto, and Watkins 2003, 313). Stimulating team members to share information is similar to the opening statement component, but the concept of process control by Edmondson does not address closing behaviour.

Finally, leader airtime management is related to the structuring behaviours of team leaders within EMCC teams as described by van der Haar et al. (2017). Compared to leader airtime management, structuring behaviours—such as goal orientation or time management—have a broader scope and do not cover the two components of opening and closing statements. Thereby, leader airtime management adds to these existing concepts by specifically addressing the management of airtime in EMCC teams; a behaviour that leaders of EMCC teams report to purposefully use in their team meetings (Hoven et al. 2018).

The relation between leader airtime management and team effectiveness across meeting phases

Team leadership has repeatedly been recognised as a highly influential factor in establishing effective teams (Burke et al. 2006; Koeslag-Kreunen et al. 2018). Different leadership styles have been shown to relate to team outcomes via their influence on team processes. In relation to team member voice specifically, research has shown that interventions by the team leader are needed to create the right conditions for member voice to occur, such as psychological safety and respect for group members, as this does not necessarily happen automatically in teams (Renger et al., 2019). In the multidisciplinary EMCC context, member voice is especially difficult because of the fact that members tend to identify stronger with team-mates from their own profession than with team members of other disciplines. This may result in a lack of psychological safety and respect for group members of other

disciplines and may negatively affect information sharing between team members.

Leader airtime management is expected to enhance a team's information sharing and decision-making by safeguarding member airtime. Member voice and speaking turn in teams are important to ensure that the information held by the different team members is shared and therefore available to the team (Sherf et al. 2018; Woolley et al. 2010). A well-distributed airtime, sharing diverse viewpoints, and using all talent in the team facilitates better decision-making and contributes to satisfied team members (Sherf et al. 2018). By steering which team member talks when, the team leader enables that all necessary information is shared in a systematic manner, such that the team gathers all available information first, then integrate information, then reaches a decision (Hoven et al. 2018).

In the specific context of EMCC teams, leader airtime management is expected to influence team effectiveness on two components (van der Haar, Segers, and Jehn 2013a). The first component refers to the team having a clear overview of the situation at hand, also known as team situation awareness (TSA). The second component involves translating decisions into concrete actions, which we here refer to as team decision-making (TDM). Firstly, TSA can be described in simple words as a team's understanding of what is going on. More formally stated, it refers to a shared understanding among team members of their current situation at a given point in time (Salas et al. 1995) based on 'the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future' (Endsley, 1995, 36). There is a long line of research on the cognitive representation by teams of a situation, the interaction involved in building and sharing that representation, and the importance thereof for coordination and performance (e.g. Salas and Fiore 2004). Secondly, the 'TDM' component refers to the outcome of the decision-making process of arriving at task-relevant decisions, incorporating all available information and expertise. Thereby TDM resembles the 'strategy formulation and planning process' in Marks, Mathieu, and Zaccaro (2001) taxonomy of team processes, involving decision-making, prioritisation, and communication of plans to all team members. Proper strategy development includes consideration of situational and time constraints, team resources, and member expertise, as well as the changing nature of the environmental conditions. The resulting strategies then contain information about member roles and responsibilities, the

order and timing of actions, and how task-related activities should be executed (Marks, Mathieu, and Zaccaro 2001). In EMCC teams, TDM does not necessarily require a complete consensus, nor does it involve all team members in all aspects (Converse, Cannon-Bowers, and Salas 1993). The goal of these teams is, of course, not simply making decisions, but achieving crisis control, while having low error rates and a high workplace safety (Baker, Day, and Salas 2006; Wilson et al. 2005; van der Haar, Segers, and Jehn 2013a).

To understand the relation of leader airtime management behaviour with team effectiveness (i.e. TSA and TDM), it is imperative to look into phases in team meetings, given the different objectives of these phases. The general team literature often distinguishes phases in teamwork, such as transition and action phases (Marks, Mathieu, and Zaccaro 2001) or preparation and action phases (Kozlowski et al. 2009). It is important that leaders adapt their behaviour to the teamwork phases and their related team tasks (e.g. Morgeson, DeRue, and Karam 2010; Salas, Burke, and Stagl 2004). Authors, such as Rosing, Frese, and Bausch (2011) and Lorinkova, Pearsall, and Sims (2013) describe the need for changes in team leadership behaviour consistent with changes in requirements and processes in these phases. In line with that, Barth, Schraagen, and Schmettow (2015) showed that surgical teams adapt their control processes to situations during a procedure. They use, for instance, more decentralised and flatter communication during complex parts of a procedure. In addition, Farh and Chen (2018) investigated the effects of team leader interventions on member voice in action teams, thereby distinguishing between preparation and action phases. They argue, based on functional leadership theory (McGrath 1962), that leadership behaviour should vary with time to accommodate necessary team functions. Their findings support the use of different leader interventions affecting the airtime of team members in the different team meeting phases.

Similar to action teams, EMCC teams follow a given work structure, going through various phases, which is illustrated in Figure 2. Here, we distinguish between transition and action phases (Marks, Mathieu, and Zaccaro 2001) and multiple team meeting phases (Uitdewilligen and Waller 2018). Evidently, EMCC team meetings are part of the transition phases, but EMCC teams also have action phases where team members communicate decisions to the field units and collect information, as described by van der Haar et al. (2015). Hence, EMCC team meetings have a big impact

on subsequent actions being taken in the field (which are not part of this study). Decisions that are made directly influence the work at the scene. Conversely, the collection of information during the action phase gives important input for team meetings during the subsequent transition phase. During meetings, EMCC teams go through three distinct phases: an (initial) structuring phase, an information sharing phase, and a decision-making phase (Uitdewilligen and Waller 2018). Teams are trained in going through these phases and use them as an explicit structure in their team meetings. During the initial structuring phase, an outline of the meeting is given, team members' roles are clarified, and ground rules for communication are established. In the information-sharing phase, team members share their individually held information and give explanations on this information. During this phase, the team situation awareness is on the team meeting agenda to be explicitly discussed. In this respect, EMCC teams differ from other teams where situation awareness is not explicitly on the team meeting agenda. During the decision-making phase, decisions are made and translated into actions, based on the previously shared information. In the latter phase, teams sometimes also engage in sharing projections of future developments (Uitdewilligen and Waller 2018). After the first team meeting, it is mostly not necessary to have another structuring phase and the team starts the next meeting with the information sharing phase followed by the decision-making phase.

We expect that leader airtime management is different in the three team meeting phases, and that this is important for EMCC team effectiveness. The structuring phase consists mostly of information being provided by the team leader to the team members, so few leader airtime management interventions are expected in this phase. In the other two phases, opening and closing statements may both be shown. However, given the specific objectives of the phases, leaders of effective teams are expected to predominantly use opening statements during the information sharing phase, whereas closing statements are more likely to prevail in the decision-making phase. Opening statements used during the information sharing phase will invite team members to share information which is essential to form team situation awareness and to come to decisions. Without sufficient team situation awareness, informed and adequate decisions cannot be made (van der Haar et al. 2015). Moreover, opening statements during the information sharing phase allow all team members to voice their ideas and to come to a more complete

General team phase	Action	Transition Meeting 1			Action	Transition Meeting 2		Action
		Initial structuring phase	Information sharing phase 1	Decision-making phase 1		Information sharing phase 2	Decision-making phase 2	
Meeting Phase								

Figure 2. Overview of team meetings and phases of EMCC teams in the Netherlands.

overview of topics for the decision-making phase (Uitdewilligen and Waller 2018). Evidently, team leaders may use closing statements during the information sharing phase, for instance, to shut down irrelevant information, but we expect these statements to be used much more frequently in the decision-making phase. When it is time to make decisions, the use of closing statements prevents the team from getting stuck in loops of discussion and sharing irrelevant information. Opening statements are likely to be underrepresented in this phase and merely used to check if all important points have been discussed to reach a decision.

Research aim and questions

The aim of this study is to investigate potential differences in leader airtime management across the three phases of EMCC team meetings (i.e. structuring phase, information sharing phase, and decision-making phase). In addition, we focus on the impact of airtime management behaviours on team effectiveness. Given the current state of the literature, we refrain from formulating hypotheses and instead state the following research questions:

RQ1: To what extent does leader airtime management differ across the three phases of EMCC team meetings?

RQ2: To what extent does leader airtime management in the three meeting phases differ between high and low effective EMCC teams?

Method

Study context and sample

For the current study, we observed 12 realistic exercises of EMCC teams in the Netherlands, in which professional teams trained to deal effectively with incidents. More specifically, we studied the team meetings of on-scene command teams. This multidisciplinary team is located at the incident scene and has the task to handle the source of the incident. The exercises concerned two different scenarios: an accident with a concrete pump and an accident with a bus. Each of the 12 teams we observed, went through

one of the two scenarios about which they had two meetings. The bus and the pump scenario were evenly distributed between the teams. The scenarios did not differ in complexity.

Participants

The median team size was eight members, with a range of 5–9 team members. Participants were members of EMCC teams in the Netherlands: team leaders, information officers, firefighters, police officers, ambulance personnel, secretaries, plotters, communication advisors, representatives of the municipality, and advisors with dangerous materials. The average age of participants was 47 years (*SD* 7.4), 72% held a bachelor's or higher degree, 86% were male and 14% were female. The median of the experience of working in real-life emergencies was 15 times (IQR 25), and of participating in simulation exercises was 15 times (IQR 18).

Procedure

Before team meetings, participants signed an informed consent for the video recordings. They then filled in a questionnaire with demographic information. Team meetings were video recorded; cameras were set in a position not to obstruct the meeting. Participants indicated that the camera did not disturb the team meeting. For this study, an ethics committee confirmed that no ethical review is required, following the local and national legal requirements. Furthermore, participants gave their informed consent and a data management plan ensured the confidentiality of the recorded data.

Team effectiveness

Team effectiveness was assessed by two raters using the team effectiveness scale of van der Haar, Segers, and Jehn (2013a). The CFA of this scale in the article by van der Haar, Segers, and Jehn (2013a), which was built based on an analysis of existing relevant literature, confirms a 5-factor structure: image building, wrapping up the meeting, quality of actions, goal

achievement, and error rate. These factors are divided into team meeting outcomes and results of the emergency response. Based on the focus of our research we used the team meeting outcomes (factors image building and wrapping up the meeting) part of the scale, which was developed and validated in the specific context of EMCC exercises in the Netherlands. Items of the 7-point Likert scale for the team meeting outcome are clustered in two components: TSA (five items; e.g. 'the team managed to create a shared image of the situation in a short time') and TDM (three items; e.g. 'the decisions are translated into an assignment for a specific professional or a team'). The extensive validation by van der Haar, Segers, and Jehn (2013a), including amongst others psychometrics, showed strong internal consistency [Cronbach's alpha for the EMCC context between 0.82 and 0.90.] and a clear factor structure. Furthermore, the validation study of van der Haar, Segers, and Jehn (2013a) substantiated the convergent and divergent validity of this instrument in the context of EMCC. The scale items can be found in [Appendix 1](#). The 'shared understanding among team members of their current situation at a given point in time' in the definition of TSA in the theoretical framework relates to the 'shared image of the situation' in the items, which reflects the situation and its dilemmas. The 'comprehension of their meaning, and the projection of their status in the near future' part of the TSA definition is reflected in the 'realistic and unambiguous image' in the items. The outcome of the decision-making process for EMCC teams is reflected in the TDM items. 'Arriving at task-relevant decisions, incorporating all available information and expertise' in the definition of TDM results in the items: 'specific assignments which are given to a relevant team or person and which are logged in a plot of the incident'.

Aggregation of the team effectiveness scores was justified based on high interrater agreement [$R_{WG(U)} \text{ TSA} = 0.86$, $R_{WG(U)} \text{ TDM} = 0.87$]. Team effectiveness was measured once per team after the second team meeting, and thus aggregated for several team phases. For each component, teams were categorised as high or low effective teams based on a median split, in line with previous research in this area (e.g. Uitdewilligen and Waller 2018; van der Haar et al. 2017).

Coding of video data

Meaningful units

Meaningful units were identified in the data by the first author based on a set of rules that were verified

with the second rater (Strijbos et al. 2006). A new unit was set when there was a speaking turn. Within a speaking turn, a new topic would also be set as a new meaningful unit. For instance, when a team member would first talk about the victims of the incident and then about the size of the fire within one speaking turn, the latter would count as a new topic and thus a new meaningful unit. We unitised all verbal behaviour within the EMCC team meeting. Thereby, units of the team were marked as such and excluded from further analysis. After this first step of identifying meaningful units, only the behaviour of the team leader was checked for leader airtime management. Identification of leader airtime management, based on our definition, was discussed and aligned between the first and second coders. Leader behaviour that did not meet the definition of leader airtime management was not included in further analyses. These were, for instance, units where team leaders welcomed the team members, used initial structuring behaviours, or explained the meeting procedure.

Coding and interrater reliability

We coded the video data, based on our coding scheme for leader airtime management (see [Table 1](#) for more information), using the video coding software the Observer XT by Noldus, version 14 (Noldus et al. 2000). Thereby, codes were mutually exclusive and exhaustive, meaning that one meaningful unit could only be assigned to one code and that the codes covered all the behaviours within the meeting. To establish interrater reliability, 10% of the data were independently double-coded by two raters, leading to an agreement quotient between .84 and .92 on the two components of leader airtime management. Disagreements between coders were discussed until a consensus was reached. During the coding process of the remaining data by the first author, the second coder could be consulted in case of doubts or questions.

To identify the three team phases we used the definitions specified by Uitdewilligen and Waller (2018) in prior research on EMCC teams. The first phase, the structuring phase, concerns providing an introduction to the general meeting structure and introducing team members to each other at the beginning of the first team meeting. The information sharing phase is characterised by sharing information about the incident at hand. During the final phase, the decision-making phase, judgments are formed on the most important multidisciplinary points and decisions are made and actions are distributed between the team

Table 1. Coding scheme leader airtime management.

Component	Behaviour	Definition	Example
Open	Request to talk/questioning	All statements that invite a team member to talk.	Do you have additional information on the situation at the scene at this moment?
	Test for understanding	Probing for further explanation, asking to clarify/for clarification.	That was not clear, do we miss a person? So you are executing that?
	Emphasise a remark Ask for opinion/alternative views	Emphasising a remark. Asking for the opinion of team members or encouraging alternative views.	A good point. Thank you! What is your opinion on scaling up?
Closing	Postponing	Stating that a statement will be picked up later on during the discussion.	When can talk about that later. I will come back to that point in a minute.
	Rejecting	Stating that a statement is not relevant for the meeting.	I only want additional information, no repetitions; this is already on the whiteboard.
	Decision	Decision that closes the discussion about a topic.	So, we increase the emergency level to GRIP 2.
	Command	Command about how to approach something which closes a topic.	Police, could you find out what exactly is located behind these buildings?

Besides a label for the behaviour and a definition, examples from the data are provided.

members (Uitdewilligen and Waller 2018). The first author watched the videos to identify the phase structure based on the phase definitions, thereby also taking into account when team leaders explicitly mentioned moving to the next phase of the team meeting. For subsequent team meetings, the phases were numbered subsequently, for instance for team meetings 1 and 2 as information sharing phase 1 and information sharing phase 2, respectively. As reported by Uitdewilligen and Waller (2018), EMCC teams indeed work in a very structured way. The trained phase structure is very generally and strictly followed across all types of incidents, although the time that teams spend in each phase differs between teams. Moreover, leaders are known to explicitly intervene when team members try to deviate from the structure, for instance when they try to jump to conclusions early in the information sharing phase.

Analyses

First, we performed a visual/descriptive analysis of the video-codings. Next, we ran two separate two-way mixed ANOVAs to test the research questions, one for each team effectiveness component (i.e. TSA and TDM). For both tests, the team meeting phase was the within-subject factor and team effectiveness (high vs. low) was the between-subject factor. Leader airtime management opening and closing were respectively the dependent variables.

We compared high-performing teams with low-performing teams (regarding TSA and TDM), to see if the leader behaviour is different in the phases of each of the meetings. Hereby, we identified phases as part of

meeting 1 or meeting 2. In practice, this means we identified five phases: structuring in meeting 1; information sharing in meeting 1; decision-making in meeting 1; information sharing in meeting 2; and decision-making in meeting 2. So, we did not simply compare all 'information sharing phases', rather we compared leader airtime management behaviour between high- and low-performing teams in the information sharing phase of meeting 1, in the decision-making phase of meeting 1, in the information sharing phase of meeting 2, and in the decision-making phase of meeting 2.

Results

Descriptives and graphical analysis

In general, leader airtime management was observed in all team meetings. By way of example, a graphical overview of two team meetings is provided in Figure 3, one of a team identified as high performing and one of a team identified as low performing on both team effectiveness components. The figure shows the airtime management behaviour that the leaders of these teams displayed in the team's first meetings in the exercise. The figure shows that the leaders used airtime management opening and closing statements regularly at different time points during the team meeting. Also, opening statements were used more often than closing statements. Means, standard deviations, and intercorrelations of all variables are presented in Table 2.

Figures 4(a-d) visualise the occurrence of leader airtime management opening and closing statements

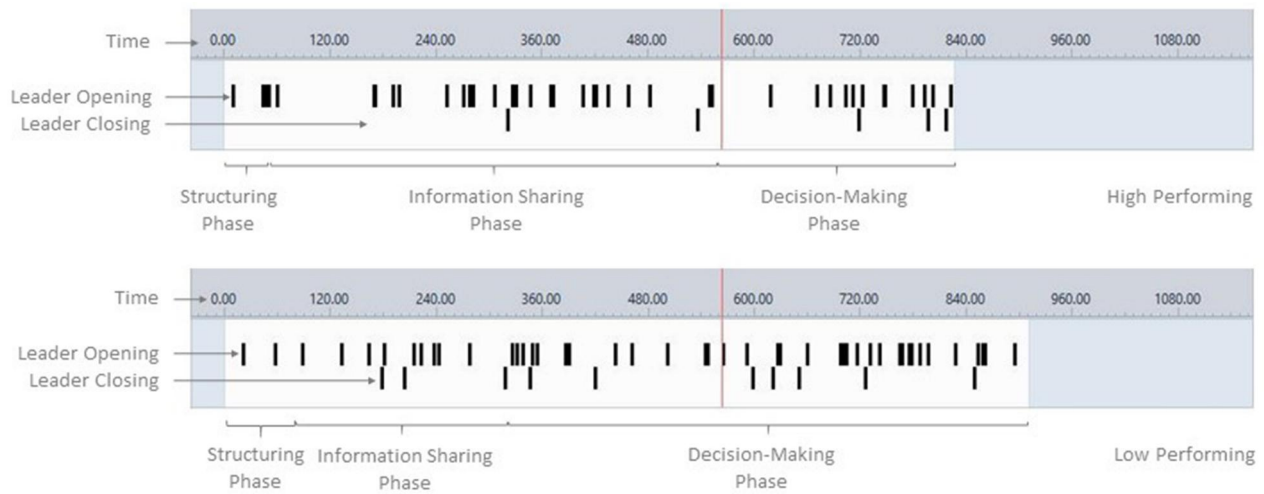


Figure 3. Graphical overview of leader airtime management in two EMCC team meetings. *Note.* The selected teams are high (Team 1) and low performing (Team 2) on both components of team effectiveness.

across the different phases of the team meeting in the entire sample. **Figures 4(a,b)** represent the use of opening and closing statements in teams with low vs. high scores on the TSA component, respectively. **Figure 4(a)** shows that leaders of teams with low effectiveness on the TSA component used more opening statements in the decision-making phases (of both meetings 1 and 2) than leaders of teams that scored high on this team effectiveness component. **Figure 4(b)** shows that the leaders of low and high effective teams both used closing statements more often in the decision-making phases (of meeting 1 and 2). **Figures 4(c,d)** represent the use of opening and closing statements in teams with low vs. high scores on the TDM component, respectively. Similar to the pattern found for team effectiveness in TSA, leaders of teams that scored low on TDM used more opening statements in the decision-making phase (meeting 1) than leaders of teams that score high on TDM (**Figure 4(a)**), whereas closing statements show a similar pattern as closing statements in the TSA component (**Figure 4(b)**). In conclusion, these graphs suggest that differences between high and low-effective

teams across team meeting phases are related to opening statements, and not so much to closing statements, and that this applies to both the TSA and TDM components of team effectiveness. Statistical tests of these patterns are presented below.

Differences in leader airtime management across phases of EMCC team meetings

Our first research question concerned differences in leader airtime management across the three phases of the team meetings. The results of the analysis are presented in **Table 3**. For the entire sample, no significant differences were found in opening statements across the different phases of the meetings [$F(4, 36) = .667, p = .619, \text{partial } \eta^2 = .069$]. However, there was a significant difference in the use of closing statements [$F(4, 36) = 13.78, p < .001, \text{partial } \eta^2 = .605$]. Leaders used significantly more closing statements in the decision-making phases of meeting 1 ($M = 3.63, SD = 1.35; p < .001$) and meeting 2 ($M = 2.80, SD = 1.69; p = .008$)

Table 2. Means, standard deviations, and intercorrelations of the study variables.

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
Leader opening phase 1	11.93	7.68	-											
Leader opening phase 2	11.07	2.68	.074	-										
Leader opening phase 3	10.75	4.01	.417	.318	-									
Leader opening phase 4	9.44	2.91	.360	.237	.343	-								
Leader opening phase 5	11.62	6.51	.723*	.484	.642*	.504	-							
Leader closing phase 1	0.00	0.00	-	-	-	-	-	-						
Leader closing phase 2	1.16	1.15	.040	-.168	.545	.273	.249	-	-					
Leader closing phase 3	3.63	1.35	.189	-.124	.039	.037	-.015	-	.201	-				
Leader closing phase 4	1.01	1.23	.157	-.288	-.189	.064	-.288	-	-.137	.547	-			
Leader closing phase 5	2.80	1.69	.265	-.066	-.033	.095	.392	-	.060	-.230	-.247	-		
TSA	4.87	1.01	.031	-.684*	-.663*	.031	-.292	-	-.044	.196	.340	.065	-	
TDM	5.67	0.79	.014	-.306	-.544	.100	-.204	-	-.163	.121	.586*	-.082	.766*	-

* $p < .05$.

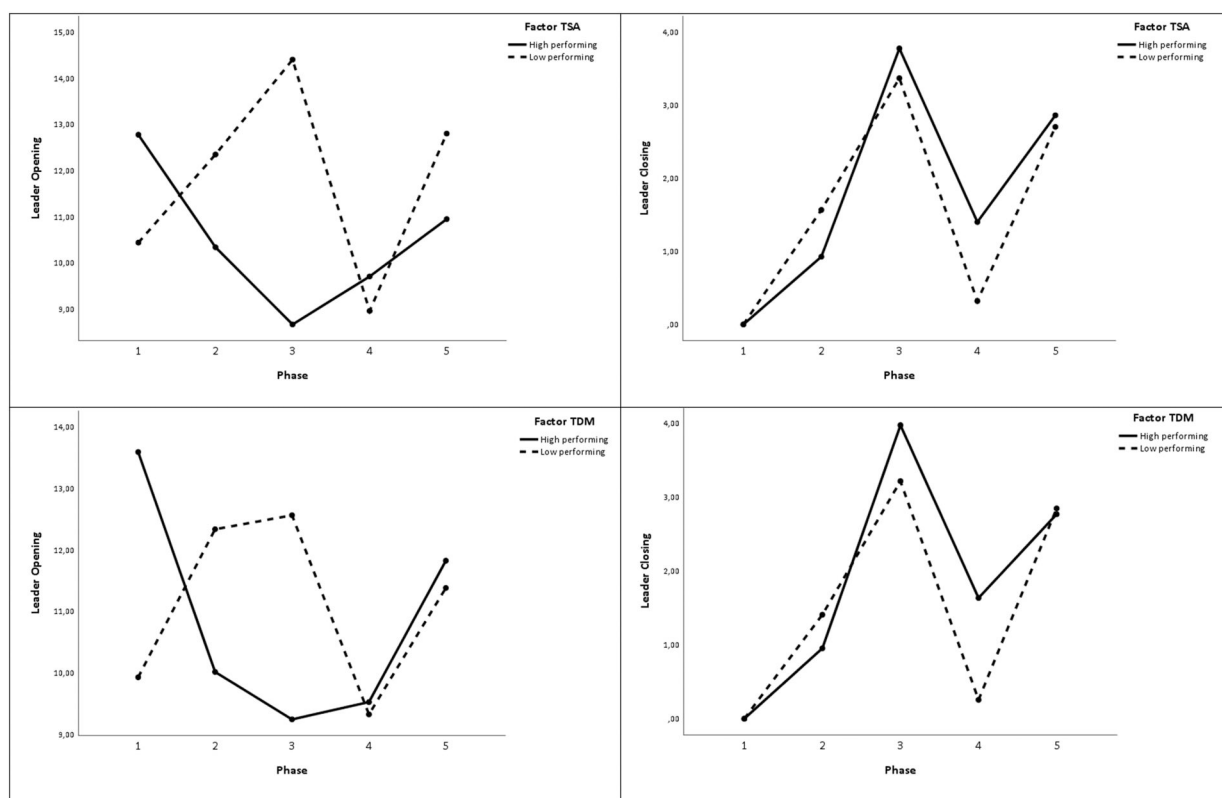


Figure 4. (a–d) Graphical overview of leader airtime management opening and closing in the different team phases between high and low effective teams. (a,b) Concern the team effectiveness component TSA. (c,d) The team effectiveness component TDM. Phase 1 = Initial structuring phase, phase 2 = information sharing phase meeting 1, phase 3 = decision-making phase meeting 1, phase 4 = information sharing phase meeting 2, phase 5 = decision-making phase meeting 2.

Table 3. Comparisons of leader airtime management across the different team phases.

Phase	Structuring		Information sharing 1		Decision-making 1		Information sharing 2		Decision-making 2		F ratio	p
Component	M	SD	M	SD	M	SD	M	SD	M	SD		
Leader opening	11.93 _a	7.68	11.07 _a	2.68	10.75 _a	4.01	9.44 _a	2.91	11.62 _a	6.51	.67	.619
Leader closing	0.00 _a	0.00	1.16 _a	1.15	3.63 _b	1.35	1.01 _a	1.23	2.80 _c	1.69	13.78	.000

^{a,b,c}Means in a row without a common superscript letter differ ($p < 0.05$), as analysed by two-way mixed ANOVA.

than in the (initial) structuring phase ($M = 0.00$, $SD = 0.00$).

Differences in leader airtime management between high and low-effective EMCC teams across phases of EMCC team meetings

Research question two concerned differences in leader airtime management between high and low-effective EMCC teams. Here, too, we took into account the three team meeting phases. The results of the analysis are presented in Table 4. The results for the TSA component of team effectiveness showed a statistically significant interaction effect between team effectiveness and team phase for leader airtime management opening statements [$F(4, 6) = 7.74$, $p = .046$, Pillai's Trace = .759; partial $\eta^2 = .759$]. Leaders of teams with

low effectiveness on the TSA component used more opening statements in the decision-making phase of meeting 1 ($M = 14.40$, $SD = 2.62$) than leaders of teams with high scores on the TSA component of team effectiveness ($M = 8.67$, $SD = 3.07$; $p = .006$). We did not find any differences between these teams in terms of leader airtime management closing statements across the three team meeting phases. Regarding team effectiveness in terms of TDM, no significant interactions were found for leader airtime management opening and closing statements across the three team meeting phases.

Conclusion and discussion

In the current study, we used video observations of EMCC team meetings to investigate leader airtime

Table 4. Comparisons of leader airtime management between teams high and low effective in TSA within the different team phases.

Factor	Component	Structuring phase				Information sharing phase 1				Decision-making phase 1				Information sharing phase 2				Decision-making phase 2				
		M	SD	F	p	M	SD	F	p	M	SD	F	p	M	SD	F	p	M	SD	F	p	
TSA	Leader opening																					
	Low performing	10.44	4.03	.217	.652	12.35	3.51	3.295	.100	14.40	2.62	12.29	.006**	8.96	3.05	.006	.939	12.80	3.76	.561	.471	
	High performing	12.78	9.37			10.34	2.03			8.67	3.07			9.70	3.04			10.95	7.88			

** $p < .01$.

management and its relationship with team effectiveness. We addressed two specific types of leader airtime management (i.e. opening and closing statements) and examined them across three team meeting phases.

First, we looked for differences in leader airtime management across the initial structuring, information-sharing, and decision-making phases of EMCC meetings. Overall, we found that closing statements were more frequently used in the decision-making phase of the team meeting than in any other phase. This makes sense because the decision-making phase is geared specifically towards reaching a conclusion and establishing a course of action, whereas the other phases are focussed more on gathering, sharing, and integrating information (Uitdewilligen and Waller 2018). Hence, team leaders are more likely to engage in closing behaviour to avoid or mute further information elaboration among team members (Barth, Schraagen, and Schmettow 2015). This is in line with prior research about differences in leader behaviour between meeting phases (Sherf et al. 2018).

Second, we addressed differences in leader airtime management across meeting phases in high and low-effective EMCC teams. Distinguishing between EMCC team effectiveness in terms of team situation awareness (TSA) and team decision-making (TDM), we found that leaders of teams that were less effective in establishing TSA used more opening statements in the decision-making phase of the first team meeting than leaders of teams that were more effective in establishing TSA. Prior research has shown that effective teams ask questions and collect information in the information-sharing phase and then make decisions in the decision-making phase based on a well-developed team situation awareness (Uitdewilligen and Waller 2018). We complement these findings with insights regarding the role of the team leader in this process (Salas and Fiore 2004). Whereas opening statements by the team leader are likely to be effective in the information gathering and sharing phases, the use of such statements in the decision-making phase is associated with lower team effectiveness (Hoogeboom and Wilderom 2020).

A possible explanation for the finding that leaders of teams with lower TSA use more opening statements in the decision-making phase of the first team meeting than leaders of teams with higher TSA, is that this type of behaviour is not in line with the main task of the decision-making phase (Marks, Mathieu, and Zaccaro 2001). Asking for new information in such a late stage of the team meeting is likely to slow down the decision-making process. This is likely to be particularly detrimental in high-stake environments characterised by high time pressure. Possibly, this behaviour is triggered by an incomplete or invalid TSA that should have been formed in the information sharing phase, and that the problem at hand is not yet sufficiently clear (Cooke et al. 2000). That this effect was found in the decision making phase of the first but not the second team meeting suggests that the nature of the decision making process in the first and second meeting may be slightly different. Notably, in the second meeting, the understanding of the task is expected to be higher and uncertainty is expected to be lower than in the first meeting, as it is likely that the incident has already evolved and the most urgent actions have already been set out (e.g. Cordery et al. 2010; Malhotra and Majchrzak 2014). Whereas previous research showed differential effects of task-focussed leader behaviours on member voice across different phases and that needs for leader behaviour vary with time (Farh and Chen 2018), we extend this knowledge by adding specific leader airtime management behaviours to the more general task-focussed behaviours already identified, and by shedding light on the effects of these behaviours not on member voice but on team effectiveness.

No effects were found for opening statements on the team effectiveness component TDM, nor were there any effects of closing statements for either team effectiveness component, TSA and TDM. It seems that opening and asking for information do influence team effectiveness in terms of TSA, but that closing statements do not influence the TDM component of team effectiveness. Possibly the team's TSA is more affected by leader airtime management because it is more closely related to information processing in the team

(e.g. Salas and Fiore 2004), which leader airtime management is deemed to have an influence on (Cave et al. 2016).

By looking at the specific and observable behaviour of team leaders in different phases of the EMCC team meeting, this study addresses current methodological gaps in leadership research. Previous research addressing team leadership, such as the meta-analyses by Koeslag-Kreunen et al. (2018) and Burke et al. (2006) looked into broader leadership styles. These are, for instance, task-focussed and person-focussed leadership styles and various substyles, such as empowering or transactional leadership. Although valuable in their own right, these leadership styles have been criticised as vague, overlapping, and overly broad (e.g. Meyer et al. 2016). In extreme teams, the fast changing circumstances and time pressure are important for a team leader when steering the team meeting (Johansson et al. 2018). Therefore, it is relevant to identify more specific and observable micro-level behaviour of team leaders (Meyer et al. 2016) to overcome these criticisms and be able to grasp the specificity of the team leadership context over time. Also, in the context of research on employee voice, Sherf et al. (2018) suggested not to measure proxies of behaviour but to actually look into behaviour of team members as exemplified by the work of Hoogeboom and Wilderom (2020) studying behavioural patterns of team information sharing. Furthermore, Farh and Chen (2018) stress that taking into account phases in team behaviour makes additional insights possible. In the current study, we responded to these gaps by looking at the specific and observable behaviour of team leaders in different phases of the EMCC team meeting.

The current study was conducted within the context of EMCC teams, and this raises the question of generalisation to other team types. These EMCC teams have characteristics that are similar to those of teams working in extreme contexts (Bell et al. 2018), including but not limited to surgical teams (Henrickson Parker et al. 2011), trauma teams (Yun, Faraj, and Sims 2005), and pilots in aviation (Bienefeld and Grote 2014). Extreme teams work under time pressure and in a high stake environment where mistakes have detrimental effects, such as an aeroplane crash or further injury or death of a patient. In sum, the similar characteristics of EMCC teams and other teams working in extreme contexts suggest that our results could also be relevant for these kinds of teams. However, the exact relevance and role of leader airtime management in these teams have to be further validated in future research, as the time frame for making critical

decisions significantly varies between these teams, and their procedures and training (e.g. crew resource management training) may also vary significantly. Furthermore, it is worth exploring how leaders of teams that do not work in extreme contexts, such as R&D teams, project teams, or top management teams, can learn lessons from EMCC teams. Although these teams work under less time pressure and lower stakes and may have a less formal structure, information sharing, and decision-making are also important in these teams, and leader airtime management in terms of opening and closing behaviours may play a significant role in determining their team effectiveness. One example is research on brainstorming, where strict rules apply regarding information exchange and decision-making (e.g. Putman and Paulus 2009). Moreover, the present study focussed on the airtime management behaviours of the formal leader (Koeslag-Kreunen et al. 2021). Yet, team members themselves could also engage in such behaviours and provide airtime management to other team members (i.e. Hoch 2014), especially in teams characterised by distributed or shared leadership. The question remains how airtime management takes place and influences team effectiveness in teams with shared leadership. Although the results of the present study are promising in supporting the existence of leader airtime management in meetings of EMCC teams and its relation with team effectiveness, we suggest future research to cross-validate these findings in a larger sample and also take into account other (extreme) team settings.

Another issue to discuss concerns the assessment of team effectiveness (i.e. TSA and TDM). We relied on ratings by experienced EMCC-team professionals, following prior EMCC research (van der Haar, Segers, and Jehn 2013a). Although methodologically stronger than relying on trained non-experts, these assessors provided an overall rating of the team effectiveness across the phases after the exercise, which may induce bias, such as outcome bias. Future research may look into developing performance ratings that can be used to assess -separately- the effectiveness of the different team meeting phases. This would also enable a more time-specific analysis of the relation of team effectiveness and leadership behaviours than currently provided. Another limitation regarding the measurement of team effectiveness, and especially the TSA component, is that due to contextual constraints, the observers in the study focussed on the interactive processes through which TSA gets built and on evidence of cognitive consensus about the situation at hand by observing verbal team interaction during EMCC team

meetings. Although it is not uncommon to assess team phenomena in terms of processes rather than outcomes (see e.g. Beal et al. 2003) and for EMCC teams, these components of team effectiveness reflect the result/outcome of the meeting, or in other words how successful it was, it would be informative to triangulate the measures used in this study with methods tapping into the cognitive underpinnings of TSA and the consequences of the decisions made. Furthermore, we did not take into account which specific team member the leader addresses. Future research should take into account which team member a leader addresses and the possible considerations of team leaders to address certain team members in certain situations and thus eventually decide not to strive for equal participation in certain situations. This would provide the opportunity to investigate whether an equal distribution of airtime (which is often shown to be effective, e.g. Sherf et al. 2018) always applies, especially with regard to teams experiencing high time pressure and unequal distribution of information. Furthermore, while we focus on the role of the team leader, the interaction of leader airtime management and behaviours of leaders to stimulate the participation of team members by creating the right conditions and a psychological safe team climate (e.g. Edmondson, Roberto, and Watkins 2003) is promising for future research. These interpersonal conditions have been shown to be highly influential for information-processing in other team types (Van den Bossche et al. 2006). In EMCC teams, the initial structuring phase is expected to be influential in creating the right conditions for effective leader airtime management (Hoven et al. 2018). Finally, while our study focussed on verbal communication, non-verbal communication is interesting to take into account for future researchers when studying team and leader interaction (e.g. Kirkpatrick and Locke 1996).

This study contributes to the theory about airtime in teams by looking into airtime management by team leaders in an extreme context and into differences in leader airtime management between high and low-effective EMCC teams. Thereby we extend previous research by specifying leader airtime management behaviours and by showing how adapting these behaviours to team meeting phases is crucial for team effectiveness. Practitioners should be made aware of the notion and consequences of leader airtime management. Our study shows that leader airtime management is relevant for EMCC teams. As we show that the effect of leader airtime management depends on the team meeting phase, leaders are advised to adjust

their airtime management over time. The specific and observable statements can be used to give leaders insights into the effects of their airtime management across different team meeting phases. In addition, the role of leaders in stimulating team interaction and the dilemma of deciding when to stimulate team interaction can be addressed. The insights of the study can be used by trainers and educators for observations of these teams, for training purposes, and during incidents. Thereby, specific interventions in airtime management can be designed and built-in into exercises, e.g. as learning goals. Leaders of EMCC teams, in general, should be conscious of the effect of their airtime management. This means they should be aware of the team meeting phase and the implications for their own behaviour and the effects of this behaviour on the team meeting. Moreover, this study also underscores the importance of the clear meeting structure. Training of team leaders to structure these meetings and train teams in effective behaviours for the different phases will increase team effectiveness (Uitdewilligen and Waller 2018). In sum, leader airtime management does matter for EMCC teams if they aim to develop team situation awareness and come to decisions on what has to be done by which action team on the scene in order to manage the crisis at hand. Moreover, some airtime management behaviours are more effective than others during the different phases of the team meetings. These findings are relevant input for the training and coaching of crisis teams and their leaders.

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Data availability statement

The data that support the findings of this study are available from the corresponding author, MH, upon reasonable request.

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Appendix 1. Items for both components of the EMCC team effectiveness scale by van der Haar et al. (2013a)

Component	Item
TSA (image)	<p>The team managed to create a shared image of the situation in a short time.</p> <p>The image reflected the situation and its dilemma's.</p> <p>The image of the situation was realistic.</p> <p>The image of the situation was unambiguous.</p> <p>The decisions, advices and assignments of the units are based on the actual own image and the overall image of the situation.</p>
TDM (decision)	<p>The decisions are translated into an assignment for a specific professional or a team.</p> <p>The assignments are given to the relevant team or person.</p> <p>The information in the plot of the team at the end of the meeting was relevant: the development and effects of the incident; risks for the rescue services and others on scene; the approach; the people and material needed.</p>