THE HEAD AND THE HEART IN CRISIS: THE TEMPORAL DYNAMICS OF THE INTERPLAY BETWEEN TEAM COGNITIVE PROCESSES AND COLLECTIVE EMOTIONS DURING CRISIS EVENTS

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ABSTRACT

Organizations commonly use teams to rapidly and appropriately respond to crises. These teams must face a multidimensional challenge because crises not only present sets of ill-defined, complex problems, but also exert high emotional demands on the team. As a result, effective team functioning in crisis events involves handling each dimension of the crisis through distinct, yet concurrent, types of responses, namely team cognitive processes and collective emotions. Research on groups also suggests that cognitive processes and collective emotions are dynamically intertwined and can influence one another. Studies of crisis events to date, however, have largely examined cognition and emotion in isolation from one another. As a result, we know little about how team cognitive processes and collective emotions go hand in hand over the course a crisis event to shape team performance. This study seeks to address this research gap. Focusing on 20 teams of MBA students dealing with a simulated organizational crisis, I used a longitudinal research design and behavioural observation methods to examine the dynamics of the interplay between team cognitive processes and collective emotions at two different temporal scales.

At the micro-temporal scale, I examined the co-occurrence (also called coupling) of team cognitive processes and collective emotions to determine which observed couplings were statistically meaningful in higher- versus lower-performing teams facing a crisis event. Lag sequential analyses revealed that compared with lower-performing teams, higher-performing teams were less likely to engage in explicit situation processing in an emotionally-midaroused team atmosphere. Higher-performing teams were also less likely than lower-performing teams to exhibit implicit situation processing in an emotionally-neutral team atmosphere. Lower-performing teams, on the other hand, had more tendency to engage in implicit situation processing in an emotionally-homogeneous team atmosphere. Finally, lower-performing teams were more likely than higher-performing teams to exhibit implicit action processing in an emotionally-midaroused team atmosphere.

At the macro-temporal scale, I tracked the evolution of couplings over the course of the crisis event by means of an exploratory visualization tool called GridWare. GridWare enabled me to characterize and compare the structure and the content of the coupling trajectory of higher- and lower-performing teams. The coupling trajectory of higher performers was not found to be any more or less variable than that of lower performers. However, according to my analyses, the coupling trajectory of higher-performing teams was significantly more likely to become absorbed in a single, strong, attracting coupling, as opposed to the coupling trajectory of lower-performing teams which tended to get drawn toward multiple, weaker, attracting couplings. The single, strong attracting coupling that pulled the trajectory of higher-performing teams was the coupling of explicit action processing and midaroused-neutral collective emotions. This indicates that higher performers had more tendency to keep returning to discussing and updating their decisions/actions in a midaroused-neutral emotional atmosphere. Theoretical contributions of this study and implications of these findings for practice and for future research are discussed.

Dedicated to the Imam of Our Time, the Awaited Savior (AJ)

May Allah hasten his reappearance.

O Allah renew for him my covenant, pledge and allegiance on my neck in the morning of this day of mine and whatever days (of my life) I live.

O Allah include me as one of his supporters, aides, protectors, those who hasten to fulfill his commands, those who obey his orders, those who support him, those who compete with each other to implement his will, and those who seek martyrdom before him.

This pact is renewed and sealed in Ramadan 1439.

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CHAPTER ONE: INTRODUCTION

Crises are becoming increasingly frequent in a wide array of businesses and organizations (James, Wooten, & Dushek, 2011; Kalavar & Mysore, 2017; Waller & Roberts, 2003), ranging from life-threatening events such as airplane malfunctions and nuclear plant near-meltdowns to major organizational crises such as large-scale product recalls, labour strikes, and financial scandals. A crisis event –or, more simply called a crisis– is defined as a certain form of extreme event that has four main characteristics: (1) the event has a low probability of occurring but, nevertheless, poses a huge threat to the viability of the organization, (2) the event takes place unexpectedly, (3) there is little or no response time available, and (4) there is ambiguity in terms of the cause, exact effect, or means of resolution of the threat (Hannah, Uhl-Bien, Avolio, & Cavarretta, 2009; Hermann, 1963; Pearson & Clair, 1998). Although crises may vary in their degree of extremity (Hannah et al., 2009), two conclusions about every crisis event are beyond question: 1) it always poses a major threat to system survival and are often hugely consequential to organizational members and communities in terms of loss and damage (e.g., psychological, environmental, financial, material, organizational reputation, human life and livelihood, etc.), and 2) it typically requires team[1] effort to quickly fashion an appropriate response (King, 2002; Waller & Kaplan, 2018).

Accordingly, researchers in fields such as organizational behaviour, communication studies, and psychology have taken an interest in the study of teams facing crises in order to understand how those teams effectively respond to crisis events. One line of research that has

[1] Throughout this manuscript, and reflecting much of the existing literature, I use the terms “group” and “team” interchangeably to refer to “interdependent collections of individuals who share responsibility for specific outcomes for their organizations” (Sundstrom, DeMeuse, & Futrell, l990, p. 120).

recently received increasing attention among scholars is focused on the behavioural aspects of team functioning during a crisis. Work in this area suggests that the effectiveness of a team's response to a crisis is largely dependent upon members' behavioural actions and interactions throughout the crisis – particularly from crisis inception until the acute stage[2] of the crisis passes. In other words, investigating real-time behaviours and interactions of team members during a crisis event can provide new insights into the factors distinguishing higher-performing teams from lower-performing ones in the time of crisis (Staw, Sandelands, & Dutton, 1981; Kolbe et al., 2014; Waller, 1999).

A great deal of work on team functioning during a crisis has focused on the role of team information-processing behaviours, also known as team cognitive processes. Team cognitive processes are members' interdependent acts of accumulation, exchange, evaluation and use of information for generating decisions and actions (Fiore & Salas, 2004; Gibson, 2001; Gibson & Earley, 2007). Given that crises are, by definition, associated with ambiguity and ill-defined problems (i.e., the fourth characteristic of a crisis event, as defined earlier), teams need to employ cognitive processes to make sense of the novel situation before generating effective responses. Empirical research has established a strong link between team performance during a crisis and different forms of cognitive processes such as explicit cognitive processes which involve overt communications (e.g., speaking up; see Edmondson, 2003), implicit cognitive processes that are employed without the need for overt communications (e.g., team member monitoring; see Marks & Panzer, 2004), cognitive processes focused on understanding the

[2] An organizational crisis moves from the pre-crisis to the acute stage when it becomes visible outside the organization. At this point in time, the crisis requires urgent attention and immediate action. When the acute stage of the crisis occurs, the crisis management team has no choice but to address the crisis. It is too late to take preventative actions and any action taken now is more associated with damage control (Fink, 1986; Kash & Darling, 1998).

situation (e.g., information collection and transfer; see Waller, 1999), and those concerning decisions and actions (e.g., task distribution; see Schmutz, Hoffmann, Heimberg, & Manser, 2015). Overall, this stream of work suggests that there are important differences in team cognitive processes exhibited by higher- versus lower-performing teams in the time of crisis.

A second, considerably smaller set of studies on team functioning during a crisis has examined the effect of emotions that emerge in the time of crisis. Emotions are a collective property of work groups (Bartel & Saavedra, 2000; Rhee, 2007); They are embedded in team members' interactions and reactions to events (Knight, 2009; Weiss & Cropanzano, 1996), manifest themselves behaviourally and spread among team members to constitute team-level collective emotion[3] (Bartel & Saavedra, 2000; Kelly & Barsade, 2001). Acknowledging the significance of the emotional aspect of crises (James et al., 2011; Kaplan, LaPort, & Waller, 2013; Pearson & Clair, 1998; Sayegh, Anthony, & Perrewe, 2004), studies have shown how team performance in crisis events varies as a function of positive or negative emotions emerged within the team (e.g., Hunziker et al., 2011; Kaplan et al., 2013). The arousal dimension of emotion has also been found to affect the capacity of the team for rapid and effective response (e.g., Gump & Kulik, 1997; Quinn & Dutton, 2005). Altogether, this body of research suggests that team-level collective emotions are an important factor in distinguishing higher- from lower-performing teams during crisis events.

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[3] I use the terms "affect" and "emotion" interchangeably in this work, considering them as semantically similar terms that encompass the general phenomenon of subjective feelings (see also Barsade, 2002; Barsade & Gibson, 1998).

Towards an Integration

As stated above, there are two main streams of research on team functioning during a crisis: one stream of research highlights team cognitive processes as a significant predictor of team performance during a crisis, while the other suggests that collective emotions have a highly consequential impact on team performance in the time of crisis. Largely missing from work in this area is integration between the two streams of research. For one thing, research on teams facing crisis events has rarely included both cognitive processes and collective emotions as predictors of team effectiveness during the crisis. The relationship between the two constructs has received even less attention by researchers, which has resulted in a dearth of cumulative knowledge regarding the effect of the interplay between team cognitive processes and collective emotions during a crisis (Barsade & Knight, 2015). Even those few research studies that have included both a cognitive process construct and an emotional construct in their investigations of teams facing crises offer inconsistent suggestions regarding the nature of the relationship between the two constructs (e.g., Gladstein & Reilly, 1985; Knight & Eisenkraft, 2015; Maitlis & Sonenshein, 2010). These inconsistencies might be due to the fact that researchers have tended to discount the dynamic character of cognitive processes and collective emotions (Collins, Lawrence, Troth, & Jordan, 2013; Kelly & Barsade, 2001; Marks, Mathieu, & Zaccaro, 2001; McGrath, 1984) and taken a static approach when capturing these constructs and, by extension, examining their interplay. In order to address this gap, a longitudinal research design is required in which each type of construct is measured at multiple points in time and the possibility of mutual influence can be properly examined. By simultaneously capturing the evolution of team cognitive processes and of collective emotions during a crisis event, researchers can capture the dynamics of the interplay between the two constructs over the course of the crisis. It is to this end that my study was aimed. Seeking to advance our understanding of how teams respond simultaneously to the cognitive and emotional aspects of a crisis over time, I specifically focused on the co-occurrences (also called couplings) of team cognitive processes and collective emotions and analyzed the dynamics of their couplings at two different temporal scales: micro-temporal and macro-temporal. The following exploratory research questions guided this endeavour:

1) How do micro-temporal couplings of team cognitive processes and collective emotions displayed during the crisis distinguish higher-performing from lower-performing teams?

2) How do higher-performing teams and lower-performing teams differ in their trajectory of the coupling between team cognitive processes and collective emotions over the timespan of a crisis event?

Boundary Conditions

There are three important boundary conditions for the present study. First, the proposed study considers organizational crises as a proper setting for investigating its research questions, because crises tend to trigger a variety of cognitive processes (Kolbe et al., 2013; 2014) and make more visible a wide spectrum of emotional reactions among team members (e.g., Barnett & Pratt, 2000; James et al., 2011). This allows for capturing a potentially higher degree of variation in the interplay between team cognitive processes and collective emotions over time. My study does not intend to extend theory and research on the conceptualization and delineation of crisis events. Exploring the causes and/or effects of variability in the four main characteristics of a crisis (i.e., consequentiality, unpredictability, time pressure, and uncertainty) is also outside the scope of this research. Rather, the present study focuses on one type of crisis event in which the dynamics of the interplay between team cognitive processes and collective emotions can be "transparently observable" (Pettigrew, 1990). In order to capture the main constructs of this study (i.e., team cognitive processes, collective emotions, and their coupling) in the context of crises, I particularly drew on the literature on teams facing crisis events and also tapped into insights from the larger literature on groups. In order to assess team performance during a crisis, I mostly consulted literature on crisis management.

Second, this research focuses on a specific type of crisis management teams, called dual-purpose action teams (Waller & Uitdewilligen, 2013). Dual-purpose action teams spend the majority of their time together completing routine tasks; however, upon recognition of a crisis event, the team is expected to immediately abandon routine tasks and effectively respond to the crisis. Examples of these teams include aviation flight crews, nuclear plant control room crews, sports teams, and theatre stage management teams. In the context of corporate crises, crisis management teams can also be characterized as dual-purpose action teams. Typically composed of top executives and individuals in senior management positions (Sayegh et al., 2004; Waller, Lei, & Pratten, 2014), members of crisis management teams have a history of working together prior to the crisis as they would regularly attend top management meetings to make joint decisions on how to improve their organization's performance. When faced with a crisis event, these top executives and senior managers quickly form into a crisis management team tasked with minimizing the immediate and long-term impacts of the crisis on the organization and its stakeholders. In contrast to dual-purpose action teams, single-purpose action teams are specifically trained to work together under tremendous time pressure to address potentially catastrophic extreme events (King, 2002; Waller & Uitdewilligen, 2013). Medical emergency teams, firefighting teams, and search-and-rescue teams are examples of this type of teams. Given the majority of teamwork in single-purpose action teams is focused on waiting for or responding to a crisis event, these teams may be more equipped than dual-purpose action teams to deal with some of the challenging aspects of the crisis (e.g., time pressure, uncertainty, and consequentiality). As a result, the cognitive and emotional dynamics of a single-purpose action team may look quite different from those of a dual-purpose action team.

The third boundary condition of this study concerns the time frame within which crisis management teams respond to a crisis event. Similar to past research on team functioning in the time of crisis (e.g., Kaplan et al., 2013; Kolbe et al., 2014; Stachowski, Kaplan, & Waller, 2009), my study investigates the behavioural actions and interactions of crisis management teams during the initial, and often most distressing, time of a crisis. More specifically, the current research aims to capture the dynamics of the interplay between team cognitive processes and collective emotions from crisis inception until the acute stage of the crisis passes, which lasts only up to a few hours for the majority of dual-purpose action teams. Therefore, the findings of this work seem most relevant to those crisis management teams that are dealing with shorter-term crises or with the initial period of prolonged crises (Coultas, Driskell, Burke, & Salas, 2014; Yu, Sengul, & Lester, 2008).

In the following chapter, I provide an overview of key insights from the literature on team functioning during a crisis, particularly pertaining to team cognitive processes, collective emotions and their interplay. I then fully describe the research gap that the current study intends to address through capturing the dynamics of the interplay between cognitive processes and collective emotions in teams dealing with a crisis. In Chapter 3, I explain my research design and discuss the method that I employed to collect, code and analyze data in order to answer my research questions. Chapter 4 summarizes the results of my analyses. In Chapter 5, I discuss the results of the study in detail. I conclude by outlining theoretical and practical implications, reflecting on the limitations of my work and exploring areas for future research.

CHAPTER TWO: LITERATURE REVIEW

Team Cognitive Processes During Crisis Events

A large body of research on teams facing crisis events has taken a cognitive approach to assessing team functioning during a crisis. This approach is based on viewing teams as collective information-processing units (Hinsz, Tindale, & Vollrath, 1997) and, thus, depicting team cognitive processes as central drivers of team performance during a crisis. Crises are, as defined earlier, a major organizational threat that is ambiguous in terms of the cause, exact effect, or means of resolution (Pearson & Clair, 1998). They have been rightly called "wicked problems" (Stubbart, 1987), because they present a high level of uncertainty and cognitive complexity (Hannah et al., 2009). As a result, teams facing a crisis event need to engage in systematic and deliberate processing of information (i.e., team cognitive processes) to be able to make sense of these ill-defined situations and generate effective responses (Waller & Uitdewilligen, 2008; Weick & Sutcliffe, 2001). Empirical evidence has supported this assertion by establishing a variety of team cognitive processes as significant predictors of team performance in high-stress and crisis-like events (Salas, Rosen, Burke, Nicholson, & Howse, 2007; Uitdewilligen, 2011).

Synthesizing the broad conceptualization of team processes (Marks et al., 2001) with narrower descriptions of team cognitive processes that currently exist in groups research literature (Fiore & Salas, 2004; Gibson, 2001; Hinsz et al., 1997), I use team cognitive processes as an umbrella term that encompasses specific forms of information processing behaviours[4]

[4] A behaviour refers to an overt action or reaction, as opposed to one's inner thoughts and feelings. Behaviours can be readily observed and takes the form of verbal utterances, written statements or nonverbal displays such as facial expressions, vocalizations, postures, and bodily movements (Breckler, 1984; Kozlowski, 2015). Behaviours are at the centre of team processes, which is why they are sometimes called "team behavioural processes" (DeChurch & Mesmer-Magnus, 2010). Team process involves members' interacting with other members and with their task environment (Marks et al. 2001), and team members often rely on one or more forms of behaviour for expressing these interactions (Kozlowski, 2015).

exhibited by team members. More specifically, I define team cognitive processes as members' interdependent acts of gathering, exchanging, interpreting, and using information directed toward generating decisions and actions in order to achieve collective goals (Fiore & Salas, 2004; Gibson, 2001; Gibson & Earley, 2007). Research suggests that most teams enact all these cognitive processes to some degree during their lifetime. However, time spent on each of these processes may vary across teams, and teams move back and forth between cognitive processes depending on the task, the dynamics of the team, and the context in which they are embedded (Corner, Kinicki, & Keats, 1994; Gibson, 2001). As a team-level construct[5], team cognitive processes emerge among the minds of team members and can therefore be located in members' verbal and nonverbal behaviours and interactions within the team space (Cooke, Gorman, & Kiekel, 2008; Kennedy & McComb, 2010). In other words, team cognitive processes take an ostensive form (Waller, Okhuysen, & Saghafian, 2016) – that is, they can be recognized by team members as well as outside observers (Marks et al., 2001; Salas et al., 2007).

Team cognitive processes are generally considered a key factor that distinguishes higher-performing teams from lower-performing ones in the time of crisis. However, research has identified some cognitive processes to be more effective than others in crisis events. These cognitive processes include a wide spectrum of behavioural processes, ranging from information

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[5] There are two separate, but interrelated, theoretical perspectives on team cognition (Fiore & Salas, 2004). One perspective conceptualizes the team cognition construct as any behavioural process that involves processing of information (see Cooke, Gorman, Myers, and Duran (2013) as well as Gibson (2001) for a review). The other perspective characterizes team cognition as a collective knowledge representation emerging as a result of those team processes (see DeChurch and Mesmer-Magnus (2010) as well as Uitdewilligen, Waller, and Zijlstra (2010) for a review). From the former perspective, team cognitive processes (e.g., gathering, exchanging, interpreting, and using information) can represent team cognition, whereas the latter perspective uses emergent cognitive states (e.g., shared mental models, transactive memory, team situation awareness) to describe team cognition. Given I am interested in the behavioural aspects of team functioning during a crisis, I approach the team cognition construct from the former perspective.

request and planning to team monitoring and talking to the room. Such diversity, if left unorganized, may present a challenge to the comparison and integration of research findings regarding the effect of team cognitive processes on the effectiveness of teams facing a crisis. Kolbe and her colleagues (Kolbe et al., 2009, 2011, 2013; Manser et al., 2008) developed a useful framework to organize cognitive processes that are most relevant to team functioning during a crisis[6]. This framework has been continually refined and improved via a series of theoretical and empirical research studies, with a particular focus on action teams in high-risk healthcare settings. The most refined version of this framework (Kolbe et al., 2013) categorizes cognitive processes along two distinct dimensions: 1) the mode of information processing, and 2) the type of information being processed.

The first dimension of Kolbe and colleagues' (2013) framework captures whether information processing is enacted in an explicit or implicit mode. A certain cognitive process is characterized as *explicit* when it involves team members overtly exchanging information, interpretation and decision/action (Entin & Serfaty, 1999; Rico, Sánchez-Manzanares, Gil, & Gibson, 2008). Explicit cognitive processes are typically expressed when team members are engaged in reciprocal interactions and, therefore, include requesting information from another team member, responding to another member's request for information, reacting to the comments or actions of a certain team member, and suggesting a new course of action with an expectation for an overt reaction from other team members (Kolbe et al., 2013). Examples of

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[6] Although Kolbe and her colleagues call this classification a "framework of coordination behaviour", their framework captures team cognitive processes more than coordination; All 12 behaviours in the framework fit the description of a team cognitive process (see the previous page for the definition). Moreover, the authors did not present a clear definition for coordination. Rather, they seem to use the term "coordination" loosely to represent team processes that are most relevant to crisis-like events.

explicit cognitive processes are task prioritization (e.g., Waller 1999; Waller, Gupta, & Giambatista, 2004), explicit reasoning (e.g., Tschan et al., 2009), and speaking up (e.g., Edmondson, 2003). Explicit information processing facilitates elaborate collective sensemaking and back-and-forth discussion about solutions required when dealing with novelty and uncertainty associated with crisis events (Rico et al., 2008; Tschan, Semmer, Hunziker, & Marsch, 2011). When team members are engaged in explicit cognitive processes, the team is more likely to avoid groupthink (Janis, 1982, 1989) and, thus, negate some of the threat-rigidity effects (Staw et al., 1981).

An *implicit* cognitive process, in contrast, is employed without the need for overt reciprocal interactions between team members (Entin & Serfaty, 1999; Wittenbaum, Stasser, & Merry, 1996). Team members use implicit mode of cognitive processes based on their tacit anticipation of task demands or their teammates' actions and needs (Rico et al., 2008). Such anticipation enables them to initiate one-way communication in which they either offer information to other team members without request or gather information without any explicit instruction (Kolbe et al., 2013). Examples of implicit cognitive processes include team member monitoring (e.g., Kolbe et al., 2014; Marks & Panzer, 2004), talking to the room (e.g., Waller & Uitdewilligen, 2008), and providing information without request (e.g., Schmutz et al., 2015). Implicit cognitive processes may be particularly effective under high time pressure (e.g., during a crisis) when teams do not have the luxury of prolonged conversation and, yet, there is an urgent need for the synchronization of members' activities (Smith-Jentsch, Kraiger, Cannon-Bowers, & Salas, 2009).

The second dimension of Kolbe and colleagues' (2013) framework revolves around the type of information being processed. In line with past research on team interactions and team decision development (Gibson, 2001; Poole & Roth, 1989; Sohrab, 2014), work on team functioning during a crisis distinguishes between team cognitive processes focused on understanding the situation and those concerning decisions and actions (Burtscher, Wacker, Grote, & Manser, 2010; Schmutz et al., 2015). *Situation-focused* cognitive processes refer to members' acts of gathering, exchanging, or interpreting facts and ideas related to various aspects of the situation at hand (e.g., problem features, environmental conditions, resources, timeline, etc.). Examples of situation-focused cognitive processes are information collection and transfer (Waller, 1999), systems monitoring (e.g., Burtscher, Kolbe, Wacker, & Manser, 2011) and information allocation (e.g., Ellis, 2006; Ellis & Pearsall, 2011). These processes enable teams to recognize potential problems in the environment and identify the underlying cause of an ongoing problem (Burke, Stagl, Salas, Pierce, & Kendall, 2006; Poole & Roth, 1989; Waller, 1999). In other words, they facilitate sensemaking at the team level (Maitlis & Sonenshein, 2010) and help create and update the team's shared understanding of the situation and the problem (Kolbe et al. 2013; Salas et al., 2007; Waller & Uitdewilligen, 2008).

Action-focused cognitive processes, on the other hand, involve gathering, exchanging, or applying facts and ideas regarding the team's decisions or members' actions. When teams enact action-focused processes during a crisis, they draw on their understanding of the situation to (re)formulate decisions on joint actions or coordinate individual actions among themselves (Gibson, 2001; Kolbe et al., 2013; Uitdewilligen, 2011). As a result, action-focused processes include sharing ideas on a decision, assigning tasks among team members, commenting on one's own actions, monitoring the actions of other team members, and providing suggestive or corrective feedback on the actions of other team members (Kolbe et al. 2013; Marks et al., 2001). Examples of action-focused cognitive processes include task distribution (e.g., Schmutz et al. 2015; Waller, 1999; Waller et al., 2004), planning (e.g., Manser, Harrison, Gaba, & Howard, 2009), and team member monitoring (e.g., Kolbe et al., 2014; Marks & Panzer, 2004). The importance of action-focused processes increases as the crisis unfolds and the team faces growing time pressure to shift from environment-probing processes to activities leading directly to crisis resolution (Schraagen, Veld, & De Koning, 2010; Salas, Sims, & Burke, 2005).

Crossing implicit/explicit cognitive processes with situation-focused/action-focused cognitive processes yields four meaningful categories of team cognitive processes in Kolbe and colleagues' (2013) framework (see Table 1). This organizing framework provides an apparatus for differentiating between various cognitive processes based on their mode of information processing and the type of information being processed. Drawing on Kolbe and colleagues as well as other work reviewed above, I define and refer to these four categories as follows. *Explicit situation processing* includes overt, reciprocal interactions between team members aimed at enhancing their shared understanding of the situation and the problem. *Implicit situation processing* captures members' unsolicited communication of or unrequested collection of information regarding the situation and the problem, driven by their anticipation of other team members' needs and task demands. *Explicit action processing* includes overt, reciprocal interactions about the team's decisions or members' actions that aims at generating the best solution to the problem and facilitating action coordination. *Implicit action processing* encompasses members' unsolicited communication of or unrequested collection of information about decisions/actions, driven by their anticipation of other members' needs/actions and task demands, in order to facilitate action coordination in the team[7]. Each of these four categories of cognitive processes captures a distinct aspect of a team's cognitive response to a crisis. Does this imply that each category needs to go hand in hand with a different collective emotion to become more (or less) effective in teams facing a crisis event? My research seeks to answer this question.

[7] Implicit action processing closely resembles the concept of "tacit coordination" or "implicit coordination" previously introduced to groups literature (Entin & Serfaty, 1999; Rico et al., 2008; Wittenbaum et al., 1996).

Table 1. Categories of team cognitive process that are most relevant to team functioning during a crisis

	Situation-focused	Action-focused
Explicit	***Explicit situation processing*** Examples: • Information collection (Waller et al., 2004) • Retrieval coordination (Ellis, 2006) • Explicit reasoning (Tschan et al., 2009) • Use of knowledge tools (Uitdewilligen, 2011)	***Explicit action processing*** Examples: • Task prioritization (Waller, 1999; Waller et al., 2004) • Task distribution (Schmutz et al. 2015; Waller, 1999; Waller et al., 2004) • Planning (Manser et al., 2008, 2009) • Structuring behaviours (Uitdewilligen, 2011) • Instruction (Kolbe et al., 2014) • Speaking up (Edmondson, 2003)
Implicit	***Implicit situation processing*** Examples: • Provide information without request (Schmutz et al. 2015) • Information allocation (Ellis, 2006; Ellis & Pearsall, 2011) • Talking to the room (situation-focused) (Kolbe et al., 2014; Tschan et al., 2009; Waller & Uitdewilligen, 2008) • Systems monitoring (Burtscher et al., 2011) • Gather information (Kolbe et al., 2014)	***Implicit action processing*** Examples: • Team member monitoring (Burtscher et al. 2011; Marks & Panzer, 2004) • Talking to the room (action-focused) (Kolbe et al., 2014) • Provide assistance (Kolbe et al., 2014)

Collective Emotions During Crisis Events

Handling a crisis is an emotional time for teams. The defining characteristics of crises (i.e., consequentiality, unpredictability, time pressure, and uncertainty) tend to elicit particular emotional experiences in team members including surprise, despair, guilt, stress, fear, or anger. Effective handling of the crisis also demands that team members display certain emotional reactions including attentiveness, calmness, or sometimes excitement (Barnett & Pratt, 2000; James et al., 2011; Pearson & Clair, 1998; Sayegh et al., 2004). The combination of these emotions within the team contributes to the development of team-level collective emotion (Barsade & Gibson, 1998). Collective emotions can enhance or hamper the capacity of the team for rapid and effective response. For example, collective emotions can broaden or narrow the team's breadth of attention and actions, increase or decrease social integration and affiliation, and facilitate or impede the effort devoted to coordinated activities (e.g., Fredrickson, Tugade, Waugh, & Larkin, 2003; Gump & Kulik, 1997; Knight & Eisenkraft, 2015; Quinn & Dutton, 2005). Consequently, collective emotions can play a large part in ultimate team effectiveness during a crisis. Although there has been limited empirical work on collective emotions during a crisis event, several studies have demonstrated the significant effect of collective emotions that emerge in the time of crisis on team performance (e.g., Drach-Zahavy & Freund, 2007; Hunziker et al., 2011, 2012; Kaplan et al., 2013).

Drawing on the work by Barsade and her colleagues (Barsade & Gibson, 1998; Barsade & Knight, 2015; Kelly & Barsade, 2001), I define collective emotion as a team-level affective state arising from a combination of members' mutual exposure to the group's context (e.g., affective norms, environmental events) and the affective experiences of team members transferred within the team through one or more affective sharing processes (e.g., contagion, emotional comparison). Collective emotion manifests itself behaviourally through verbal communications as well as nonverbal behaviours such as facial expressions, vocalizations, postures, and movements. It can be reliably recognized by group members and outside observers (Barsade, 2002; Barsade & Gibson, 2007; Bartel & Saavedra, 2000; Kelly & Barsade, 2001; Totterdell, Kellet, Teuchmann, & Briner, 1998). As a result, and much like team cognitive processes, collective emotions can be characterized as an ostensive emergent phenomenon (Waller et al., 2016).

Scholars have long recognized emotion as a multidimensional construct. Common among most prominent models of emotion are two basic, orthogonal, dimensions (Larsen & Diener, 1992; Russell, 1978; 1980). One dimension captures hedonic valence or pleasantness, ranging from positive (pleasant) to neutral to negative (unpleasant). The second dimension represents arousal or intensity, ranging from aroused to moderately aroused to unaroused. These two dimensions reflect a composite of hedonic valence and arousal for each specific emotion. For example, happiness is a positive feeling state experienced with a medium level of arousal, surprise is characterized by neutral valence and high arousal, and boredom is a negative low-arousal emotion. Together, these two dimensions of emotion create the circumplex model of emotion (see Figure 1). This model has received strong empirical support at both physiological and psychological levels (Larsen & Diener, 1992; Posner, Russell, & Peterson, 2005; Russell, 1980; Van Katwyk, Fox, Spector, & Kelloway, 2000; Weiss & Cropanzano, 1996). Moreover, compared with other existing emotion models such as the Positive Activation-Negative Activation model (Watson & Tellegen, 1985; Watson, Wiese, Vaidya, & Tellegen, 1999) and the basic emotion model (Ekman, 1992), the two-dimensional circumplex model of emotion helps capture a much broader range of emotions, including the less studied ones. Finally, the circumplex model has been found to be more consistent with recent findings from behavioural, cognitive neuroscience, and developmental studies of emotion, compared with the basic emotion model (Posner et al., 2005). Although originally developed for individual-level emotion, the circumplex model of emotion has also been adopted as an organizing framework for classifying team-level collective emotions and received empirical support (e.g., Barsade 2002; Bartel & Saavedra, 2000; Lehmann-Willenbrock, Meyers, Kauffeld, Neininger, & Henschel, 2011).

Collective emotion during crisis events has almost always been examined based on its hedonic valence – more specifically, how positive (toward pleasant) or negative (toward unpleasant) the collective emotion is. On the one hand, there is broad consensus that positive emotions are generally conducive to making better decision choices in the face of crisis (Sayegh et al., 2004; Sommer, Howell, & Hadley, 2016). Experiencing positive emotions during the crisis broadens people's attention, thinking, and behavioural repertoires, thereby facilitating flexibility and creativity required to deal with ambiguities, time pressure, and limited resources associated with crisis events (Fredrickson et al., 2003). When positive emotions are expressed and spread within the team, their broadening effects can improve the quality of interactions among team members, enable the collection and integration of diverse information, and lead to the generation of novel and creative solutions to the problem at hand (Burke et al., 2006, Walter & Bruch, 2008). Research evidence also suggests that team-level positive emotions predict higher team performance during a crisis event (e.g., Drach-Zahavy & Freund, 2007; Hunziker et al., 2011).

On the other hand, there is less than unanimous agreement on the effect of team-level negative emotions in teams facing crisis events. For the most part, negative emotions have been considered detrimental to team performance during a crisis (e.g., Gladstein & Reilly, 1985; Hunziker et al., 2011; Kaplan et al., 2013), mainly due to the conviction that negative emotional reactions tend to limit the possible ways a crisis can be resolved (Fredrickson, 2001; James et al., 2011). Nevertheless, a recent meta-analysis indicates that team-level negative emotions can, in fact, enhance social integration and, ultimately, team performance when the team faces a common external threat (Knight & Eisenkraft, 2015). A closer examination of the trajectory of collective emotions during a crisis also revealed that members of higher-performing teams exhibit negative emotions at certain points during the acute stage of a crisis event, once at the start and again toward the end of the acute stage (Saghafian & Waller, 2015). Taken together, past research focusing on the pleasantness dimension of collective emotion supports the notion that the hedonic tone of collective emotions, whether toward a positive or a negative end, can distinguish higher- from lower-performing teams dealing with a crisis.

The effect of team-level neutral emotion on team performance in general, and during a crisis in particular, has received almost no scholarly attention. Research studies often incorporate neutral emotions only as a baseline or a control condition to make the effects of positive or negative emotions more visible. The most explicit discussion on neutrality can be found in research on neutral display rules in some professional organizations such as law offices, medical units, and police departments where employees are socialized to act with “affective neutrality” (Smith & Kleinman, 1989; Wharton & Erickson, 1993). According to affect climate theory (Parke & Seo, 2017), while constant expression of neutrality within an organizational unit reduces the number of errors made out of carelessness or emotional biases, it also diminishes creativity and members' ability to effectively resolve new threats due to greater social distance among members and lower psychological safety.

Emotional arousal at the team level refers to the intensity with which emotions are expressed and communicated among team members. It characterizes the salience of the nonverbal displays of emotion such as facial expressions, bodily movements, and vocalizations (Barsade, 2002; Bartel & Saavedra, 2000). Research shows that emotional arousal has motivational effects; it influences the amount and direction of the effort that team members exert in their coordinated activities (e.g., Johnson, 2009; Quinn & Dutton, 2005). Moreover, when people face novel threat conditions, their shared experiences of emotional arousal have been found to promote affiliation among them (Gump & Kulik, 1997; Schachter, 1959; Townsend, Kim, & Mesquita 2014). A high level of emotional arousal also tends to signal the significance of changing circumstances in the environment and stimulate collaborative information processing among team members to make sense of those changes (Bartel & Saavedra, 2000; Knight & Baer, 2014). Finally, emotional arousal may increase the vigilance needed to recognize potential problems in the environment and search for information (Gaudine & Thorne, 2001). Nevertheless, excessive emotional arousal has been linked to less systematic information processing, reliance on simplistic response strategies, and superficial consideration of environmental evidence, leading to a distorted interpretation of the situation (Lazar, 1999; Sayegh et al., 2004). Medium-level emotional arousal, on the other hand, consumes less cognitive resources and enables more adaptive sensemaking during a crisis (Maitlis & Sonenshein, 2010).

In line with previous research on team-level collective emotion, I captured the evolution of collective emotion along its two basic dimensions of hedonic valence (positive, neutral, negative) and arousal (high, medium, low). As shown in Table 2, these two orthogonal dimensions can create nine categories of emotion that help capture a potentially high degree of variation in affective states and are, therefore, more consistent with an exploratory research approach[8]. Focusing on teams undergoing a crisis event, I used this two-dimensional framework to assess the degree to which teams manifest each dimension of collective emotion. This enabled me to provide more nuanced answers to the two research questions of this study.

[8] During the coding process, I decided to remove three categories from and add a new category to this framework. I ended up using a seven-category framework to assess collective emotions in my research context. Please see Chapter 3 for more details.

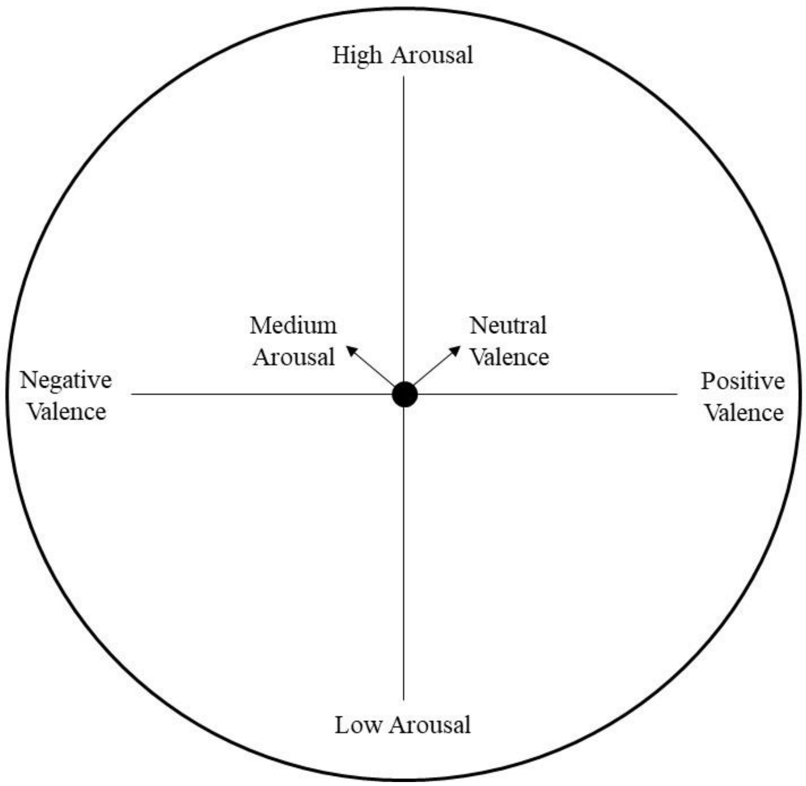


Figure 1. Circumplex model of emotion
(adapted from Larsen & Diener, 1992; Russell, 2003)

Table 2. Categories of collective emotions

	Positive Valence	Neutral Valence	Negative Valence
High Arousal	***Aroused-Positive*** Examples: • Enthusiastic • Excited • Elated	***Aroused-Neutral*** Examples: • Surprised • Astonished • Active • Intense	***Aroused-Negative*** Examples: • Anxious • Fearful • Stressed • Angry • Disgusted
Medium Arousal	***Midaroused-Positive*** Examples: • Happy • Pleased • Cheerful • Amused • Interested	***Midaroused-Neutral*** Examples: • Focused • Attentive • Certain	***Midaroused-Negative*** Examples: • Sad • Gloomy • Annoyed • Disappointed • Frustrated • Confused
Low Arousal	***Unaroused-Positive*** Examples: • Content • Relaxed • At ease	***Unaroused-Neutral*** Examples: • Quiet • Idle • Inactive	***Unaroused-Negative*** Examples: • Tired • Drowsy • Bored • Depressed

Interplay of Team Cognitive Processes and Collective Emotions during Crisis Events

Cognitive approaches to team functioning have enhanced our understanding of the role that team cognitive processes play in teams dealing with a crisis event. Past research on collective emotions has also established how emotions that emerge at the team level matter in the time of crisis. Although both streams of research share a focus on team functioning during a crisis, they lack adequate integration with one another. This lack of integrative approach stands in stark contrast with the reality of teams undergoing a crisis, where teams not only must navigate through cognitive complexities and information ambiguity associated with crisis events (Stubbart, 1987; Waller & Uitdewilligen, 2008), but also need to work in an emotionally demanding atmosphere as the team is subject to conditions of time pressure and limited resources while under the shadow of potentially severe consequences (Kaplan et al., 2013; Pearson & Clair, 1998; Sayegh et al., 2004). As a result, crises may bring about a complex array of cognitive and emotional responses that unfold in tandem with each other and drive performance one way or another. Team functioning in crisis events, thus, involves two distinct, yet concurrent, behavioural dimensions (i.e., cognitive processes and collective emotions). This logic is in alignment with theoretical and empirical research on groups in general which suggests that cognitive processes and collective emotions are essentially interrelated and can influence one another (e.g., Barsade & Knight, 2015; Lehmann-Willenbrock et al., 2011; Metiu & Rothbard, 2013), including when the team deals with the crisis (e.g., Ellis, 2006; Gladstein & Reilly, 1985; James et al., 2011). In other words, team cognitive processes and collective emotions are inherently intertwined and go hand in hand in shaping team performance.

Despite all this, we currently know very little about the nature of the interplay between cognitive processes and collective emotions in teams facing a crisis event. This is mainly because the majority of studies on teams facing crises have focused on the performance effect of only one of these behavioural dimensions of team functioning at a time, without accounting for its interplay with the other dimension. This may mask the effects of the latter dimension on team effectiveness, and results in under- or over-estimating the effect of the former. We are, thus, confronted with challenges in adequately predicting team performance during a crisis and isolating the underlying causes of a high (versus low) level of team performance after the crisis has happened. There is a need to simultaneously account for both cognitive processes and collective emotions in the study of teams dealing with crisis events and directly establish a relationship between the two constructs. Without a deep and accurate understanding of the interplay between cognitive processes and collective emotions, team performance during a crisis cannot be adequately predicted.

In order to properly address this shortcoming in the research literature, I argue, researchers should take into account the dynamic nature of team processes (Marks et al., 2001; McGrath, 1984) and team-level emotions (Collins et al., 2013; Kelly & Barsade, 2001). The dynamism of a construct entails having "a beginning (onset) and an end (offset), a duration, and a trajectory of growth and decline" (Roe, Gockel, & Meyer, 2012, p.641). A dynamic construct unfolds over a certain timescale – that is, the length of time needed for a construct and for its relationships with other constructs to emerge and unfold (Leenders, Contractor, & DeChurch, 2016; Zaheer, Albert, & Zaheer, 1999). Existing models of team cognitive processes (e.g., Knight, 2015; Liu & Maitlis, 2014; Marks et al., 2001; Rafaeli, Ravid, & Cheshin, 2009) and theories of collective emotions (Barsade & Knight, 2015; Hareli & Rafaeli, 2008; Walter &

Bruch, 2008) emphasize this dynamic view. Empirical research on the interplay between cognitive processes and collective emotions during a crisis, however, lags behind in terms of incorporating dynamism and often fails to explicitly consider the timescale and the temporal unfolding of cognitive processes and collective emotions when it comes to conceptualizing and operationalizing each of these constructs. As a result, each empirical study has captured a certain, often unique, fraction of the dynamics of the interplay between the two constructs. This has led to generating seemingly inconsistent results (e.g., Gladstein & Reilly, 1985; Knight & Eisenkraft, 2015; Maitlis & Sonenshein, 2010) and impeded the integration of the findings concerning the effectiveness of the interplay between cognitive processes and collective emotions.

Incorporating the dynamic nature of cognitive processes and collective emotions into investigation entails using a longitudinal research design in which both constructs are each measured multiple times over their timescale. On the one hand, Marks and colleagues' (2001) temporal framework of team processes suggests that the timescale for the unfolding of team processes, including cognitive processes, spans a task performance episode. Given a crisis event consists of one or more performance episodes (Waller et al., 2014), it can be considered long enough to cover at least one timescale for the unfolding of cognitive processes. On the other hand, Zaheer and colleagues (1999) suggest that the timescale for the unfolding of continuous constructs, such as collective emotions, corresponds to the life span of that construct. In the context of research on team functioning during a crisis event, the life span of collective emotions that emerge during a crisis is obviously the crisis event itself. Taken together, an appropriate observation interval for capturing the evolution of both cognitive processes and collective emotions is the entire duration of a crisis event. Choosing the duration of a crisis as the observation interval allows both constructs to emerge and unfold over at least a single length of their timescale (Zaheer et al., 1999). By measuring cognitive processes and collective emotions at multiple points over the course of a crisis event, researchers can take into account the dynamic nature of team processes and team-level emotions and capture the trajectory of change for each construct. These trajectories then serve as a basis for investigating the dynamics of the interplay between the two constructs.

When researchers intend to rely on repeated measurements of a dynamic construct, they must make further choices about when, for how long, and how often to measure the values of their construct of interest. This poses a potentially problematic challenge to researchers since there is still very little theory about time lags, feedback loops, and durations that can inform such important decisions (Ancona, Goodman, Lawrence, & Tushman, 2001). One reasonable strategy to address this challenge is to measure the construct at very small time intervals (Kozlowski, 2015; Leenders et al., 2016; Zaheer et al., 1999). This allows researchers to track the evolution of the dynamic construct (which is likely nonlinear and unevenly spaced across time) in a fine-grained temporal scale, “without having to make arbitrary and largely atheoretical decisions about time interval” (Leenders et al., 2016). Adopting this strategy for the measurement of team cognitive processes and collective emotions entails plotting fine-grained trajectories for both constructs, which can then be used to examine the dynamics of the interplay between them at the micro-temporal scale (i.e., coupling). Analysis of micro-temporal couplings helps identify those co-occurrences of cognitive processes and collective emotions that can strongly discriminate higher- from lower-performing teams in the time of crisis. Also, given the coupling between cognitive processes and collective emotions may vary over the course of the crisis, a macro-temporal analysis of its trajectory throughout the crisis event enables researchers to obtain additional insights into the dynamics of the interplay between cognitive processes and collective emotions. These additional insights may include information about the types, frequency, duration, variability and trend, possible patterns, and the distribution of couplings across time (Holmes & Poole, 1991; Lamey, Hollenstein, Lewis, & Granic, 2004). Macro-temporal analysis helps researchers specify whether and how the trajectory of the coupling between cognitive processes and collective emotions is systematically different in higher- versus lower-performing teams facing a crisis event.

There is a lack of longitudinal research on the dynamics of the interplay, not only between cognitive processes and collective emotions, but also among other underlying elements of team functioning. This observation could be generalized across different research contexts, (i.e., crisis or non-crisis), different forms of interplay (e.g., co-occurrences, sequential strings) and different temporal scales (e.g., micro, macro). With respect to the micro-temporal interplay between underlying elements of team functioning, there are a few exemplar exceptions. Kolbe and colleagues (2014), for example, focused on action teams working in a high-risk environment and showed that higher-performing action teams displayed specific sequential patterns of team cognitive processes. Lag sequential analysis (Bakeman & Gottman, 1997; Bakeman & Quera, 2011) revealed that higher-performing teams were characterized by patterns in which team member monitoring was directly followed by speaking up, providing assistance, or giving instructions and also by patterns in which talking to the room was directly followed by further talking to the room and not followed by giving instructions. Their findings suggested that it was not the frequencies of team member monitoring and talking to the room that mattered; rather, it was what the team exhibited subsequent to each of these team processes that discriminated higher- from lower-performing action teams. In a similar example, Kauffeld and Meyers (2009) investigated the sequential strings of three team processes in work group discussions: complaining, solution-oriented, and structuring communicative behaviours. Using lag sequential analysis, the authors observed that complaining and solution-oriented statements led to statements of the same type in group discussions. In other words, complaining encouraged further complaining and solution-oriented statements were immediately followed by other solution-oriented statements. A complaining behaviour sequence was also found to negatively affect measures of team outcome. Moreover, their study showed that structuring statements could break the complaining behaviour sequences, because the probability of a structuring statement being directly followed by a complaining statement was significantly below chance. Similarly, Knight (2015) examined the co-occurrence of team-level mood and team exploratory search – a cognitive process defined as experimenting with new ideas and alternative approaches to the team's tasks. He hypothesized that team exploratory search early in a team's life would be positively associated with early team positive mood and negatively associated with early team negative mood. Although his findings did not support these hypotheses, there was a strong trend in the direction of the predictions for team positive mood. The author suggested that the timing of his measurement might have accounted for these non-significant results, and that further research with more frequent measurements of team-level mood and team exploratory search would be useful to specify the true effect of the interplay between these two constructs.

The macro-temporal dynamics of the interplay between underlying elements of team functioning has received almost no scholarly attention. Recently, Boon (2016) explored the possibility of mutual influence between team creative efficacy and team creative processes over time. Using cross-lagged structural equation modeling, she found that these constructs influenced one another at certain points in the team's life and that the direction and magnitude of this effect changed over time. One the one hand, the effect of team creative processes on team creative efficacy was significant and positive right after the team would move past a performance deadline and this effect increased over time. On the other hand, the effect of team creative efficacy on team creative processes was significant and positive when the team was approaching a deadline and this effect weakened over time. While this research can be considered a step forward in the study of the macro-temporal pattern of the relationship between elements of team functioning, it did not examine whether and how such dynamics contributed to team performance.

Building on studies such as the above-mentioned ones (Boon, 2016; Kauffeld & Meyers, 2009; Knight, 2015; Kolbe et al., 2014), the purpose of the present research is to use a longitudinal design in order to examine the micro-temporal and macro-temporal dynamics of the interplay between team cognitive processes and collective emotions in teams facing a crisis event. As my review of literature revealed, theoretical work on this topic is clearly underdeveloped and empirical research is lacking. Because of this shortcoming, I take (took) an exploratory approach to investigate the following research questions. Such an approach can help generate new insights on current inconsistent findings and also discover patterns that previously were difficult, if not impossible, to detect (Bamberger & Ang, 2016).

1) Micro-temporal dynamics: How do micro-temporal couplings of team cognitive

processes and collective emotions displayed during the crisis distinguish higher-performing from lower-performing teams?

2) Macro-temporal dynamics: How do higher-performing teams and lower-performing teams differ in their trajectory of the coupling between team cognitive processes and collective emotions over the timespan of a crisis event?

CHAPTER THREE: METHOD

Research Context

I collected data for this research from teams facing a simulated organizational crisis. Simulation is commonly used in professional fields such as the military, aviation, firefighting, mining, and medicine as an instructional strategy to create highly realistic scenarios and high degrees of psychological fidelity in order to train teams how to adapt to nonroutine events quickly and accurately (Gladstein & Reilly, 1985; Perrow, 1984; Waller et al., 2014). I specifically focused on a team-based crisis simulation provided to MBA students as an obligatory part of a crisis management course offered at a large Canadian business school. The course instructor designed, developed and implemented this simulation in line with the instructions provided by Waller and colleagues (2014) on simulation-based training for crisis management. The simulation scenario revolved around the unfolding of a crisis happening in an organization for which a crisis management team had been formed to quickly design and implement an appropriate crisis response. The purpose of the simulation was to provide an opportunity for student teams to practice key crisis management capabilities during an organizational crisis. York University ethics approval was obtained in advance and all students in the course provided written consent to participate in my research allowing me to collect data from them before, during, and after the crisis simulation.

Procedure

The research context in this study is an MBA-level crisis management course that was offered in two sections during the winter term in 2016. On Week 7 of the 12-week course, all students across both sections of this course were randomly assigned to a total of 20 crisis management teams (4 or 5 members in each team) and randomly assigned the role of one of the functional area vice presidents within a hypothetical organization that was about to face the simulated crisis[9]. On Week 9, all students filled out a short questionnaire and on Week 10, every student received an information packet about their hypothetical organization including the link to the corporate website and a brief memorandum that reflected the current status of their assigned functional area within the organization (no information was provided about other functional areas).

On the day of the simulation (Week 11), each student team was directed to a separate breakout room where team members were asked to first complete a brief questionnaire. Then, the simulation scenario was started at the same time for all teams within each section and lasted for about 90 minutes. All teams were video-recorded throughout the simulation. Immediately after the end of the simulation, team members were asked to fill out another questionnaire. One week after the simulation, the course instructor held a debrief session for each section of the course and presented an overview of the crisis that took place during the simulation. She also provided every team with actual performance feedback approximately one week after the simulation.

Simulation

The simulation scenario involved a fictitious organization, Blink Industrial, Inc., a technology firm focused on the development of virtual reality training solutions for military organizations. A website was created for Blink that presented an overview of the organization

[9] In total, there were 19 four-member teams and 1 five-member team. The fifth member in the five-member team was assigned the role of an observer. An observer is expected to actively participate in group discussions and help shape the team's response to each incoming communication. However, the observer does not receive and cannot send any email messages during the simulation.

(overall financial situation, operational strategy, products, etc.) and provided some historical data in the form of past press releases. According to the website, Blink's headquarter was located in Toronto and its executive team consisted of CEO, VP R&D, VP External Affairs, VP Finance, and VP Marketing. One week before the simulation, students received the link to the website along with a brief memorandum related to the functional area associated with their VP role. Taken together, the information provided on the website, in the press releases, and in the memorandums help form a basis of knowledge construction in simulation training (Waller et al., 2014). Students were also told to bring at least one Internet-capable device (e.g., laptop, tablet, smartphone) to the simulation and were asked for provide an active email address in advance.

After arriving in their assigned room, team members were first asked to complete a questionnaire. They were, then, told that the simulation would begin shortly, and that they would have approximately 10 minutes to respond to any externally communicated queries they might receive via email. The first communication that the executive team received indicated that the simulation had begun. Shortly thereafter, all team members received an email from the CEO of the organization saying that she would be on a commercial airline flight and unavailable for the next several hours, and that the team needed to choose a venue for an upcoming annual general meeting. From this point onward and over the next 90 minutes, executive team members received numerous email and Twitter messages at predetermined times, sent by fictitious external parties and stakeholders including Blink's Director of Product Development, US Department of Defense as an important client, a news reporter, a subcontractor, Toronto Stock Exchange, a stock analyst from a major Canadian bank, an important investor, and a vocal group of employees. These messages required the executive team to make several decisions and respond in an appropriate manner under tight time constraints. As appropriate response entails that the team was able to quickly update its interpretation of the situation at hand as new information continued to surface during the crisis. There were also multiple opportunities for the executive team to collect information from and initiate communication with each external party and stakeholder during the simulation. In order to simulate actual information flows within and across organizations, most external communications were sent only to the appropriate vice-president roles. For example, media inquiries were sent only to the external affairs and marketing VPs, and inquiries from the stock analyst went to R&D and finance VPs. All team members received three emails at approximately equal time intervals during the simulation that asked for the team's assessment of the crisis type and the appropriate response strategy, based on what they learned from the material covered during the course[10]. At the end of the simulation, crisis management team members received an email from their CEO giving them 30 minutes to develop and send her an action plan for Blink to implement within the next 24 hours.

The main narrative of the crisis simulation revolved around allegations against Blink that its new virtual reality training technology – called AlphaScan – had been operating based on random data rather than on the supposed advanced algorithm that the company had developed. AlphaScan had already been purchased and employed by a number of military organizations including Blink's most important client, US Department of Defense. As the simulation narrative unfolded over time, the Blink executive team had to morph into a crisis management team and

[10] The main objective of this course was to help students develop knowledge about the characteristics of crisis events, developing and implementing crisis plans, and choosing an appropriate strategy to communicate to stakeholders during a crisis. The course did not offer any explicit training regarding team dynamics, particularly the effective use of team cognitive processes and collective emotions, during a crisis event. Furthermore, prior to the crisis simulation, none of the course assignments and class exercises involved working as a team in a crisis-like situation.

face an organizational crisis, concerning the AlphaScan data problem. The crisis began when US Department of Defense suddenly informed Blink that it had suspended its contract with Blink because it had discovered that AlphaScan was operating based on random data. US Department of Defense also threatened to file fraud charges. Shortly afterwards, the Blink executive team received a message from a news reporter pressuring the team to comment on the accusations made by US Department of Defense. The reporter also claimed that he had obtained evidence of the AlphaScan data problem from an anonymous Blink whistleblower. A vocal group of employees also kept posting angry tweets about their work at Blink. At the same time, several other external parties and stakeholders (e.g., stock analyst and investor) who had heard about the accusations contacted the Blink executive team and demanded a clear explanation. Toward the end of this scene, the team received an email that asked for the team's assessment of the crisis type and the appropriate response strategy. The scene ended when the team prepared an answer to this request and submitted it.

The above scene from the simulation scenario matches the defining characteristics of a crisis event presented in Chapter 1: low probability of occurrence, taking place unexpectedly, high potential impact, with little or no response time available, and ambiguous in terms of cause, exact effect, or means of resolution. First, based on the historical data provided in press releases and the memorandums, Blink had a very positive track record. So, the Blink executive team had no reason to expect such problems. Second, Blink had to face huge consequences when it lost its most important client over accusations of fraud and deception. Its reputation among its stakeholders and the public was also put at risk. Third, throughout this scene, the crisis management team was required to make several decisions on how to deal with different external parties and stakeholders in a timely and appropriate manner (e.g., how to communicate with media, whether and how to respond to angry employee tweets, and how to address stakeholders' concerns). Finally, the Blink executive team did not have sufficient information at the time to precisely determine the root cause of the problem. It was only after this scene and later in the simulation that revelations by Blink's Director of Product Development and a subcontractor shed some light on the true cause of AlphaScan data problem. Taken all together, this specific scene from the simulation covers the unfolding of a crisis event – more specifically, from crisis inception until the acute stage of the crisis passes. I focus on this crisis scene to address my exploratory research questions. The scene started 26 minutes into the simulation and lasted for 21 minutes on average (*SD* = 2.73).

Data Collection

Using a longitudinal research design, I collected three types of data from my research context: 1) video recordings of crisis management team members as they worked together during the crisis simulation, 2) performance evaluation of teams during the simulation provided by the course instructor, and 3) team members' response to a number of questionnaires that were collected on three occasions. First, all crisis management teams were video-recorded (and audio-recorded) throughout the simulation using two cameras for four-member teams and three cameras for the five-member team. I asked the participants to ignore the cameras, which were placed at the end of their meeting table and across the room in order to cause as little distraction as possible. Observations such as occasional use of swear words in reaction to the content of an incoming message or participants making an annoyed/angry face without other members knowing indicate that the videotaping was largely ignored by the participants. Video-based data enables using behavioural observation methods and capturing the nuances and subtleties of real-time behaviours and interactions within the team, particularly cognitive processes and emotional displays, at multiple points in time (Lehmann-Willenbrock & Allen, 2017; Waller & Kaplan, 2018).

Second, the course instructor provided me with her evaluation of team performance during the simulation for all 20 teams. She graded team performance based on a pre-determined set of criteria (Waller et al., 2014) including the average time taken to respond to external messages and inquiries, the frequency of unsolicited proactive messages sent, the team's correct identification of crisis type and response strategy, and the quality of the 24-hour crisis plan. The performance evaluation for each team was quite detailed and contained explicit remarks about how well the team performed in response to each and every demand during the simulation. Since the focus of this study was on a certain scene from the simulation (i.e., crisis scene), I did not need the instructor's assessment of team performance prior to the crisis scene. Therefore, for each team's performance evaluation, I first pinpointed those assessments pertaining to team performance prior to the crisis scene and subtracted points associated with those assessments from the total team performance evaluation score. Based on these updated team performance evaluation scores, I performed median split to create two clusters of higher- and lower-performing teams (above the median = higher-performing teams [n = 10 teams], below the median = lower-performing teams [n = 10 teams]). The two clusters significantly differed with regard to their performance evaluation scores (for higher performers, $M = 14.33$, $SD = .43$; for lower performers, $M = 13.18$, $SD = .17$, $U = 0$, $p < .001$)[11]. Therefore, I felt confident in using the

[11] Because of the small sample size, I used Mann-Whitney U test as a nonparametric alternative to the independent sample t-test.

median split as a means for clustering higher- versus lower-performing teams. This method was also previously used in other research on team-level behavioural patterns, particularly when the sample size was small (e.g., Kolbe et al., 2014; Stachowski e al., 2009; Waller, 1999; Waller et al., 2004).

Third, team members were asked to fill out a questionnaire at three different points in time. The first round was on Week 9, two weeks before the simulation, when they provided some personal background information. The second round was on the day of the simulation and immediately before the start of the simulation. In this round, participants provided their current assessment of their team and completed an extended version of international short form of the Positive and Negative Affect Schedule (I-PANAS-SF; Thompson, 2007) to indicate the extent to which they were experiencing 18 discrete emotions at the present moment. The third and final round of questionnaire was administered immediately after the end of the simulation asking participants to evaluate their team's performance during the simulation. The primary source of data in this research study was video recordings, team performance evaluations, and participants' response to the personal background questionnaire.

Data Coding

Data coding was conducted in two phases. The purpose of the first phase is to select and refine two coding schemes, one for team cognitive processes and another for collective emotions. In the second phase of data coding, I hired and trained four research assistants, two for coding cognitive processes and two for coding collective emotions, to code all the videotapes using the most refined version of the coding scheme.

Coding Scheme Selection and Refinement

The behavioural coding scheme that was used to capture team cognitive processes was a slightly modified version of the Co-ACT coding scheme (Kolbe, Burtscher, & Manser, 2013). Co-ACT was originally developed to capture behavioural dimensions of team functioning in acute care teams. It consists of 12 behavioural codes that are organized into four quadrants (see Figure 2). Each quadrant represents one of the combinations of two basic dimensions of teamwork behaviours: explicit versus implicit, and action versus situation[12]. The primary purpose of Co-ACT is to operationalize the four categories of cognitive processes presented in Kolbe and colleagues' framework (Kolbe et al., 2009, 2011, 2013; Manser et al., 2008). As my review of literature suggested, this framework provides a useful tool for capturing cognitive processes that are most relevant to team functioning during a crisis.

The Co-ACT coding scheme was refined and improved throughout the coding process to fit my specific research context and increase intercoder reliability. As a result, the definition, description and examples of behaviours under each category were clarified or updated. Moreover, a new behaviour (i.e., action-focused inquiry, depicted in italics in Figure 2) was added to the category of explicit action processing to help the coders distinguish between different types of questions that members ask each other about a decision/action. Finally, in order for the coding scheme to become mutually exclusive and exhaustive, a fifth coding category (i.e., residual) was added to the coding scheme to capture all other instances of behavioural processes that do not exactly belong to any of the four main categories of team cognitive processes.

[12] Kolbe and colleagues used the term "information" to label situation-focused processes. I changed this label and used the term "situation" instead, because the latter term reflects the definition of its corresponding dimension more precisely and helps clarify the differences between the two types of information being processed.

Examples of behaviours under this fifth category include acknowledgements, incomplete or inaudible sentences, utterances that do not fit the definition of a cognitive process, and multiple cognitive processes occurring simultaneously. A summary of the coding scheme is presented in Appendix A.

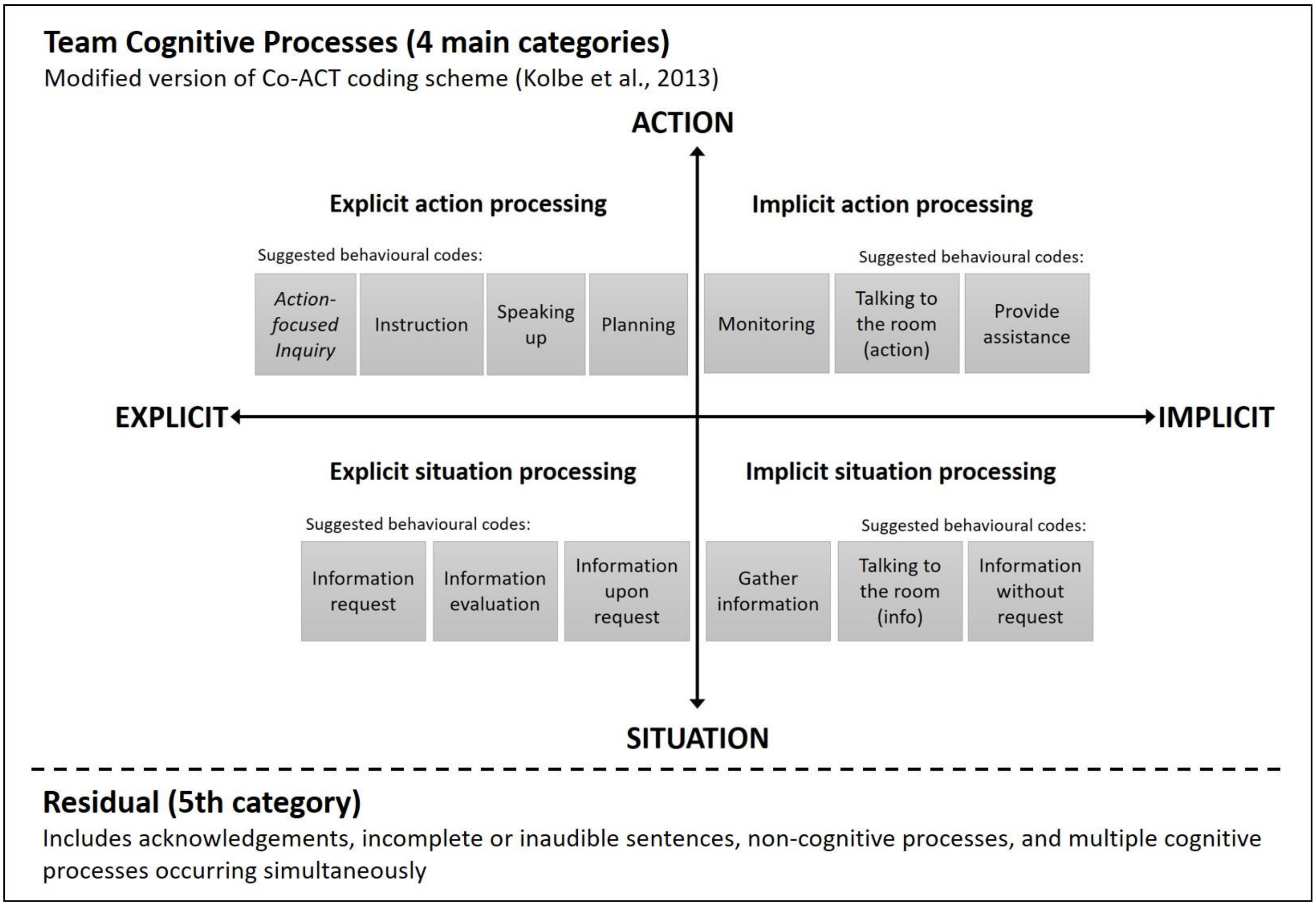


Figure 2. Coding scheme for team cognitive processes

Previous research shows that team-level collective emotions can be recognized and reliably assessed by outside observers when using an appropriate coding scheme (Barsade 2002; Bartel & Saavedra, 2000; Lehmann-Willenbrock et al., 2011; Sanchez-Burks, Bartel, Rees & Huy, 2016). In order to capture the behavioural manifestations of collective emotions in teams, I developed a behavioural coding scheme, building on two existing emotion coding frameworks: Observer's Instrument for Work Group Mood (Bartel & Saavedra, 2000) and Displayed Emotion Coding Scheme (Liu & Maitlis, 2014). Observer's Instrument for Work Group Mood was specifically developed to assess emotions expressed in a team setting and presents a list of behavioural anchors associated with each of the emotion categories in the circumplex model of emotion, except for the category of midaroused-neutral. In order to provide more information for coders and enhance their coding precision, this framework was supplemented with verbal and nonverbal behavioural cues provided in Displayed Emotion Coding Scheme (Liu & Maitlis, 2014). Displayed Emotion Coding Scheme provides a set of behavioural indicators for eight specific emotions displayed in teams (i.e., excited, amused, relaxed, angry, annoyed, frustrated, contemptuous, and neutral). Observer's Instrument for Work Group Mood and Displayed Emotion Coding Scheme fit well together, given both have been developed based on the circumplex model of emotion (see Table 3). Therefore, it was rather quick and effortless for me to combine these two coding schemes into one behavioural coding scheme for collective emotions. This coding scheme was then refined and improved throughout the coding process. Some behavioural anchors were added or modified under each emotion category. Moreover, all three categories of low arousal were removed from the behavioural coding scheme, because video observations revealed that the characteristics of the task during the crisis scene (i.e., high impact, time pressure, quick unfolding of the simulation narrative, every team member receiving at least one external communication during the crisis scene) put all team members in an active mode and kept the team away from becoming inactive or inattentive. A summary of the behavioural coding scheme is presented in Appendix B.

The behavioural indicators that were listed under each emotion category in the behavioural coding scheme are essentially at the individual level – that is, they help the coders to assess each member's displayed emotion within the team. But the coders also needed a clear instruction as to how to move beyond coding these individual-level displays of emotion toward generating an overall assessment of collective emotion at the team level. Through an iterative process between existing guidelines (e.g., Bartel & Saavedra, 2000; Sanchez-Burks et al., 2016) and video observations, I developed a decision flowchart for identifying team-level collective emotion. The flowchart asks the coder to first identify all members' expressions of emotions using the behavioural coding scheme. Then, it outlines a process through which the coder would be able to assign the most appropriate emotion category to the team-level collective emotion, taking into account all individual-level displays of emotion. Similar to the behavioural coding scheme, the decision flowchart was refined and improved throughout the coding process. By systemizing the coding procedure for collective emotions, the decision flowchart helped the coders produce more reliable codes. It also resulted in further adjusting the behavioural coding scheme to the team-level context by adding a new category for capturing dispersed emotions. Dispersed emotions represent a particular form of collective emotion that occurs when there is meaningful variation in team members' emotional expressions (Barsade & Gibson, 1998; Sanchez-Burks & Huy, 2009; Sanchez-Burks et al., 2016). Collective emotion is coded as dispersed when there are different pockets of emotion categories within the team and these various emotional expressions do not converge into one dominant emotion category at the team level during the coding interval. Adding the category of dispersed emotions enhances the precision of the coding process because it signals to the coders that they now need to carefully examine the distribution of individual-level displays of emotion within the team and observe whether and how this distribution changes during the coding interval before assigning the most appropriate code to the team's collective emotion. The decision flowchart is included in Appendix C. Overall, the behavioural coding scheme ended up constituting seven emotion categories. Table 3 provides more details about how the criteria for coding individual-level displays of each emotion category were obtained from the two existing coding schemes and how team-level collective emotion was coded based on the newly developed decision flowchart.

Table 3.
Criteria for coding emotions at the individual level and at the team level

Emotion Category	**Criteria for Coding at the Individual Level**	**Criteria for Coding at the Team Level**
	Matching the coding categories identified in the two existing coding schemes with the emotion categories in my coding scheme	Decision Flowchart (see Appendix C)
Aroused-positive	Bartel & Saavedra (2000): Activated pleasant Liu & Maitlis (2014): Excited	The majority of the team members express one or more behavioural cues associated with aroused-positive emotion at the individual-level. Expressions of aroused-positive emotion among team members must last for at least 3 seconds altogether.
Aroused-Neutral	Bartel & Saavedra (2000): High activation	The majority of the team members express one or more behavioural cues associated with aroused-neutral emotion at the individual-level. Expressions of aroused-neutral emotion among team members must last for at least 3 seconds altogether.
Aroused-Negative	Bartel & Saavedra (2000): Activated unpleasant Liu & Maitlis (2014): Angry	The majority of the team members express one or more behavioural cues associated with aroused-negative emotion at the individual-level. Expressions of aroused-negative emotion among team members must last for at least 3 seconds altogether.
Midaroused-Positive	Bartel & Saavedra (2000): Pleasant	The majority of the team members express one or more behavioural cues associated with midaroused-positive emotion at the individual-level. Expressions of midaroused-positive emotion among team members must last for at least 3 seconds altogether.
Midaroused-Neutral	Liu & Maitlis (2014): Neutral	The majority of the team members express one or more behavioural cues associated with midaroused-neutral emotion at the individual-level. Expressions of midaroused-neutral emotion among team members must last for at least 3 seconds altogether.

Table 3. (continued)

<table>
<tr><th>Emotion Category</th><th>Criteria for Coding
at the Individual Level</th><th>Criteria for Coding
at the Team Level</th></tr>
<tr><td></td><td>Matching the coding categories identified in the two existing coding schemes with the emotion categories in my coding scheme</td><td>Decision Flowchart
(see Appendix C)</td></tr>
<tr><td>Midaroused-Negative</td><td>Bartel & Saavedra (2000): Unpleasant

Liu & Maitlis (2014): Annoyed, Frustrated, Contemptuous</td><td>The majority of the team members express one or more behavioural cues associated with midaroused-negative emotion at the individual-level.
Expressions of midaroused-negative emotion among team members must last for at least 3 seconds altogether.</td></tr>
<tr><td>Dispersed</td><td>Not applicable to individual-level emotion coding</td><td>There are two subgroups within the team and each subgroup expresses a distinct collective emotion category; Or
Every single member of the team is expressing a distinct emotion category.</td></tr>
<tr><td colspan="3">Note:
Activation = Arousal

Coding interval = 10 seconds

Although Bartel & Saavedra (2000) did not explicitly indicate the level of activation in “pleasant” and “unpleasant” emotion categories, they based their work on the circumplex model of emotion (shown in Figure 1, p. 207) which clearly shows that these two emotion categories are at the midpoint of the activation dimension (i.e., medium level of arousal).

Although Bartel & Saavedra (2000) did not explicitly indicate the degree of valence in “high activation” and “low activation” emotion categories, they based their work on the circumplex model of emotion (shown in Figure 1, p. 207) which clearly shows that these two emotion categories are at the midpoint of the valence dimension (i.e., neutral valence).

Liu & Maitlis (2014) explicitly indicated the level of arousal when describing the behavioural cues associated with some of the discrete emotions in their coding scheme (e.g., annoyed). For other discrete emotions, the description of the behavioural cues could be matched with the definition of either a low, medium or high level of arousal (e.g., the behavioural cues provided for the category of “neutral” emotion in their coding scheme essentially describes a midaroused-neutral emotion category).</td></tr>
</table>

Coding Cognitive Processes and Collective Emotions

Following Waller and Kaplan's (2018) guidelines for using video-based behavioural observation methods, I recruited two coders for coding cognitive processes and another two for coding collective emotions in each team during the crisis event. The coders were extensively trained to use their assigned coding scheme (separate training sessions held for each pair of coders). They were also provided with video clips from sample recordings to practice. Weekly calibration meetings were scheduled to discuss and minimize discrepancies. After the training was completed, the coders independently coded 20% of the video data for the purpose of calculating intercoder agreement (Bakeman, Deckner, & Quera, 2005). During this period, I arranged and facilitated regular meetings where the coders could compare their codes, discuss discrepancies, and agree on a final code for each case of discrepancy. Given cognitive processes and collective emotions were each coded sequentially, I used a software program called Generalized Sequential Querier **(**GSEQ) to calculate intercoder agreement associated with coding each construct. GSEQ was developed by Bakeman and Quera (1995, 2011) for the analysis of sequential observational data. GSEQ computes kappa as an index of point-by-point agreement between coders (Bakeman & Quera, 2011; Bakemen, Quera, & Gnisci, 2009). The overall kappa for team cognitive processes was .64 (73% agreement). According to the guideline provided by Bakeman and Quera (2011) for the interpretation of kappa values, this value indicates an acceptable level of agreement for sequential data. Therefore, the remaining 80% of video data was divided equally between the two coders. Two kappas were calculated for collective emotions, one for the dimension emotional valence and one for the dimension of emotional arousal. The main reason was that as the coding process evolved, the coders and I discovered that each dimension of collective emotion would have to be independently evaluated to produce an accurate code for collective emotion. Our observation is also consistent with the previous characterization of emotional valence and emotional arousal as conceptually and statistically distinct dimensions of emotion (Ozcelik, 2017; Russell, Weiss, & Mendelsohn, 1989). The overall kappa was .52 for emotional valence (78% agreement) and .61 for emotional arousal (80% agreement). Both of these values also indicate an acceptable level of agreement for coding sequential data (Bakeman & Quera, (2011). Therefore, the remaining 80% of video data was divided equally between the two coders. Individual values of kappa for each category of team cognitive processes are presented in Appendix A. Individual values of kappa for each category of emotional valence and emotional arousal are presented in Appendix B.

The coding process for team cognitive processes followed Waller and Kaplan's (2018) guideline for event coding. Accordingly, the two coders hired to code cognitive processes were asked to record all discrete occurrences of each of the key behaviours identified in the cognitive process coding scheme within each 10-second interval. This method has been used in several other studies of team interactions (e.g., Su et al., 2013; Waller, 1999; Waller et al., 2004) to increase the ease and speed at which the coders would complete and compare their work (Waller & Kaplan, 2018). The two coders recruited to code collective emotions were instructed to identify the presence or absence of each category of collective emotion within each 10-second interval. At the end of the coding process, the stream of cognitive process codes was aligned with the stream of collective emotion codes along their corresponding 10-second intervals to generate a final code sheet for each team.

Data Analysis

Micro-temporal Dynamics

My first research question concerns the micro-temporal dynamics of the coupling between team cognitive processes and collective emotions during a crisis event. Coupling refers to the co-occurrence of cognitive processes and collective emotions. In order to address this question, I used lag sequential analysis (Bakeman & Gottman, 1997; Bakeman & Quera, 2011). This method allows for examining temporal patterns in concurrently coded variables to determine which co-occurrences occur significantly above or beyond chance. Accordingly, I conducted lag sequential analysis at lag = 0 to specify how often a certain cognitive process category co-occurs with a certain collective emotion category. I carried out this analysis separately for each performance cluster (i.e., one lag sequential analysis for higher-performing teams and one for lower-performing ones). The results of these analyses would reveal the more (or less) effective micro-temporal couplings between team cognitive processes and collective emotions during a crisis event.

Prior to performing the analysis, I checked whether the length of the sequential data (i.e., number of codes) associated with each team would allow for valid sequential analysis. Adopting the formula suggested by Wickens (1989), the calculations revealed that every team's sequential data must contain at least 175 codes. Given the length of the sequential data across the 20 teams ranged between 184 to 353 codes, I was allowed to perform lag sequential analysis. Next, I created a contingency table for each team by crossing all five cognitive process categories and all seven collective emotion categories (5 × 7 table). Each contingency table contains joint frequencies for every combination of cognitive process × collective emotion categories. According to the guidelines for lag sequential analysis (Bakeman & Quera, 2011; Klonek, Quera, Burba, & Kauffeld, 2016; Yoder & Symons, 2010), in order to obtain statistical parameters that can be trusted, the expected value for any joint frequency in the contingency table should be at least five, and row/column sums of joint frequencies should be larger than 30. These two criteria were not fully met in most of the 5 × 7 contingency tables across the 20 teams. This could render the accuracy of the interpretation of sequential analysis questionable. Klonek and colleagues (2016) recommend two strategies to address this issue. The first is to combine and integrate coded categories associated with each construct in a theoretically meaningful way to create a smaller set of higher-order categories. Adopting this strategy, I created smaller contingency tables for each of the four categories of team cognitive processes in which the focal cognitive process category was placed at the first row and all other instances of coded processes (four other categories in the cognitive process coding scheme, or simply "Other") was placed at the second row. I was also able to combine collective emotion categories along each of their two basic dimensions (i.e., arousal and valence), given these dimensions have been characterized as independent and distinct from one another (Ozcelik, 2017; Russell et al.,1989). This resulted in the formation of three categories for collective emotional arousal (high arousal, medium arousal, and dispersed) and four categories for collective emotional valence (positive, neutral, negative, and dispersed). Since the dispersed emotions category could not be characterized along any of these two dimensions, it appeared in both new categorizations. These two new categorizations of collective emotions constituted the columns of the contingency tables. In other words, each contingency table included either three columns associated with categories of collective emotional arousal or four columns representing categories of collective emotional valence. Taken together, each team cognitive process category was analyzed using two separate contingency tables, one for investigating the coupling of that cognitive process category with collective emotional arousal (2 × 3 table) and one for examining its coupling with collective emotional valence (2 × 4 table). Figure 3 shows an example of 2 × 3 and 2 × 4 contingency tables generated for one of the teams (Team 10) to analyze the coupling of explicit situation processing with collective emotional arousal and with collective emotional valence, respectively.

Joint Frequencies	High Arousal	Medium Arousal	Dispersed Emotions	Total
Explicit situation processing	14	25	2	41
Other	75	133	9	217
Total	89	158	11	258

Joint Frequencies	Positive Valence	Neutral Valence	Negative Valence	Dispersed Emotions	Total
Explicit situation processing	9	24	6	2	41
Other	24	133	51	9	217
Total	33	157	57	11	258

Figure 3. Example of a 2 × 3 contingency table (top) and a 2 × 4 contingency table (bottom) generated for Team 10

The second strategy suggested by Klonek and colleagues (2016) is to pool all sequential data across teams. In the context of my research, this strategy would entail pooling data across all the ten teams associated with each performance cluster. More specifically, I had to generate two pooled contingency tables (2 × 3 and 2 × 4) for each category of team cognitive processes in each performance cluster. But in order to be able to pool data across a set of teams, researchers first need to establish homogeneity (i.e., similarity of contingency tables) among those teams. Tests of homogeneity can help to alleviate the risk of over-generalizing findings that arise in only a few teams within the set (Chorney, Garcia, Berlin, Bakeman, & Kain, 2010; Connor, Fletcher, & Salmon, 2009; Klonek et al., 2016). Accordingly, I used log-linear analysis (Bakeman & Gottman, 1997) to test for the homogeneity of each of the two contingency tables generated for each category of team cognitive processes. Separate tests were conducted for higher-performing and lower-performing teams (total of 8 tests for each performance cluster). Nonsignificant likelihood ratio G^2(p > .05) indicates homogeneity and allows for using the pooled contingency table for subsequent lag sequential analysis. Nonhomogeneous contingency tables were excluded from further analysis.

Lag sequential analysis begins with testing for a global association within the pooled contingency table. A significant χ^2-value indicates that there is at least one association between coupled categories that is not determined by chance (i.e., the cognitive process category co-occurs more often with at least one collective emotion category and less often with others). If there is a significant global association, researchers are allowed to further look for cell-specific couplings and investigate which coupled categories are significantly associated. Adjusted residuals (Bakeman & Quera, 2011) are calculated and tested to identify significant cell-specific couplings. Adjusted residuals are standardized raw residuals (based on the difference between the observed and expected joint frequency). This cell-specific statistic reveals whether the coupling is more or less likely to be expected by chance. If an adjusted residual is > 1.96 (p < .05), there is a significant positive association between the coupled categories; if it is < -1.96 (p < .05), there is a negative association between them (Bakeman & Quera, 1995; Klonek et al., 2016). Given cellwise statistics often entail multiple tests, a reduced alpha level may be used to protect against type I error (Bakeman, Robinson, & Quera, 1996). Applying the Bonferroni-correction, the overall alpha value should be divided by the number of tests performed within the pooled contingency table to create a new alpha value for each cell-specific test. Since each pooled contingency table was created to examine the couplings pertaining to a certain cognitive process category (not “Other” category), the number of tests performed within each contingency table would be equal to the number of cells in a row. Therefore, choosing the overall significance level of .05, the Bonferroni-corrected alpha level for each test within a pooled contingency table containing categories of collective emotional arousal would be .016 (.05 divided by 3) and for each test within a pooled contingency table containing categories of collective emotional valence would be .012 (.05 divided by 4). These new alpha values were applied to indicate the significance of adjusted residuals in each pooled contingency table. The software program GSEQ was used to both test the global associations and identify statistically significant cell-specific couplings.

Since my first research question looked for those couplings that could differentiate higher- from lower-performing teams, I only focused on those contingency tables that underwent the entire procedure of lag sequential analysis in both performance clusters so that I could make a comparison between the two clusters of teams. More specifically, if a certain contingency table was found to be nonhomogeneous among either higher- or lower-performing teams, that contingency table was excluded from subsequent lag sequential analysis all together. For example, pooled contingency tables for the co-occurrence of explicit action processing with collective emotional arousal and with collective emotional valence were removed from lag sequential analysis due to a lack homogeneity.

Macro-temporal Dynamics

My second research question concerns the macro-temporal dynamics of the coupling of team cognitive processes and collective emotions throughout a crisis event. In order to answer this question, I used a software program called GridWare (Lamey et al., 2004) to plot the trajectory of change in the coupling of cognitive processes and collective emotions over the course of the crisis event. GridWare was developed based on the work of three developmental psychologists (Lewis, Lamey & Douglas, 1999) to represent the dynamics of the interplay between two synchronized streams of categorical data on a two-dimensional grid (Figure 4). This program provides visualization and characterizes two macro-temporal features of the trajectory of coupled time series: structure and content.

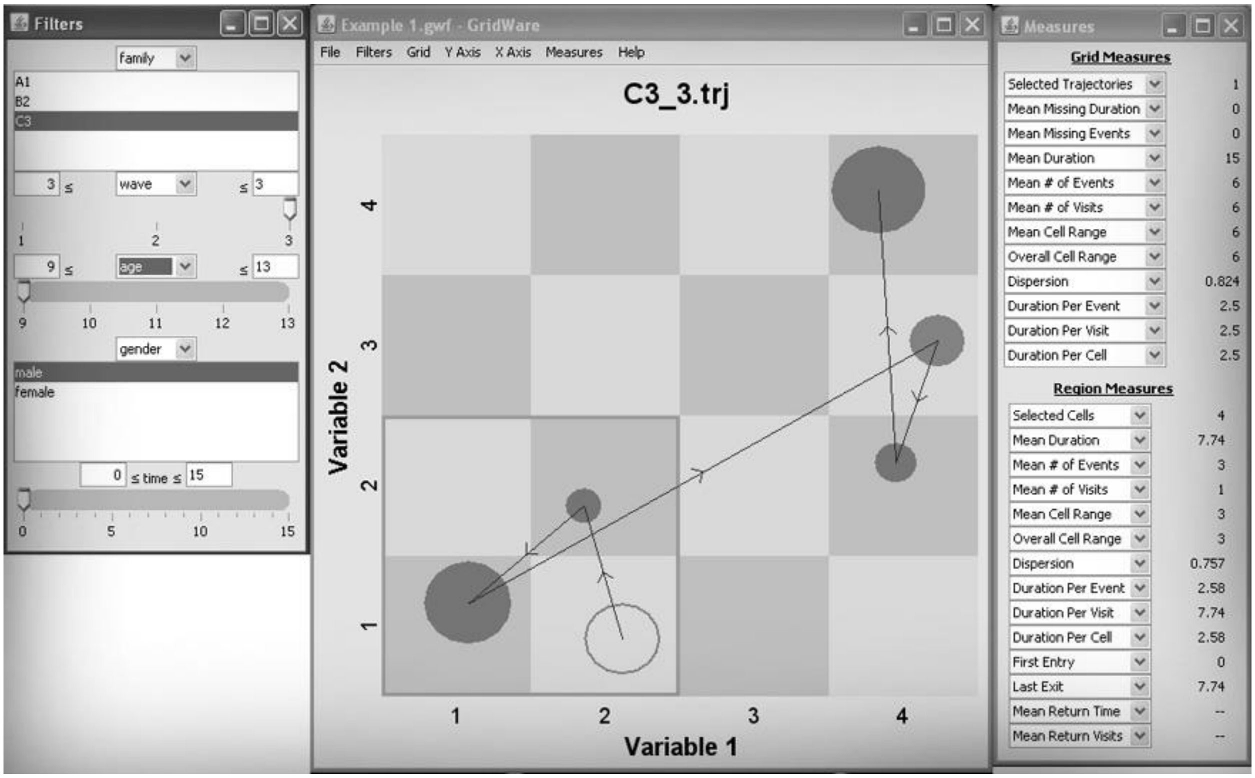


Figure 4. Example of GridWare output that displays (middle window) and provides characterizing measures (right window) for the trajectory of change in the coupling of variable 1 and variable 2. Each cell on the grid represents the coupling of a certain category of variable 1 with a certain category of variable 2. The user can select trajectories to display based on a pre-specified set of criteria (left window).

As an initial step, I used my coded sequential data as a basis to generate one GirdWare file and twenty trajectory files (one file per team). These files were used as input to GridWare. A GridWare file specified the categorical data (i.e., cognitive processes and collective emotions) and listed general features of the coupling trajectories associated with each team (i.e., team number and performance cluster). Each trajectory file contained two synchronized streams of categorical data (one stream for cognitive processes and another for collective emotions) associated with each team. These files were prepared according to the guidelines outlined in the

GridWare manual[13]. Once these input files were read in to GridWare, GridWare could display and provide characterizing measures for every team's coupling trajectory. The trajectories would be displayed on a two-dimensional grid that has five categories of cognitive processes on the x-axis and seven categories of collective emotions on the y-axis (see Figure 5). Each cell on the grid represents the coupling between a certain category of cognitive processes and a certain category of collective emotions. GridWare provides several measures to characterize the structure as well as the content of each team's coupling trajectory. These measures were then used to perform an analysis on the structure (also called *whole-grid analysis*) and on the content (also called *attractor analysis*) of the coupling trajectories of teams. This enabled me to compare higher- and lower-performing teams' coupling trajectories in terms of structure and content.

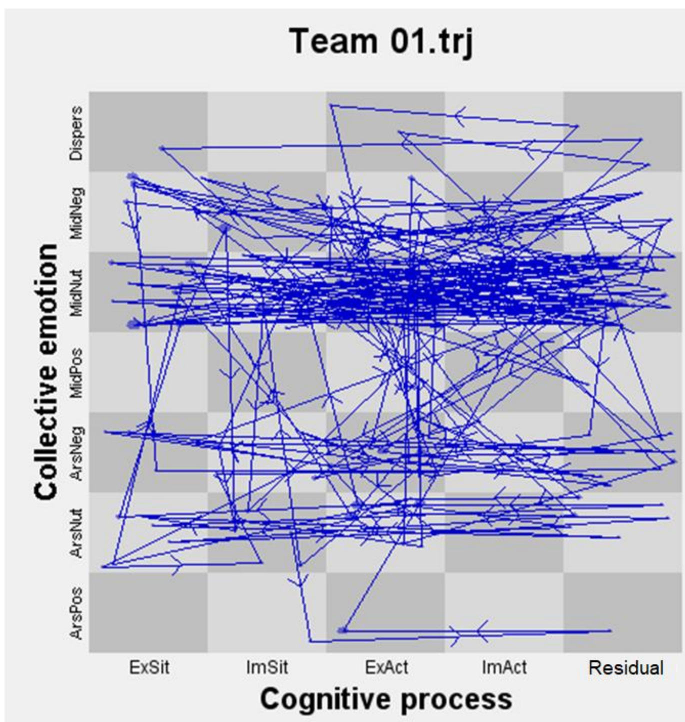


Figure 5. Example of GridWare trajectory display for my dataset

[13] Retrieved from the official website for GridWare: http://statespacegrids.org/

Whole-grid Analysis. The structural measures are also called whole-grid measures because they are derived from the information across all the cells. Structural measures are mostly used to specify the overall variability of a coupling trajectory. Variability refers to moment-to-moment fluctuations of a coupling trajectory due to the reciprocal influence of its underlying elements (Hollenstein, 2013). Variability has two dimensions: 1) the range of different cells that a coupling trajectory visits over time, and 2) the frequency of shifting in and out of different cells over time (Lougheed & Hollenstein, 2016). If a coupling trajectory remains in a small number of cells and makes few transitions between cells, this trajectory may be characterized as rigid or inflexible. In contrast, a coupling trajectory that moves around to many cells across the grid and makes frequent changes between cells may indicate a highly variable or flexible pattern (Hollenstein, 2007). One of the primary GridWare measures for capturing the first dimension of variability is *dispersion*. Dispersion determines the spread of the coupling trajectory across the grid and is calculated as the sum of the squared proportional durations across all cells, corrected for the number of cells, and inverted so that values range from 0 (no dispersion at all – trajectory remains in one cell over time) to 1 (maximum dispersion – trajectory is equally distributed across the grid). This measure is produced by the following formula (Hollenstein, 2007):

$$\text{Dispersion} = 1 - \frac{(n\sum(d_i/D)^2 - 1}{n - 1}$$

Where *D* is the total duration of the coupling trajectory, d_i is the duration in cell *i*, and *n* is the total number of cells in the grid. GridWare automatically calculates dispersion and displays its value in the Measures window (right window in Figure 3).

The second dimension of variability is often captured by a measure called *transitions per* *minute*. The measure of *transitions* denotes the number of transitions between cells within the grid. Transitions can be directly derived from GridWare Measures window. When the duration of coupling trajectories within the sample is not the same, researchers often prefer to use transitions per minute instead of transitions (Hollenstein & Lewis, 2006). Transitions per minute is calculated by dividing transitions by the total duration of the trajectory. Given the focus of my research was on the dynamics of the coupling trajectory throughout the crisis scene and the duration of the crisis scene was not exactly equal across teams (M = 21, SD = 2.73), I used transitions per minute to capture the second dimension of variability. Higher values of transitions per minute denotes greater variability.

Attractor Analysis. GridWare measures of content describe the characteristics of one or multiple cells selected within the grid. These measures are mostly used to identify attractors and quantify attractor strength. An *attractor* is defined as one cell (or a group of cells) on the grid that "attracts" the trajectory away from entering other cells across the grid. Attractors have been depicted topographically as valleys on a dynamic landscape (see Figure 6). The deeper the attractor, the more likely the trajectory is to "fall" into it and remain there, and the more resistant the trajectory is to changes in the environment (Hollenstein, 2007; Mainhard, Pennings, Wubbels, & Brekelmans, 2012). As a result, an attractor has two main characteristics: 1) it has the highest probability of recurrence (i.e., duration), and 2) it has the shortest return latency (i.e., the time it takes before the trajectory returns to the cell) than other cells across the grid. Coupling between two variables essentially tends to move in a trajectory towards the attractor cell(s). Once the trajectory enters an attractor, it is difficult for the trajectory to be freed from it (Hollenstein, 2013). Lewis and colleagues (1999) developed a two-step process for identifying and evaluating attractor cell(s) on the grid. The first step is to specify the location of attractor cell(s). The second step is to further ascertain that the identified attractor is significantly stronger than other cells across the grid.

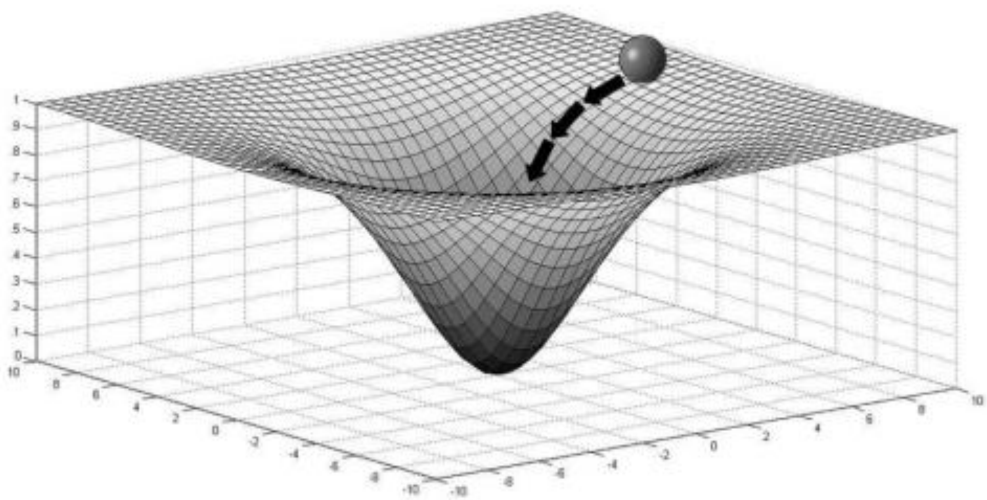


Figure 6. The landscape of an attractor. The depth of the valley represents the strength of the attractor (Adapted from Vallacher, Van Geert, & Nowak, 2015)

Attractor cells are, by definition, more probable than other cells on the grid (first characteristic of attractors stated above). Therefore, the most straightforward method of identifying an attractor on the grid is to find it among the cells with highest duration[14] (Hollenstein, 2013). Lewis and colleagues (1999) suggested a winnowing procedure to detect the location of attractors based on cell durations. This procedure begins with considering all the cells as potential attractors and progresses in an iterative fashion by eliminating the cell with the lowest duration in the set one-by-one in each step. Eventually, the cell or cells with the highest

[14] Cell duration can be directly obtained from the GridWare Measures window.

duration remain based on a criterion called *heterogeneity score*. In order to generate the heterogeneity score at each iterative step, the expected value is first calculated as the total duration of the trajectory divided by the number of cells in that iteration. Then, each cell's deviation from that expected value is squared and summed across cells. This sum is then divided by the number of cells in that iteration to obtain the heterogeneity score:

$$\text{Heterogeneity}_j = \frac{\sum (Observed_i - Expected_j)^2 / Expected_j}{\#\ of\ Cells_j}$$

where *i* is an index of the cell and *j* is an index of the current iteration. Cells are eliminated one by one in each iterative step until there was little change (< 50%) in the heterogeneity score. This resulted in one or multiple cells with the highest cell durations.

Once the location of attractor cell(s) is identified in the first step, Lewis and colleagues (1999) suggested taking a second step to further ascertain that the identified attractor cell(s) is significantly stronger than other cells. The relative strength, or pull that the attractor has on the coupling trajectory, is operationalized as the probability of transition from other cells into the attractor cell(s) (i.e., second characteristic of attractors stated earlier). Therefore, the most direct way to measure attractor strength is using the index of *return visits*. Return visits is defined as the latency to return to the selected cell(s) and calculated as the number of discrete visits to any of the other cells before returning to the selected cell(s). Lower return visits (faster returns) indicate a stronger attractor (Hollenstein, 2007; Lewis et al., 1999). Return visits can be directly obtained from the GridWare Measures window. In order to determine whether the attractor is significantly stronger than other cells, the return visits measure of each attractor is compared with the return visits measure of a "nonattractor" cell. Nonattractor is defined as the last cell eliminated from the list of potential attractors in the winnowing procedure. For those grids that have a multicell attractor (as opposed to a single-cell attractor), the attractor cell with the lowest duration should be chosen for comparison with the nonattractor cell. Statistical tests are performed and if the return visits of the attractor are found to be significantly lower than the return visits of the nonattractor cell, it can be inferred that the attractor has a stronger pull than other cells on the grid (Lewis et al., 1999).

CHAPTER FOUR: RESULTS

Table 4 displays means, standard deviations and intercorrelations between demographic variables and team performance evaluation scores. Demographics were obtained from the participants' response to one of the pre-simulation questionnaires and aggregated to the team level. As shown in the table, team performance during the crisis event was not associated with any of these demographic variables.

I also compared higher-performing and lower-performing teams in terms of how frequently they exhibited each of the coded categories of team cognitive processes and collective emotions during the crisis event. Considering that the duration of the crisis scene in my research context was not exactly equal across teams (M = 21, SD = 2.73), I based my comparisons on the relative frequencies of coded variables in order to have a more meaningful comparison between higher- and lower-performing teams. Relative frequencies were calculated by dividing the number of instances of each coded variable by the duration of the crisis scene. I used the Mann-Whitney U test as a nonparametric alternative to the independent sample t-test to accommodate my small sample size. Nonparametric statistics are inferential tests that do not require assumptions about the distribution of the population from which the samples were taken (Hinkle, Wiersma, & Jurs, 2003). Separate Mann-Whitney U tests were conducted on each of the coded variables (see Table 5). With the exception of implicit situation processing, which was more likely to occur in higher-performing teams than in lower-performing ones (for higher performers, M = 3.14, SD = .76; for lower performers, M = 2.27, SD = .66, U = 18, p = .015), there were no significant differences between higher- and lower-performing teams in terms of how frequently they exhibited each category of cognitive processes and collective emotions during the crisis.

This could be an indication that in most cases, cognitive processes and collective emotions did not necessarily operate in isolation to shape team performance during a crisis event. Indeed, it is possible that each cognitive process category had to go hand in hand with a certain collective emotion to be able to characterize higher (versus lower) team performance during the crisis. In the next step, I carefully investigated this possibility by examining the dynamics of these co-occurrences at both micro-temporal (first research question) and macro-temporal (second research question) scales.

Table 4.
Descriptive statistics and intercorrelations between demographic variables and team performance evaluation scores

	M	*SD*	1	2	3	4	5
1. Average age	28.82	1.67	–	-.51*	.72*	0.29	0.25
2. Team gender composition	2.95	1.05		–	-0.38	-0.15	0.04
3. Average work experience	3.12	0.44			–	0.03	0.03
4. Average prior experience in crisis management	0.82	0.52				–	-0.23
5. Team performance evaluation scores	13.55	0.72					–

Note: N = 20 teams

Gender composition of the team was dummy coded (1 = all teammates male; 2 = majority of teammates male; 3 = half of teammates male, 4 = majority of teammates female, 5 = all teammates female).

Work experience at individual level was dummy coded (1 = less than 1 year, 2 = 1-3 years, 3 = 3-5 years, 4 = more than 5 years).

Prior experience in crisis management was measured with the single questionnaire item “How many times have you been involved in handling a real organizational crisis?”

* $p < .05$

Table 5.
Mean relative frequencies, standard deviations, and comparison of relative frequencies of coded variables between higher- and lower-performing teams

	Higher Performers		Lower Performers			
	M	*SD*	*M*	*SD*	*U*	*p*
Team Cognitive Processes:						
Explicit situation processing	1.31	.57	1.74	.67	66	.25
Implicit situation processing	3.14	.76	2.27	.66	18	.015*
Explicit action processing	5.94	1.07	5.68	1.48	42	.58
Implicit action processing	.42	.18	.38	.17	45	.74
Residual	2.73	1.01	3.26	1.09	59	.53
Collective Emotions:						
Aroused-positive	.66	.41	1.00	.71	67	.22
Aroused-neutral	2.96	1.45	3.96	2.36	63	.35
Aroused-negative	.76	.59	.97	.72	58.5	.53
Midaroused-positive	.93	.66	.58	.54	33	.22
Midaroused-neutral	6.46	.74	5.43	1.81	30	.14
Midaroused-negative	1.08	.56	.73	.59	35	.28
Dispersed emotions	.68	.45	.67	.52	48.5	.91

Note: Results based on 10 higher performing teams and 10 lower-performing teams

Relative frequency = absolute frequency per minute

U = Mann-Whitney U

* $p < .05$

Micro-temporal Dynamics

My first research question concerns the micro-temporal dynamics of the coupling between team cognitive processes and collective emotions during a crisis event. More specifically, I asked: How do micro-temporal couplings of team cognitive processes and collective emotions displayed during the crisis distinguish higher-performing from lower-performing teams?

Accordingly, I performed lag sequential analyses to determine which observed couplings of team cognitive processes and collective emotions were statistically meaningful in either higher- or lower-performing teams facing a crisis event. Below, I present the results, organizing them based on the coupling of each cognitive process category with collective emotions.

Coupling of Explicit Situation Processing and Collective Emotions

As previously described in Chapter 2, explicit situation processing captures those cognitive processes that are focused on understating the situation while being enacted in an explicit mode. In other words, explicit situation processing involves reciprocal interactions between team members about the situation at hand. Examples of this cognitive process category include requesting information from another team member, evaluating and discussing information with teammates, or sharing information upon request (see Figure 2). In order to explore whether and how explicit situation processing co-occurs with a certain collective emotion category, I followed the procedure outlined in Chapter 3 (see the first section under Data Analysis for more details). As an initial step, I generated two contingency tables for each team, one for investigating the coupling of this cognitive process category with collective emotional arousal and one for examining its coupling with collective emotional valence. The latter contingency table was found to lack homogeneity across higher-performing teams ($G^2(27) = 71.75,$ p < .01), thus preventing me from performing lag sequential analysis and comparing higher- and lower-performing teams in terms of the co-occurrence of explicit situation processing and the valence dimension of collective emotions. Lag sequential analysis was successfully performed on the contingency tables associated with the coupling of explicit situation processing and the arousal dimension of collective emotions. As shown in Table 6, higher-performing teams were found to differ from lower-performing teams in the level of emotional arousal they were less likely to express during the exhibition of explicit situation processing. More specifically, the co-occurrence of explicit situation processing with collective midaroused emotion was significantly below chance in higher-performing teams, as opposed to lower-performing ones (for higher performers, *ADRJ* = -2.67, *p* =.01; for lower performers, *ADRJ* = -1.49, *p* =.14).

Table 6.
Adjusted residuals for the coupling of explicit situation processing and collective emotions

Cognitive process: Explicit situation processing	Co-occurring collective emotion		
	High arousal	Medium arousal	Dispersed emotions
Higher-performing teams	1.55	-2.67*	2.62
Lower-performing teams	0.11	-1.49	3.17

Note: Results based on 10 higher performing teams and 10 lower-performing teams

* *p* < .016 (Bonferroni-corrected for 3 tests)

Coupling of Implicit Situation Processing and Collective Emotions

As mentioned in Chapter 2, implicit situation processing captures those cognitive processes that are focused on understating the situation while being exhibited in an implicit mode. Unlike explicit situation processing which involves reciprocal interactions between team members about the situation at hand, implicit mode of situation processing entails initiating a one-way flow of information about the situation that is either offered to the team without request or gathered from the task environment without any explicit instruction (see Figure 2). Following a similar procedure used for the coupling of explicit situation processing and collective emotions, I investigated the co-occurrence of implicit situation processing with collective emotions. The contingency tables associated with the coupling of implicit situation processing and the arousal dimension of collective emotions were found to lack homogeneity across both higher and lower performers (for higher performers, $G^2(18) = 44.27,\ p < .01$; for lower performer, $G^2(18) = 36.19,\ p < .01$). Therefore, higher- and lower-performing teams were not compared in terms of the co-occurrence of this cognitive process category and collective emotional arousal. With respect to the coupling of implicit situation processing and collective emotional valence, lag sequential analysis revealed that the co-occurrence of implicit situation processing and collective neutral emotion was significantly below chance in higher-performing teams, as opposed to lower-performing teams (for higher performers, *ADRJ* = -2.85, $p < .01$; for lower performers, *ADRJ* = -.35, $p = .73$). Moreover, the coupling of implicit situation processing and dispersed emotional displays was significantly below chance in lower-performing teams, as opposed to higher-performing teams (for higher performers, *ADRJ* = -.36, $p = .72$; for lower performers, *ADRJ* = -3.34, $p < .001$). The respective adjusted residuals are shown in Table 7.

Table 7.
Adjusted residuals for the coupling of implicit situation processing and collective emotions

Cognitive process: Implicit situation processing	Co-occurring collective emotion			
	Positive valence	Neutral valence	Negative valence	Dispersed emotions
Higher-performing teams	3.71	-2.85**	0.6	-0.36
Lower-performing teams	2.87	-0.35	-0.07	-3.34**

Note: Results based on 10 higher performing teams and 10 lower-performing teams
** *p* < .012 (Bonferroni-corrected for 4 tests)

Coupling of Explicit Action Processing and Collective Emotions

Explicit action processing, as defined in Chapter 2, captures those cognitive processes that are focused on decisions/actions while being enacted in an explicit mode. This cognitive process category occurs when team members engage in reciprocal interactions to, for example, distribute tasks among themselves, ask questions about a current decision/action, speak up to challenge or correct a decision/action, or make plans for future decisions/actions (see Figure 2). I expected to find explicit action processing, like other cognitive process categories, to co-occur with a certain collective emotion to be able to differentiate higher- from lower-performing teams. To examine this expectation, I employed a similar procedure used for the above-mentioned two cognitive process categories and began with testing the homogeneity of the two contingency tables generated for teams. Results showed that the contingency tables associated with the co-occurrence of explicit action processing and the arousal dimension of collective emotions lacked homogeneity across lower-performing teams ($G^2(18) = 30.38,$ $p < .05$). Similarly, the contingency tables associated with the co-occurrence of explicit action processing and the valence dimension of collective emotions were found to be nonhomogeneous across higher-performing teams ($G^2(27) = 56.85,$ $p < .01$). Such a lack of homogeneity entails that the coupling of explicit action processing with dimensions of collective emotion did not always have a similar pattern within each performance cluster, preventing me from pooling the contingency tables for subsequent lag sequential analysis. In order to be able to compare higher- and lower-performing teams in terms of the co-occurrence of explicit action processing and collective emotions, further research is needed to thoroughly investigate the cause of this nonhomogeneity. Perhaps teams should be re-clustered based on both team performance and the factor causing some of them to display distinct coupling patterns.

Coupling of Implicit Action Processing and Collective Emotions

As previously stated in Chapter 2, implicit action processing captures those cognitive processes that are focused on decisions/actions while being enacted in an implicit mode. It essentially involves initiating a one-way flow of information about a current decision/action which could be in the form of offering unsolicited comments about a current decision/action, collecting information about the performance of other team members without any explicit instruction, or offering assistance to a teammate without prior request (see Figure 2). Following a similar procedure used for other three cognitive process categories, I investigated the co-occurrence of implicit action processing with the arousal and also with the valence dimensions of collective emotions. With respect to the co-occurrence of implicit action processing and collective emotional valence, lag sequential analysis revealed no significant global coupling association in both higher-performing and lower-performing teams (for higher-performers, $\chi^2(3) = 1.73$, $p = .63$; for lower-performers, $\chi^2(3) = 3.11$, $p = .38$). This could indicate that the exhibition of implicit action processing was not naturally associated with collective emotional valence. However, because in all pooled contingency tables associated with both performance clusters, there was at least one cell with expected value of less than five, this result could not be taken as conclusive (see Chapter 3 for more details about the guidelines for lag sequential analysis). The co-occurrence of implicit action processing and collective emotional arousal was also examined (see Table 8). Lag sequential analysis showed that the coupling of implicit action processing and collective midaroused emotion was significantly above chance in lower-performing teams, as opposed to higher-performing ones (for higher performers, *ADRJ* = 1.12, $p = .26$; for lower performers, *ADRJ* = 2.87, $p < .01$).

Table 8.
Adjusted residuals for the coupling of implicit action processing and collective emotions

Cognitive process: Implicit action processing	Co-occurring collective emotion		
	High arousal	Medium arousal	Dispersed emotions
Higher-performing teams^	-0.65	1.12	-1.1
Lower-performing teams	-2.19	2.87*	-1.59

Note: Results based on 10 higher performing teams and 10 lower-performing teams

^ Global coupling association was nonsignificant for higher performers ($\chi^2(2) = 1.91, p = .39$)

* $p < .016$ (Bonferroni-corrected for 3 tests)

Figure 7 summarizes all the above-mentioned results concerning the co-occurrence of each of the four cognitive process categories with collective emotions.

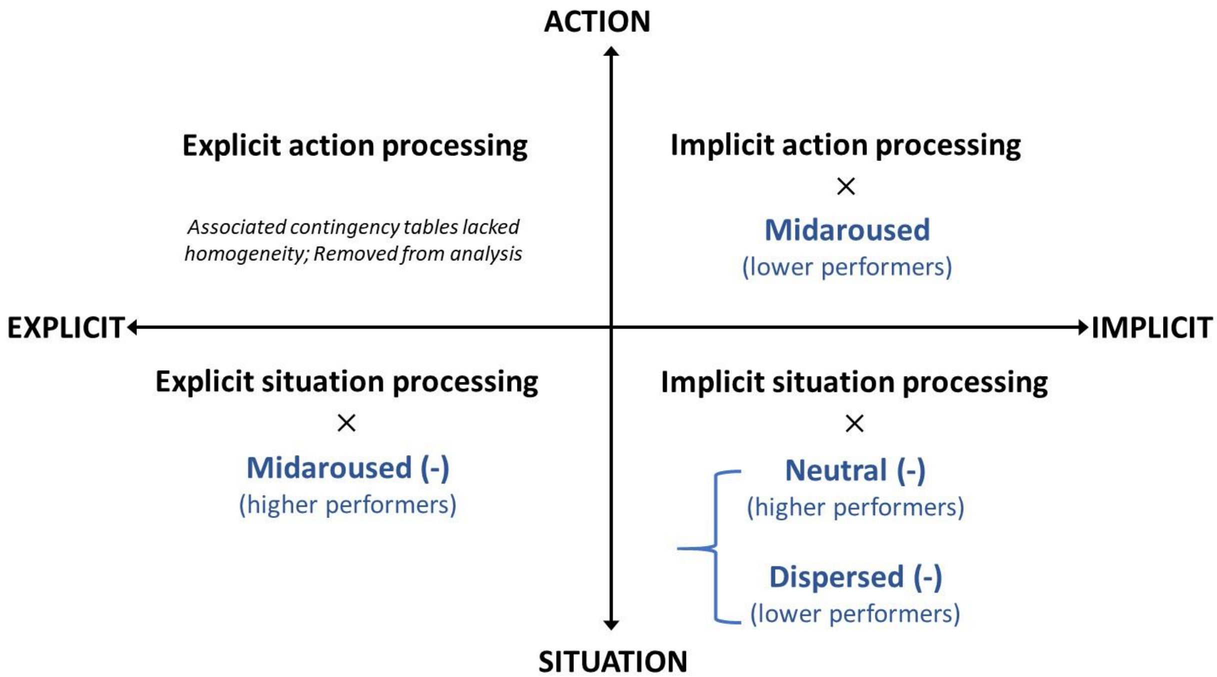


Figure 7. Micro-temporal coupling associations between cognitive process categories and collective emotions that distinguished higher- from lower-performing teams
Coupling = cognitive process × collective emotion
Minus sign (-) denotes negative coupling association

Macro-temporal Dynamics

My second research question focused on the macro-temporal dynamics of the coupling between team cognitive processes and collective emotions throughout a crisis event. Using GridWare, I examined two macro-temporal characteristics of the trajectory of the couplings over time: structure and content. Accordingly, I conducted whole-grid analysis to examine whether and how higher- and lower-performing teams could be distinguished based on the structure of their coupling trajectory during the crisis. Attractor analysis was also performed to compare higher- and lower-performing teams in terms of the content of their coupling trajectory.

Whole-grid Analysis of the Structure of Coupling Trajectories

As explained in Chapter 3, two whole-grid measures of structure were obtained from GridWare for each team's coupling trajectory: dispersion and transitions per minute. These two structural measures capture the overall variability of a coupling trajectory. Dispersion reflects the range or spread of observed couplings during the crisis while transitions per minute represent the frequency of shifts between couplings within that range. I used these two measures to compare higher-performing and lower-performing teams in terms of the variability of their coupling trajectory. Because of the small sample size, I performed the Mann-Whitney U test as a nonparametric alternative to the independent sample t-test. Separate Mann-Whitney U tests were conducted on each measure of variability. These tests revealed no difference in dispersion and transitions per minute between higher and lower performers (see Table 9). Both higher-performing and lower-performing teams exhibited a broad range of couplings between cognitive processes and collective emotions during the crises (for higher performers, $M_{\text{Dispersion}}$= .919, $SD_{\text{Dispersion}}$= .02; for lower performers, $M_{\text{Dispersion}}$= .922, $SD_{\text{Dispersion}}$= .03, U = 58.5, p = .53).

Moreover, while higher--performing teams shifted in and out of different couplings at a slightly lower rate than lower-performing teams, these rates of transitions were not significantly different (for higher performers, $M_{\text{Transitions per minute}}$= 8.14, $SD_{\text{Transitions per minute}}$= 1.27; for lower performers, $M_{\text{Transitions per minute}}$= 8.41, $SD_{\text{Transitions per minute}}$= 1.38, U = 57, p = .63).

Table 9.
Descriptive statistics and comparisons of whole-grid measures of structure between higher- and lower-performing teams

	Higher		Lower			
	M	*SD*	*M*	*SD*	*U*	*p*
Whole-Grid Measures of Structure:						
Dispersion	.919	.024	.922	.032	58.5	.53
Transitions per minute	8.144	1.266	8.409	1.377	57	.63

Note: Results based on 10 higher performing teams and 10 lower-performing teams
U = Mann-Whitney U
* $p < .05$

Attractor Analysis for the Content of Coupling Trajectories

Macro-temporal dynamics of the coupling trajectory of higher- and lower-performing teams could also be compared in terms of the location and the strength of their attractor. As defined in Chapter 3, an attractor is one or more cells (i.e., couplings) on the grid that pulls the trajectory from entering other cells across the grid. The coupling trajectory essentially tends to move towards its attractor cell(s). Accordingly, I employed Lewis and colleagues' (1999) two-step process to identify and quantify the strength of attractor cell(s) in each team's coupling trajectory (see Chapter 3 for more details). In the first step, I performed a winnowing procedure to specify the location of attractor cell(s) on each grid (see Table 10). The second step was taken to further ascertain that the identified attractor cell(s) was significantly stronger than other cells on the grid (in terms of pulling the trajectory). Accordingly, the measure of return visits was obtained from GridWare to operationalize strength and the attractor cell (or the lowest-duration attractor cell in case of a multicell attractor) was compared with the nonattractor cell on the same grid in terms of their return visits (Table 10). The Shapiro-Wilk Test indicated that the distribution of the return visits associated with the nonattractor cell deviated significantly from the normal distribution ($p = .01$). Therefore, I performed Wilcoxon-signed-rank test as a nonparametric test equivalent to the paired sample t-test. Results showed that return visits associated with identified attractors were significantly lower than return visits associated with their corresponding nonattractors (for attractors, $M = 3.1$, $SD = .85$; for nonattractors, $M = 3.83$, $SD = .81$, $Z = -2.94$, $p = .003$). Given lower return visits indicate a stronger pull, identified attractors were thus found to be significantly stronger than the nonattractor cell and, by extension, every other cell on the same grid (Lewis et al., 1999).

Table 10.
Location and return visits of identified attractors and their corresponding nonattractors

	Attractor		Nonattractor	
	Cell(s)	Return Visits	Cell	Return Visits
Team 01	ExAct-MidNut, Residual-MidNut	2.75	ExSit-MidNut	5.62
Team 02	ExAct-MidNut, ImSit-MidNut	1	ExAct-ArsNut	4
Team 03	ExAct-MidNut	2	Residual-MidNut	4
Team 04	ExAct-MidNut, ExAct-ArsNut, ImSit-MidNut	1	ExAct-ArsPos	5.67
Team 05	ExAct-MidNut	3	Residual-MidNut	3.58
Team 06	ExAct-MidNut	2	ExAct-ArsNut	3.25
Team 07	ExAct-MidNut, ExAct-ArsNut	2	ImSit-MidNut	4
Team 08	ExAct-MidNut	3	Residual-MidNut	3
Team 09	ExAct-ArsNut, Residual-ArsNut	2	ImSit-ArsNut	3.35
Team 10	ExAct-MidNut	3	ExAct-ArsNut	3.75
Team 11	ExAct-MidNut, Residual-MidNut	3	ExAct-ArsNut	4.41
Team 12	ExAct-MidNut	2	Residual-MidNut	3
Team 13	ExAct-MidNut	2	ImSit-MidNut	3
Team 14	ExAct-MidNut	3.78	ImSit-MidNut	3
Team 15	ExAct-MidNut	3.58	ImSit-MidNut	3.53
Team 16	ExAct-MidNut, ExAct-ArsNut, Residual-MidNut	2	ImSit-MidNut	4
Team 17	ExAct-MidNut, ExAct-ArsNut, Residual-ArsNut, ImSit-MidNut	2	ExSit-ArsNut	4.8

Table 10. (continued)

	Attractor		Nonattractor	
	Cell(s)	Return Visits	Cell	Return Visits
Team 18	ExAct-MidNut, Residual-MidNut, ImSit-MidNut	3	Residual-ArsNut	4.25
Team 19	ExAct-MidNut	2.78	ImSit-MidNut	3
Team 20	ExAct-ArsNut	2	Residual-ArsNut	3.47

Note:

ExSit = Explicit situation processing
ImSit = Implicit situation processing
ExAct = Explicit action processing

ArsPos = Aroused-Positive
ArsNut = Aroused-Neutral
MidNut = Midaroused-Neutral

Next, I explored the potential differences between higher- and lower-performing teams in terms of the location and strength of their attractor. I began by visually inspecting the GridWare coupling trajectory of each team for potential differences. Visual comparison of attractor locations suggested that the coupling trajectory of higher-performing teams was more likely to have a single-cell attractor while the coupling trajectory of lower-performing teams tended to contain a multicell attractor (Figure 8). In order to verify this observation, I statistically compared the coupling trajectories of higher- and lower-performing teams in terms of the proportion of single-cell and multicell attractors. Accordingly, I created a 2×2 contingency table by crossing performance cluster (higher versus lower) with attractor size (single-cell versus multicell). Because some of the expected values for this contingency table were less than 5, I conducted the more conservative Fisher's exact test as a nonparametric alternative to the χ^2 test of independence. Results of the Fisher's exact test confirmed that performance cluster would be marginally significantly associated with attractor size (p = .07). In other words, the coupling trajectory of higher-performing teams was found to be more likely to fall into a single-cell attractor whereas the coupling trajectory of lower-performing teams tended to get drawn toward a multicell attractor. I also compared higher- and lower-performing teams in terms of attractor strength. Using the measure of return visits to represent attractor strength (Table 10), I performed the Mann-Whitney U test and found no significant difference in return visits between higher- and lower-performing teams (for higher performers, M = 2.51, SD = .86; for lower performers, M = 2.28, SD = .65, U = 41.5, p = .53), indicating that higher-performing and lower-performing teams did not differ in terms of their attractor strength.

Combining the results of the above two tests revealed that while the attractor in both performance clusters pulled the coupling trajectory with the same strength, such strength was concentrated in a single attractor cell for higher performers whereas it tended to be distributed among multiple attractor cells for lower performers. In other words, higher-performing teams were more likely to become absorbed in one attracting coupling of cognitive processes and collective emotions where their trajectory would rest over extended periods of time and to which it would return very quickly. The trajectory of couplings in lower-performing teams, however, tended to get drawn toward a more diverse set of weaker attracting couplings which entailed that the trajectory would remain in each attracting coupling for a relatively shorter time and would not return to it very quickly.

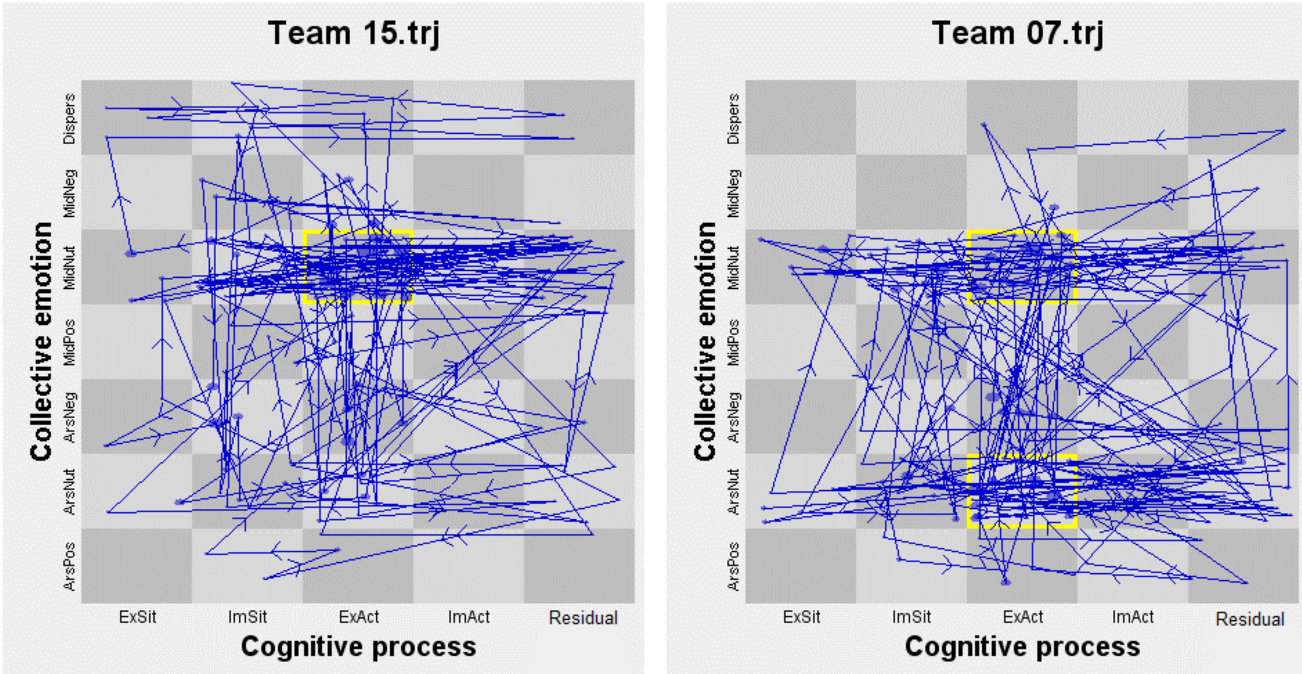


Figure 8. Attractor cell(s), highlighted on the grids, in the coupling trajectory of a higher-performing team (left) and a lower-performing team (right)

In addition to comparing higher- and lower-performing teams in terms of the number of attracting couplings, I also looked at the content of these attracting couplings in each performance cluster. The single, strong attracting coupling that pulled the trajectory of higher-performing teams was the coupling between explicit action processing and midaroused-neutral collective emotions. This coupling also emerged as one of the several attracting couplings in the trajectory of the majority of lower-performing teams. No other attracting coupling was found to be as highly shared among the trajectories of lower-performing teams. In fact, the composition of attractors in the trajectory of each lower-performing team was so distinct that no two lower-performing teams were found to get drawn toward the same set of attracting couplings. While the coupling trajectory of both higher- and lower-performing teams had tendency to settle in the coupling of explicit action processing and midaroused-neutral collective emotions, the strength of this attracting coupling was significantly higher (i.e., lower return visits) in higher-performing teams than lower-performing ones (for higher performers, $M = 2.81$, $SD = .64$; for lower performers, $M = 3.32$, $SD = .69$, $U = 61.5$, $p = .05$).

CHAPTER FIVE: DISCUSSION

Organizations commonly use teams to rapidly and appropriately respond to crises. These teams must face a multidimensional challenge because crises not only present sets of ill-defined, complex problems, but also exert high emotional demands on the team. As a result, effective team functioning in crisis events involves handling each dimension of the crisis through distinct, yet concurrent, types of responses, namely team cognitive processes and collective emotions. Studies of crisis events to date, however, have largely examined cognition and emotion in isolation from one another. As a result, we know little about how team cognitive processes and collective emotions interact to produce a more (versus less) effective cognitive-emotional response to the crisis. The purpose of this dissertation was to address this question. More specifically, I aimed to investigate whether and how higher- and lower-performing teams differ in terms of the temporal dynamics of the coupling between team cognitive processes and collective emotions. In order to provide a more in-depth understanding of these dynamics, I conducted my investigation at both micro-temporal and macro-temporal scales.

Accordingly, I used a longitudinal research design and behavioural observation methods to collect data from 20 MBA student teams dealing with a simulated organizational crisis. Taking an exploratory approach, I examined how the coupling between cognitive processes and collective emotions characterized higher versus lower performance in these teams. Team cognitive processes were captured along four main categories which Kolbe and colleagues (2013) suggested as most relevant to team functioning during a crisis. These four categories were: explicit situation processing, implicit situation processing, explicit action processing, and implicit action processing. Collective emotions were coded using a seven-category framework to capture a high degree of variation in team-level affective states during a crisis. These seven categories were: aroused-positive, aroused-neutral, aroused-negative, midaroused-positive, midaroused-neutral, midaroused-negative, and dispersed.

Micro-temporal Dynamics

In order to answer my first research question regarding the micro-temporal dynamics of the coupling between team cognitive processes and collective emotions during a crisis event, I performed a series of lag sequential analyses and identified those co-occurrences of team cognitive process categories and collective emotion categories that were statistically meaningful in higher- versus lower-performing teams dealing with a crisis event. Adjusted residuals were calculated and tested to indicate significant coupling associations in each performance cluster. Significant adjusted residuals could take either a positive or a negative value, indicating a positive or a negative coupling association, respectively. In the context of my research, significant positive associations would indicate those couplings between team cognitive processes and collective emotions that occurred significantly above chance. Significant negative associations would suggest that the coupling occurred significantly below chance.

Coupling of Explicit Situation Processing and Collective Emotions

Lag sequential analyses showed that higher-performing teams differed from lower-performing teams in what emotion they were less likely to express during the exhibition of explicit situation processing. More specifically, the probability of explicit situation processing co-occurring with midaroused collective emotion was significantly below chance in higher- versus lower-performing teams (see Table 6). As explained in my review of literature on team cognitive processes, explicit situation processing can be considered a main element of collective sensemaking (Maitlis & Sonenshein, 2010). Some previous research on the role of emotional arousal in sensemaking during crises suggested that a medium-level emotional arousal would be associated with more adaptive sensemaking during a crisis, compared with a high level of emotional arousal (Maitlis & Sonenshein, 2010; Maitlis, Vogus, & Lawrence, 2013). This is because midaroused sensemaking tends to consume less cognitive resources and allows greater openness to and more in-depth consideration of situational cues (Bazerman et al., 1998; Harmon-Jones, Gable, & Price, 2011, 2013). Similarly, the greatest probability of vigilant information processing has been shown to occur at medium levels of emotional arousal (Elsbach & Barr, 1999; Lazarus, 1991). Although my result seems to stand in contrast to these findings from past research, I argue that my work can actually extend and add nuances to them in an important way: While previous research has established the constructive role of midaroused emotions during sensemaking at the individual level, my research suggests that such a coupling does not necessarily characterize more effective sensemaking at the team level. My analyses showed that higher-performing teams did not need to collectively express medium levels of emotional arousal during explicit situation processing of a crisis event. Perhaps, only those team members directly involved in explicit situation processing would need to remain emotionally midaroused and the lower the probability of the rest of the team joining them in expressing midaroused emotions during the exhibition of explicit situation processing, the higher the team performance. There is some preliminary support for this conjecture in my data as lag sequential analysis revealed that explicit situation processing naturally tended to occur in an emotionally-dispersed team atmosphere, regardless of team performance (for higher performers, *ADRJ* = 2.62, p =.01; for lower performers, *ADRJ* = 3.17, p <.01). However, given my coded data did not include any information about team members' individual-level display of emotions during explicit situation processing, testing and confirming this conjecture is beyond the scope of the present study and needs further empirical research.

Coupling of Implicit Situation Processing and Collective Emotions

Lag sequential analyses revealed that higher-performing teams were significantly less likely than lower-performing teams to engage in implicit situation processing in an emotionally-neutral team atmosphere (see Table 7). Unlike explicit situation processing which is embedded in reciprocal interactions between team members, implicit situation processing involves initiating a one-way flow of information that is either offered to the team without request or gathered from the task environment without any explicit instruction. Central to the notion of implicit situation processing is, thus, a powerful sense of commitment to helping one's team update its sensemaking and enhancing the teammates' understanding of the situation at hand. In this way, implicit situation processing can be characterized as a prosocial behaviour (Bolino & Grant, 2016; Gagné, 2009; Wang & Noe, 2010). Defined as those behaviours undertaken with the intention of benefiting an individual, group, or organization (Brief & Motowidlo, 1986), prosocial behaviours encompass a range of different ways through which organizational members contribute to their team or their organization (Bateman & Organ, 1983; Bolino & Grant, 2016). Past research has established a significant association between positive collective emotions and the likelihood of prosocial behaviours in the team (Knight & Eisenkraft, 2015). The logic behind this emotional connection to prosocial behaviours is that shared positive feelings signal the pervasiveness of affiliative and cooperative tendencies within the team (Lyubomirsky, King, & Diener, 2005) and indicate a high level of social integration (Barsade &

Gibson, 1998). In such a socially integrated atmosphere, team members are more likely to exhibit commitment to their team's task through enacting prosocial behaviours (Beal, Cohen, Burke, & McLendon, 2003, Knight & Eisenkraft, 2015). My result can add nuances to these overall findings by emphasizing that it is emotional non-neutrality, rather than a specific emotional valence, at the team level that determines the effectiveness of a prosocial behaviour such as implicit situation processing in teams facing a crisis event. Compared with valenced collective emotions, neutral collective emotion has been linked to lower creativity and less effective sensemaking due to greater social distance and lower psychological safety that it creates among team members (Parke & Seo, 2017). My analyses suggest that the dysfunctional role of neutral collective emotions in teams dealing with a crisis event would be most likely pronounced when team members are engaged in implicit situation processing. One possible explanation for this finding may pertain to the effect of emotional neutrality on team members' perception of and reaction to the exhibition of implicit situation processing in their team. Lack of emotional valence in team atmosphere during a member's exhibition of implicit situation processing may render the knowledge contribution of that member less psychologically meaningful to others and discourage the team from taking this input very seriously (Harvey, 2014). As a result, team members may fail to appropriately use this information to enhance their understanding of the situation, which may ultimately lead to generating a less effective response to the problem at hand.

The present research revealed another significant difference between higher- and lower-performing teams with respect to the coupling of implicit situation processing and collective emotions. Compared with higher-performing teams, my analyses suggested, lower-performing teams were less likely to engage in implicit situation processing during the time that members' emotions were dispersed (see Table 7). In other words, lower-performing teams had more tendency than higher-performing teams to implicit situation processing in an emotionally-homogeneous team atmosphere. On the one hand, as discussed earlier, implicit situation processing can be considered as a type of prosocial behaviour. Past research has shown that prosocial behaviours are likely to take place when team members demonstrate a high level of group bonding and social integration (Beal et al., 2003, Knight & Eisenkraft, 2015). One the other hand, a number of research studies have suggested that emotional homogeneity in a team and social integration among team members may be reciprocally related, with both constructs positively influencing each other (Bartel & Saavedra, 2000; Spoor & Kelly, 2004; Walter & Bruch, 2008). Integrating these two findings from previous research suggests that a prosocial behaviour such as implicit situation processing would be likely to naturally occur in an emotionally-homogeneous team atmosphere. This leads us to expect to find the co-occurrence of implicit situation processing and emotional homogeneity in both higher- and lower-performing teams. However, that the significant coupling association between implicit situation processing and emotional homogeneity only appeared in lower-performing teams suggests that implicit situation processing may not create a natural coupling with emotional homogeneity during a crisis event. While members of lower-performing teams were less likely to engage in implicit situation processing when emotions were dispersed, members of higher-performing teams did not necessarily wait for team atmosphere to become emotionally homogeneous before making unsolicited knowledge contributions during the crisis. Rather, they would sometimes go out of their way to help their team update its sensemaking even when the team has a less favourable atmosphere for the exhibition of implicit situation processing. Compared with lower-performing teams, higher performers thus seemed more committed to enhancing team situation awareness during the crisis and less concerned about the emotional homogeneity of their team's atmosphere during their exhibition of a prosocial behaviour such as implicit situation processing.

Coupling of Implicit Action Processing and Collective Emotions

Implicit action processing was found to co-occur with midaroused collective emotion significantly above chance in lower-performing teams, as opposed to higher-performing ones (see Table 8). In other words, lower-performing teams were more likely to enact implicit action processing in an emotionally-midaroused team atmosphere. As previously described in Chapters 2 and 3, implicit action processing takes place when team members offer unsolicited comments to their team about a current decision/action, monitor the actions of other team members without any explicit instruction, or provide another teammate with unsolicited feedback or assistance. In order to effectively enact implicit action processing, team members often need to pay close attention to the actions and needs of their teammates, move or lean toward others to be able to check their performance, or speak in a relatively loud voice to get the attention of the entire team about a current decision/action (Marks et al., 2001; Rico et al., 2008). This suggests that team members typically exhibit a high level of emotional arousal while engaging in implicit action processing. Emotional arousal at the team level, however, seems to be less important than individual-level emotional arousal in generating more effective implicit action processing during the crisis (as indicated by nonsignificant global coupling association for higher performers; see Table 8). Rather, it is the characteristic of lower-performing teams to enact implicit action processing at a certain level of collective emotional arousal – namely, at a medium level. Frequent occurrences of implicit action processing in a midaroused team atmosphere could imply that team members are often midaroused themselves when engaging in implicit action processing. Consequently, their level of mental and physical effort (e.g., attention, body movement, tone of voice) would only be high enough to detect and address a more restricted range of action-focused needs in their team, compared with a highly aroused emotional state. This may negatively impact the potency of implicit action processing in the team during the crisis.

Macro-temporal Dynamics

My first research question was focused on identifying the micro-temporal co-occurrences of cognitive processes and collective emotions that could discriminate higher- from lower-performing teams dealing with a crisis event. Given the dynamic character of both cognitive processes and collective emotions, their co-occurrences or couplings was expected to be dynamic as well, changing along a trajectory over time. My second research question, thus, focused on the trajectory of couplings and asked which characteristics of this trajectory could differentiate higher- from lower-performing teams. I used GridWare to trace the unfolding of these couplings over the timespan of the crisis event within each performance cluster. GridWare not only visualizes the coupling trajectory but also provides quantitative measures that characterize the underlying structure and the content of this trajectory. In this way, GridWare enables taking a more holistic view and searching for meaningful macro-temporal patterns that were not obvious by merely looking at the coded data or even at the contingency tables derived from lag sequential analysis (Lehmann-Willenbrock & Allen, 2017; Magnusson, 2000; 2004).

Structure of Coupling Trajectories

The overall structure of the trajectory of the couplings, which was plotted on a two-dimensional grid in GridWare, was examined based on two measures: dispersion and transitions per minute. As previously discussed in Chapter 3, these two measures capture different aspects of the overall variability of a coupling trajectory (Lougheed & Hollenstein, 2016). Whole-grid analyses found no significant difference between the coupling trajectory of higher- and lower-performing teams in terms of dispersion and transitions per minute (see Table 9). In other words, higher performers' trajectory of cognitive-emotional responses to the crisis was not found to be any more or less variable than that of lower performers. Previous research has suggested that higher team effectiveness in dealing with unexpected, rapidly-changing situations requires a wider repertoire of behavioural responses and a broader capacity to flexibly switch from one behavioural response to another (e.g., Burke et al. 2006; Cooke et al., 2013; Ellis & Pearsall, 2011; Lei, Waller, Hagen, & Kaplan, 2016; Waller & Uitdewilligen, 2013). When variations in behavioural responses matches the changing dynamics of the situation at hand, the team would be equipped to switch to the most appropriate response in a timely manner (Ancona & Waller, 2007; Gorman, Cooke, & Amazeen, 2010; Kelly & McGrath, 1985). My analyses showed, however, that behavioural responses in higher-performing teams did not need to demonstrate higher variability over very short timescales. This could be because moment-to-moment fluctuations in behavioural responses often occurred at a faster rate than changes in situational demands (e.g., change of crisis type, new demands from stakeholders during an organizational crisis). Adapting to the dynamics of those situational demands, thus, did not seem to depend on higher moment-to-moment variability in the trajectory of behavioural responses.

Content of Coupling Trajectories

Although the overall variability of the trajectory of couplings between cognitive processes and collective emotions could not differentiate higher from lower team performance during a crisis event, my analyses revealed that the configuration of the attractors across the grid was a significant discriminating factor. More specifically, the coupling trajectory of higher-performing teams was more likely to become absorbed in a single, strong, attracting coupling, as opposed to the coupling trajectory of lower-performing teams which tended to get drawn toward multiple, weaker, attracting couplings. A coupling becomes an attractor when it "pulls" the trajectory from entering other possible couplings. As previously described in Chapter 3, an attractor has two main characteristics: 1) it has a higher probability of recurrence than other couplings, and 2) it has shorter return latency than other couplings. Attractors seem to resemble the notion of interaction patterns, defined as regular sequences of behaviour, both verbal and nonverbal, that team members exhibit during task performance (LePine, 2003; Zellmer-Bruhn, Waller, & Ancona, 2004). However, whereas interaction patterns consist of recurring strings of behaviour that make for a consistent and orderly behavioural trajectory, attractors are not only recurring but also absorbing behaviours that prevent the trajectory from settling in other behaviours. These two constructs, thus, configure the team's behavioural trajectory in two distinct manners. Fewer interaction patterns suggest more ability to shed consistent sequences of behaviours and more flexibility to exhibit new isolated behaviours, as has been found in higher-performing teams (Stachowski et al., 2009; Zijlstra, Waller, & Phillips, 2012). Fewer attractors, on the other hand, indicate that the team has more tendency to settle in a small number of behaviours and exhibits less flexibility to spend equal time in many other potential behaviours, which my research found to be the case in higher-performing teams. Taken together, higher team performance seems to entail displaying more flexibility in one aspect of the team's behavioural trajectory and, at the same time, less flexibility in another aspect. Given the focus of research on interaction patterns has been on patterns of team cognitive processes and the focus of my work was on the coupling of team cognitive processes and collective emotions, these two findings cannot be integrated in a more specific manner. A more in-depth understanding of how attractors and interaction patterns can differentially configure the temporal pattern of higher- versus lower-performing teams facing a crisis event requires performing attractor analysis on the temporal trajectory of team cognitive processes or using pattern detection methods on the couplings of cognitive processes and collective emotions, depending on the focus of the research.

Going beyond the number of attracting couplings, I also looked at the content of these attracting couplings in each performance cluster. The single, strong attracting coupling that pulled the trajectory of higher-performing teams was the coupling between explicit action processing and midaroused-neutral collective emotions. This coupling also emerged as one of the several attracting couplings in the trajectory of the majority of lower-performing teams. While the coupling trajectory of both higher- and lower-performing teams had tendency to settle in the coupling of explicit action processing and midaroused-neutral collective emotions, higher-performing teams were more strongly drawn toward this attracting coupling than lower-performing teams, as suggested by my attractor analysis. Given attractor strength reflects the pull that the attractor has on the coupling trajectory and is determined by the number of return visits or latency to return to the coupling, this result indicates that there were shorter time intervals between successive pulls of the attracting coupling in higher-performing teams. In other words, these teams tended to return to exhibiting this coupling more quickly throughout the crisis event, compared with lower-performing teams.

Explicit action processing includes reciprocal interactions between team members about the team's decisions or members' actions that aims at generating the best solution to the problem and facilitating action coordination (Kolbe et al., 2013). Every time team members engage in explicit action processing, their team has a chance to discuss and update their decisions/actions on the basis of their latest understanding of the situation at hand. During ambiguous, rapidly-changing situations such as crises, team members need to keep returning to discussing and updating their decisions/actions as more information becomes available and they learn more about the root cause of the problem. Explicit action processing, particularly when exhibited consecutively, has been found to be more or less effective depending on the team's emotional atmosphere (Kauffeld & Meyers, 2009; Lehmann-Willenbrock et al., 2011). Those action-focused discussions that occur in an aroused-positive atmosphere are facilitative, engaging, and constructive, thus enhancing team effectiveness. Aroused-negative discussions about decisions/actions, on the other hand, often take the form of complaining, seeking others to blame, or counterproductive arguments, thus wasting precious meeting time and leading to development of poor solutions (Kauffeld & Lehmann-Willenbrock, 2012). These findings, however, are derived from research on regular team meetings and may not be totally applicable to team functioning during crisis situations. As described in Chapter 1, crises are, by definition, hugely consequential to organizational members and communities in terms of losses and damage, and, at the same time, occur with very little response time available. Unlike in a regular team meeting, crisis management teams have to be both meticulous and quick in weighing their options and searching for alternative solutions to avert the risk of facing severe consequences. A highly-aroused team atmosphere may be too distracting and swallow too much cognitive resources for such a thorough and, at the same time, quick review of response options (Maitlis & Sonenshein, 2010). In a positively-valenced team atmosphere, team members are more likely to assess the solutions they have already generated as satisfactory and, thus, less likely to exert as much effort as before in revising their decisions and actions (George & Zhou 2002; Knight, 2015). This may reduce their ability (or motivation) to critically review and quickly update their response in the light of new developments in the crisis situation, which eventually leads to generation of a less effective response. Negatively-valenced discussions might reverse the undesirable function of positively-valenced discussions, but simultaneously reduce the quality of interactions among team members, as previous research has suggested (Kauffeld & Meyers, 2009; Lehmann-Willenbrock et al., 2011). Overall, medium levels of arousal and neutral valence seem to characterize the most beneficial emotional atmosphere for discussing and updating the team's response to the crisis in a meticulous and quick manner. This might explain the higher propensity in higher-performing teams to continually return to the coupling of explicit action processing and midaroused-neutral collective emotions throughout the crisis.

CHAPTER SIX: CONCLUSION

Theoretical and Practical Implications

The present research contributes to two different literatures. First, this study extends the crisis management literature by exploring how more (versus less) effective crisis management teams simultaneously respond to the cognitive and emotional aspects of an organizational crisis. Prominent frameworks for crisis management depict an organizational crisis as a cognitively complex and emotional event which requires a combination of cognitive and emotional responses from the organization (e.g., Hannah et al., 2009; James et al., 2011; Pearson & Clair, 1998; Pearson & Mitroff, 1993). Yet, these frameworks mostly fall short of clearly identifying how these two types of responses combine to characterize more (versus less) team effectiveness during an organizational crisis. Moreover, team-level emotional responses to a crisis situation have generally been less explored than team cognitive responses, with the highest attention having been allocated to positive and negative team-level emotions and almost no scholarly attention to other categories of team-level emotions (e.g., emotional neutrality, emotional arousal and dispersed emotions). In the same vein, previous work has mostly examined the effectiveness of the coupling of team cognitive responses with valenced emotions at the team level, while the possibility of coupling team cognitive responses with other team-level emotions has remained largely under-explored. By using coding schemes that captured a broad and comprehensive range of team-level emotions, I was able to demonstrate that compared with more-studied, valenced emotions at the team level, under-explored categories of team-level emotions could more often determine whether a certain team cognitive process was more or less effective when the team was dealing with a crisis. More specifically, the coupling of team-level midaroused emotions with explicit situation processing and with implicit action processing could distinguish higher-performing crisis management teams from lower-performing ones. Also, the coupling of implicit situation processing with dispersed emotions and with team-level neutral emotions separated higher from lower team effectiveness during the crisis. Finally, the coupling of explicit action processing and midaroused-neutral emotions at the team level was found to more strongly pull the trajectory of higher- than lower-performing crisis management teams. Although often treated as separate, emotion and cognition have been conceptualized as intricately and inseparably linked (Ashkanasy, Humphrey, & Huy, 2017; Forgas, 2008). The current research explored this link at the team level of analysis and demonstrated how it could characterize more (versus less) effective crisis management.

Second, the present research responds to calls for more dynamism in the study of teams (e.g., Cronin, Weingart, & Todorova, 2011; Lehmann-Willenbrock & Allen, 2017; McGrath et al., 2000; Waller et al., 2016) by capturing the unfolding of team cognitive processes and collective emotions as they occurred in real time and examining the temporal dynamics of their co-occurrences over time. Although existing theoretical work often emphasizes the changing nature of both team cognitive processes and collective emotions and characterizes them as dynamically intertwined (e.g., Barsade & Knight, 2015; Marks et al., 2001; Walter & Bruch, 2008), there has been a dearth of empirical research on how their interplay varies over time. We have also known very little about whether and how the temporal dynamics of such an interplay characterize higher (versus lower) team performance. My study is one of the first to address these research gaps by using behavioural observation methods and advanced techniques for quantifying the temporal dynamics of interplays (Bakeman & Quera, 2011; Hollenstein, 2013; Lehmann-Willenbrock & Allen, 2017; Waller & Kaplan, 2016). It is also one the few to focus on the temporal dynamics of the co-occurrences of these two team-level constructs. I performed an in-depth analysis of co-occurrences by examining them at two different temporal scales. At the micro-temporal scale, I performed lag sequential analyses to determine which observed co-occurrences of team cognitive processes and collective emotions were statistically meaningful in higher- versus lower-performing teams facing a crisis event. At the macro-temporal scale, I tracked the evolution of co-occurrences over time by means of an exploratory visualization tool called GridWare. GridWare enabled me to characterize and compare higher- and lower-performing teams' trajectories of co-occurrences in order to further our holistic understanding of how the features of the temporal unfolding of the co-occurrences underlie differences in team performance, particularly in teams dealing with a crisis. This analysis shares an emphasis on the impact of time and the timing of behaviours in teams with time-based theories of team activities and processes (e.g., Gersick, 1988, 1989; Kozlowski, Gully, Nason, & Smith, 1999; McGrath, 1991; Marks et al., 2001) as well as empirical studies on macro-temporal team dynamics (e.g., Ancona & Waller, 2007; Okhuysen & Waller, 2002; Stachowski et al., 2009; Waller, 1999). At the same time, it extends previous work by introducing the concept of attractor and showing how it could provide new information about the behavioural trajectory of higher- versus lower-performing teams. As previously discussed in Chapter 5, attractors are similar to interaction patterns in characterizing the consistency of the behavioural trajectory during task performance. However, the latter construct is based on conceptualizing consistency as recurrence while the former captures a different aspect of consistency, one that is based on both recurrence and short return latency. Attractors can also be distinguished from other macro-temporal factors such as midpoint transitions, episodic cycles and entrainment patterns. For example, while attractors indicate the team's tendency to settle in a small number of behaviours that remain unchanging during task performance, other macro-temporal factors are often used to capture the team's tendency to shift from one behaviour to another during task performance and how attention to time influences this shift.

The findings of my research also have implications for practice by shedding light on how team cognitive processes go hand in hand with collective emotions to characterize higher versus lower team performance during the crisis. First, patterns of behaviour are often extremely difficult to detect, especially for those involved in performing the task at hand (Lehmann-Willenbrock & Allen, 2017; Lei et al., 2015; Magnusson, 2000; 2004). Such patterns may be even more difficult to discern in real time when they encompass the mutual occurrence of two behavioural constructs, as opposed to the occurrence of a single behaviour. A systematic behavioural analysis is needed to identify these patterns and inform practitioners about which patterns enhance (or diminish) team performance. The present study conducted such analysis on teams dealing with a crisis event and its results can help crisis management teams take advantage of behavioural patterns to generate a more effective response to the crisis. For example, my research found explicit situation processing and implicit action processing to be less effective when exhibited in a midaroused team atmosphere. Leaders and members of crisis management teams should, thus, avoid the emergence of these two couplings when their team is dealing with a crisis. More specifically, they need to immediately display highly aroused emotions as soon as a team member (including they themselves) begins to engage in either of these two cognitive processes. They can accomplish this by simply starting to speak in a louder voice, use excessive hand gestures, or poise for action. My study also identified the coupling of implicit situation processing and neutral collective emotion as less effective. This finding suggests that leaders and members of crisis management teams should avoid the emergence of neutral emotional atmosphere during the exhibition of implicit situation processing. Given implicit situation processing can be characterized as a prosocial behaviour and past research has established a strong link between positive collective emotions and prosocial behaviours (Knight & Eisenkraft, 2015), it is recommended that crisis management team leaders and members engage in positive emotional expressions as soon as the exhibition of implicit situation processing begins in their team. They may, for example, smile, crack a joke, tease another teammate in a good-natured way, or simply nod in agreement.

Second, the results can be incorporated into the training of students as well as practitioners to enhance their team-level behavioural capabilities for crisis management. More specifically, practitioners and students could receive training on how to increase the effectiveness of each cognitive process by maintaining (or avoiding) a certain emotional atmosphere in their team during the exhibition of that cognitive process. Emphasis could also be put on the importance of frequently returning to discussing and updating decisions/actions in a midaroused-neutral emotional atmosphere. Crisis simulations can provide practitioners and students with opportunities to practice these behavioural capabilities in a team setting and become more competent in exhibiting more effective couplings while avoiding less effective ones during future crises. Moreover, during debriefings or after-action reviews, trainees could be encouraged to reflect on their team's coupling exhibitions and discuss new ways to ensure an appropriate emotional atmosphere prevails in their team during the occurrence of a certain cognitive process. For example, team members can try to enact each cognitive process with the appropriate emotional tone and make sure their teammates notice their tone in order to increase the likelihood of emotional contagion within their team (Barsade, 2002). Each cognitive process carries a certain "emotional tone" depending on how it is worded and which nonverbal displays accompany it. Implicit situation processing with a positive emotional tone, for instance, may contain positively-valenced words, humour, assent, or nonverbal displays such as smiling or nodding. The emotion embedded in the exhibition of each cognitive process can be transferred to other team members through affective sharing processes such as mimicry and synchrony, resulting in emotional contagion (Kauffeld & Meyers, 2009; Lehmann-Willenbrock et al., 2011). This way, an appropriate collective emotion may emerge and prevail as team members engage in a certain cognitive process.

Limitations and Future Research Directions

This study had several limitations which suggest directions for future research. First, although my exploratory approach helped me surface an under-theorized phenomenon (i.e., coupling of cognitive processes and collective emotions during crisis) and uncover poorly-understood dynamics associated with this phenomenon, the findings should be regarded as provisional and open to revision (Bamberger & Ang, 2016; Behfar & Okhuysen, 2018). In making a first step toward providing insight into how the coupling of cognitive processes and collective emotions characterize more (versus less) effective teams during the crisis, this research offers empirically-grounded "first suggestions" when previous research did not yield any clear predictions (Bamberger, 2018). Future research can treat the results of the present study as testable propositions and subject them to validation. It would also be important to investigate why certain couplings are more (or less) effective during the crisis. As an initial step, those possible explanations presented for each result can be empirically examined and verified.

Second, my research is based on a relatively small sample size of 20 teams. The small sample size reduced the statistical power of some of my analyses. However, I used a considerably rich data (i.e., about 21-minute video recording) for each team. In addition, and congruent with calls for more focus on “actual behaviours” and behavioural patterns in real time (as opposed to retrospective perceptions of behaviour) in groups and organizations (e.g., Baumeister, Vohs, & Funder, 2007; Lehmann-Willenbrock & Allen, 2017), I used fine-grained behavioural coding to capture my focal constructs, which produced a total of 5,629 behavioural events as input to my analyses. Moreover, research that examines relatively few teams in deep detail to develop an understanding of an under-explored phenomenon is not uncommon (e.g., Gersick, 1989; Stachowski et al., 2009; Waller, 1999; Weick, 1993; Zijlstra et al., 2012). Nevertheless, the results of the present study should be considered as initial insights and further research is needed to replicate these findings using a larger sample size.

Third, my findings are based on behavioural observations of teams dealing with a crisis in a simulated environment. Although other studies have also used simulation to examine team-level behaviours (e.g., Christianson, 2017; Stachowski et al., 2009; Su et al., 2013; Tschan et al., 2009; Waller, 1999; Zijlstra et al., 2012), questions may be raised regarding the external validity of the findings. Specifically, because participants were MBA students, they might not have enough motivation to perform as well in a simulated environment as they would in a professional organizational setting. However, as previously stated in Chapter 3, our video observations found no instance of students displaying an inactive or inattentive mode during the simulation so much so that my coders and I decided to remove the entire category of unaroused emotions from the coding scheme. This could indicate that students in this study were fairly engaged with the simulation scenario. Moreover, students knew that their course grade would be influenced by their team performance in the crisis simulation. Therefore, they were very likely to perceive the simulated crisis as consequential.

Another limitation with using simulations for studying crisis management teams concerns their duration. The crisis simulation in my research, for example, was not designed to walk the students through all possible stages of an organizational crisis. Rather, it covered the unfolding of the initial period of a crisis. Although this period is considered the peak of a crisis when the main characteristics of the crisis (i.e., unpredictability, time pressure, and uncertainty) are at their highest level, many crises would not be fully resolved by the end of this period. Crisis management teams may still need to deal with chronic problems that remain unresolved and ensure the organization is on its path to recovery (Kash & Darling, 1998; Pearson & Mitroff, 1993). Therefore, the results of the present study might be associated with the short-term effectiveness of crisis management teams. In field situations, researchers will be able to track the performance of crisis management teams over a longer time span and examine how the temporal dynamics of the coupling between team cognitive processes and collective emotions during the initial period of the crisis characterize the long-term (as opposed to short-term) effectiveness of crisis management teams.

With regard to other future research, it would also be beneficial to conduct a similar study in other contexts to shed light on the generalizability of the results obtained from the present research. For example, as mentioned in Chapter 1, the primary focus of my research was on dual-purpose action teams. However, it may be reasonable to assume that the cognitive and emotional dynamics of dual-purpose action teams differ from those of single-purpose action teams. Unlike dual-purpose action teams, single-purpose action teams are specifically trained to manage crises and spend the majority of their time waiting for or responding to a crisis event (Waller & Uitdewilligen, 2013). These teams may, thus, develop a different (perhaps more confident) perception of the level of cognitive complexity and the intensity of emotional demands imposed by the crisis. Additional research should examine whether and how these dissimilarities change the way single-purpose action teams respond to the cognitive and emotional aspects of the crisis. Furthermore, the present findings are based on studying one type of organizational crisis (i.e., crisis of deception). The intensity of each main characteristic of the crisis (i.e., consequentiality, unpredictability, time pressure, and uncertainty) was also pre-specified and maintained at the same level during the simulated crisis. It would be worthwhile to investigate the research questions of this study in the context of other types of crisis (see Coombs, 2007 for a widely-referenced typology of crises). Future research can also explore how variability in each main characteristic of the crisis, within or across crisis events, influences the effectiveness of the temporal dynamics of the interplay between cognitive processes and collective emotions.

Conclusion

As the old saying goes, into each life some rain must fall. Likewise, we might say, into each business some crisis must occur. Crises typically require team effort to handle an inextricable intertwinement of cognitive complexities with emotional demands. My research shows that the manner in which crisis management teams couple their response to the cognitive and emotional aspects of the crisis may significantly enhance (or undermine) their effectiveness. Moreover, crisis management teams need to be mindful of their coupling exhibition at both micro-temporal and macro-temporal scales. Overall, the present study suggests that rather than examining the dynamics of cognitive processes and collective emotions separately, researchers should consider the coupling of both as possible simultaneous factors in distinguishing higher from lower team performance during the crisis.

REFRENECES

Ancona, D. G., Goodman, P. S., Lawrence, B. S., & Tushman, M. L. (2001). Time: A new research lens. *Academy of management Review, 26*(4), 645-663.

Ancona, D. G., & Waller, M. J. (2007). The dance of entrainment: Temporally navigating across multiple pacers. In B. Rubin (Ed.), *Research in the sociology of work* (Vol. 17, pp.115–146). Oxford, UK: Elsevier.

Ashkanasy, N. M., Humphrey, R. H., & Huy, Q. N. (2017). Integrating Emotions and Affect in Theories of Management. *Academy of Management Review, 42*(2), 175-189.

Bakeman, R., & Gottman, J. M. (1997). *Observing interaction: An introduction to sequential analysis* (2nd edition). Cambridge, UK: Cambridge University Press.

Bakeman, R., & Quera, V. (1995). *Analyzing interaction: Sequential analysis with SDIS and GSEQ*. New York, NY: Cambridge University Press.

Bakeman, R., & Quera, V. (2011). *Sequential analysis and observational methods for the behavioral sciences*. New York, NY: Cambridge University Press.

Bakeman, R., Quera, V., & Gnisci, A. (2009). Observer agreement for timed-event sequential data: A comparison of time-based and event-based algorithms. *Behavior Research Methods, 41*(1), 137–147.

Bakeman, R., Robinson, B. F., & Quera, V. (1996). Testing sequential association: Estimating exact p values using sampled permutations. *Psychological methods, 1*(1), 4-15.

Bamberger, P. A. (2018). AMD—Clarifying What We Are about and Where We Are Going.

Academy of Management Discoveries, 4(1), 1–10.

Bamberger, P., & Ang, S. (2016). The quantitative discovery: What is it and how to get it published. *Academy of Management Discoveries, 2*(1), 1-6.

Barnett, C. K., & Pratt, M. G. (2000). From threat-rigidity to flexibility-Toward a learning model of autogenic crisis in organizations. *Journal of Organizational Change Management, 13*(1), 74-88.

Barsade, S. G. (2002). The ripple effect: Emotional contagion and its influence on group behavior. *Administrative Science Quarterly, 47*(4), 644-675.

Barsade, S. G., & Gibson, D. E. (1998). Group emotion: A view from top and bottom. *Research on Managing Groups and Teams, 1*(4), 81-102.

Barsade, S. G., & Knight, A. P. (2015). Group affect. *Annual Review of Organizational Psychology and Organizational Behavior, 2*(1), 21-46.

Bartel, C. A., & Saavedra, R. (2000). The collective construction of work group moods. *Administrative Science Quarterly, 45*, 197-231.

Bateman, T. S., & Organ, D. W. (1983). Job satisfaction and the good soldier: The relationship between affect and employee “citizenship”. *Academy of Management Journal*, *26,* 587–595.

Baumeister, R. F., Vohs, K. D., & Funder, D. C. (2007). Psychology as the science of self-reports and finger movements: Whatever happened to actual behavior? *Perspectives on Psychological Science*, 2, 396–403.

Bazerman, M., Tenbrunsel, A., & Wade-Benzoni, K. (1998). Negotiating with yourself and losing: making decisions with competing internal preferences. *Academy of Management Review, 23,* 225–41.

Beal, D. J., Cohen, R. R., Burke, M. J., & McLendon, C. L. (2003). Cohesion and performance in groups: A meta-analytic clarification of construct relations. *Journal of Applied Psychology, 88,* 989–1004.

Behfar, K., & Okhuysen, G. A. (2018). Perspective-Discovery Within Validation Logic: Deliberately Surfacing, Complementing, and Substituting Abductive Reasoning in Hypothetico-Deductive Inquiry. *Organization Science,* 1-18.

Bolino, M. C., & Grant, A. M. (2016). The bright side of being prosocial at work, and the dark side, too: A review and agenda for research on other-oriented motives, behavior, and impact in organizations. *Academy of Management Annals, 10*(1), 599-670.

Boon, A. (2016). *Complexity, creativity, teams. Exploring task complexity and creative processes in project teams* (Doctoral Dissertation). University of Leuven.

Breckler, S. J. (1984). Empirical validation of affect, behavior, and cognition as distinct components of attitude. *Journal of Personality and Social Psychology, 47*(6), 1191-1205.

Brief, A. P., & Motowidlo, S. J. (1986). Prosocial organizational behaviors. *Academy of Management Review, 11,* 710–725.

Burke, C. S., Stagl, K. C., Salas, E., Pierce, L., & Kendall, D. (2006). Understanding team adaptation: a conceptual analysis and model. *Journal of Applied Psychology, 91*(6), 1189-

1207.

Burtscher, M. J., Kolbe, M., Wacker, J., & Manser, T. (2011). Interactions of team mental models and monitoring behaviors predict team performance in simulated anesthesia inductions. *Journal of Experimental Psychology: Applied, 17*(3), 257-269.

Burtscher, M. J., Wacker, J., Grote, G., & Manser, T. (2010). Managing nonroutine events in anesthesia: the role of adaptive coordination. *Human Factors, 52*(2), 282-294.

Chorney, J. M., Garcia, A. M., Berlin, K. S., Bakeman, R., & Kain, Z. N. (2010). Time-window sequential analysis: An introduction for pediatric psychologists. *Journal of Pediatric Psychology*, *35*(10), 1061-1070.

Christianson, M. K. (2017). More and Less Effective Updating: The Role of Trajectory Management in Making Sense Again. *Administrative Science Quarterly*, DOI: https://doi.org/10.1177/0001839217750856

Collins, A. L., Lawrence, S. A., Troth, A. C., & Jordan, P. J. (2013). Group affective tone: A review and future research directions. *Journal of Organizational Behavior, 34*(S1), S43-S62.

Connor, M., Fletcher, I., & Salmon, P. (2009). The analysis of verbal interaction sequences in dyadic clinical communication: a review of methods. *Patient Education and Counseling*, *75*(2), 169-177.

Cooke, N. J., Gorman, J. C., & Kiekel, P. A. (2008). Communication as team-level cognitive processing. *Macrocognition in Teams*, 51-64.

Cooke, N. J., Gorman, J. C., Myers, C. W., & Duran, J. L. (2013). Interactive team cognition. *Cognitive Science*, *37*(2), 255-285.

Coombs, W. T. (2007). Protecting organization reputations during a crisis: The development and application of situational crisis communication theory. *Corporate Reputation Review, 10*(3), 163-176.

Corner, P. D., Kinicki, A. J., & Keats, B. W. (1994). Integrating organizational and individual information processing perspectives on choice. *Organization Science 5*, 294-308.

Coultas, C. W., Driskell, T., Burke, C. S., & Salas, E. (2014). A conceptual review of emergent state measurement current problems, future solutions. *Small Group Research*, *45*(6), 671–703.

Cronin, M.A., Weingart, L.R., & Todorova, G. (2011). Dynamics in groups: Are we there yet?. *Academy of Management Annals, 5*(1), 571–612.

DeChurch, L. A., & Mesmer-Magnus, J. R. (2010). The cognitive underpinnings of effective teamwork: a meta-analysis. *Journal of Applied Psychology*, *95*(1), 32-53.

Drach-Zahavy, A., & Freund, A. (2007). Team effectiveness under stress: A structural contingency approach. *Journal of Organizational Behavior*, *28*(4), 423-450.

Edmondson, A. C. (2003). Speaking up in the operating room: How team leaders promote learning in interdisciplinary action teams. *Journal of Management Studies, 40*, 1419-1452.

Ekman, P. (1992). An argument for basic emotions. *Cognition & Emotion*, *6*(3-4), 169-200.

Elfenbein, H. A., Polzer, J. T., & Ambady, N. (2007). Team emotion recognition accuracy and team performance. In N. M. Ashkanasy, W. J. Zerbe, & C. E. J. Hartel (Eds.), *Research on emotions in organizations* (Vol. 3, pp. 87–119). Amsterdam, the Netherlands: Elsevier.

Ellis, A.P. (2006). System breakdown: The role of mental models and transactive memory in the relationship between acute stress and team performance. *Academy of Management Journal, 49*(3), 576-589.

Ellis, A. P., & Pearsall, M. J. (2011). Reducing the negative effects of stress in teams through cross-training: A job demands-resources model. *Group Dynamics: Theory, Research, and Practice, 15*(1), 16-31.

Elsbach, K. D., & Barr, P. S. (1999). The effects of mood on individuals' use of structured decision protocols. *Organization Science, 10*(2), 181-198.

Entin, E. E., & Serfaty, D. (1999). Adaptive Team Coordination. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 41*(2), 312-325.

Fink, S. (1986). *Crisis Management: Planning for the Inevitable*. American Management Association, New York, NY.

Fiore, S. M., & Salas, E. (2004). Why we need team cognition. In E. Salas, & S. M. Fiore (Eds.), *Team cognition: Understanding the factors that drive process and performance* (pp. 235-248). Washington, DC: American Psychological Association.

Forgas, J. P. (2008). Affect and cognition. *Perspectives on Psychological Science*, 3(2), 94-101.

Fredrickson, B. L., Tugade, M. M., Waugh, C. E., & Larkin, G. R. (2003). What good are positive emotions in crisis? A prospective study of resilience and emotions following the terrorist attacks on the United States on September 11th, 2001. *Journal of Personality and Social Psychology*, *84*(2), 365.

Gagné, M. (2009). A model of knowledge-sharing motivation. *Human Resource Management, 48*, 571–589.

Gaudine, A., & Thorne, L. (2001). Emotion and ethical decision-making in organizations. *Journal of Business Ethics, 31*(2), 175-187.

George, J. M., & Zhou, J. (2002). Understanding when bad moods foster creativity and good ones don't: the role of context and clarity of feelings. *Journal of Applied Psychology, 87*(4), 687.

Gersick, C. J. (1988). Time and transition in work teams: Toward a new model of group development. *Academy of Management journal, 31*(1), 9-41.

Gersick, C. J. (1989). Marking time: Predictable transitions in task groups. *Academy of Management journal, 32*(2), 274-309.

Gibson, C. B. (2001). From knowledge accumulation to accommodation: Cycles of collective cognition in work groups. *Journal of Organizational Behavior, 22*(2), 121-134.

Gibson, C. B., & Earley, P. C. (2007). Collective Cognition in Action: Accumulation, Interaction, Examination, and Accommodation in the Development and Operation of Group Efficacy Beliefs in the Workplace. *Academy of Management Review, 32*(2), 438-

458.

Gladstein, D. L., & Reilly, N. P. (1985). Group decision making under threat: The tycoon game. *Academy of Management Journal, 28*(3), 613-627.

Gorman, J. C., Cooke, N. J., & Amazeen, P. G. (2010). Training adaptive teams. *Human Factors, 52*(2), 295-307.

Gump, B. B., & Kulik, J. A. (1997). Stress, affiliation, and emotional contagion. *Journal of Personality and Social Psychology, 72*(2), 305-319.

Hannah, S. T., UhlBien, M., Avolio, B. J., & Cavarretta, F. L. (2009). A framework for examining leadership in extreme contexts. *The Leadership Quarterly, 20*, 897-919.

Hareli, S., & Rafaeli, A. (2008). Emotion cycles: On the social influence of emotion in organizations. *Research in organizational behavior, 28,* 35-59.

Harmon-Jones, E., Gable, P. A., & Price, T. F. (2011). Toward an understanding of the influence of affective states on attentional tuning: Comment on Friedman and Forster (2010). *Psychological bulletin, 137,* 508–512.

Harmon-Jones, E., Gable, P. A., & Price, T. F. (2013). Does negative affect always narrow and positive affect always broaden the mind? Considering the influence of motivational intensity on cognitive scope. *Current Directions in Psychological Science, 22*(4), 301-307.

Harvey, S. 2014. Creative synthesis: Exploring the process of extraordinary group creativity. *Academy of Management Review, 39,* 324 – 343.

Hermann, C. F. (1963). Some consequences of crisis which limit the viability of organizations. *Administrative Science Quarterly, 8*, 61-82.

Hinkle, D. E., Wiersma, W., & Jurs, S. G. (2003). Appl*ied statistics for the behavioral sciences* (Vol. 663). Boston, MA: Houghton Mifflin College Division.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (1997). The emerging conceptualization of groups as information processors. *Psychological Bulletin, 121*(1), 43-64.

Hollenstein, T. (2007). State space grids: Analyzing dynamics across development. *International Journal of Behavioral Development, 31*(4), 384-396.

Hollenstein, T. (2013). *State space grids: Depicting dynamics across development*. New York: Springer.

Hollenstein, T., & Lewis, M. D. (2006). A state space analysis of emotion and flexibility in parent-child interactions. *Emotion, 6*(4), 656-662.

Holmes, M., & Poole, M. S. (1991). The longitudinal analysis of interaction. In B. Montgomery, & S. Duck (Eds.), *Studying interpersonal interaction* (pp. 286-302). New York, NY: Guilford.

Hunziker, S., Laschinger, L., Portmann-Schwarz, S., Semmer, N. K., Tschan, F., & Marsch, S. (2011). Perceived stress and team performance during a simulated resuscitation. *Intensive Care Medicine, 37*(9), 1473-1479.

Hunziker, S., Semmer, N. K., Tschan, F., Schuetz, P., Mueller, B., & Marsch, S. (2012). Dynamics and association of different acute stress markers with performance during a simulated resuscitation. *Resuscitation, 83*(5), 572-578.

James, E. H., Wooten, L. P., & Dushek, K. (2011). Crisis management: Informing a new leadership research agenda. *Academy of Management Annals, 5*(1), 455-493.

Janis, I. L. (1982). *Groupthink: Psychological studies of policy decisions and fiascoes* (Vol. 349). Boston: Houghton Mifflin.

Janis, I. L. (1989). *Crucial decisions: Leadership in policymaking and crisis management*. Simon and Schuster.

Johnson, S. K. (2009). Do you feel what I feel? Mood contagion and leadership outcomes. *The Leadership Quarterly, 20*(5), 814-827.

Kalavar, S., Mysore, M. (2017). Are you prepared for a corporate crisis? *McKinsey Quarterly, 2,* 103-112.

Kaplan, S., LaPort, K., & Waller, M. J. (2013). The role of positive affectivity in team effectiveness during crises. *Journal of Organizational Behavior, 34*(4), 473-491.

Kash, T. J., & Darling, J. R. (1998). Crisis management: prevention, diagnosis and intervention. *Leadership & Organization Development Journal, 19*(4), 179-186.

Kauffeld, S., & Lehmann-Willenbrock, N. (2012). Meetings matter: Effects of team meetings on team and organizational success. *Small Group Research, 43*(2), 130-158.

Kauffeld, S., & Meyers, R. A. (2009). Complaint and solution-oriented circles: Interaction patterns in work group discussions. *European Journal of Work and Organizational Psychology, 18*(3), 267-294.

Kelly, J. R., & Barsade, S.G. (2001). Mood and emotions in small groups and work teams. *Organizational Behavior and Human Decision Processes, 86*(1): 99-130.

Kelly, J. R., & McGrath, J. E. (1985). Effects of time limits and task types on task performance and interaction of four-person groups. *Journal of personality and social psychology, 49*(2), 395.

Kennedy, D.M. & McComb, S.A. (2010). Examining the mental model convergence process through team communication. *Theoretical Issues of Ergonomic Science, 11*(4), 340-358.

King III, G. (2002). Crisis management & team effectiveness: A closer examination. *Journal of Business Ethics, 41*(3), 235-249.

Klonek, F. E., Quera, V., Burba, M., & Kauffeld. S. (2016). Group interactions and time: Using sequential analysis to study group dynamics in project meetings. *Group Dynamics: Theory, Research, and Practice, 20*(3), 209-222.

Knight, A. P. (2009). *Positive affect and project team development and effectiveness* (Doctoral Dissertation). University of Pennsylvania.

Knight, A. P. (2013). Mood at the midpoint: Affect and change in exploratory search over time in teams that face a deadline. *Organization Science, 26*(1), 99-118.

Knight, A. P., & Baer, M. (2014). Get Up, Stand Up The Effects of a Non-Sedentary Workspace on Information Elaboration and Group Performance. *Social Psychological and Personality Science, 5*(8), 910-917.

Knight, A. P., & Eisenkraft, N. (2015). Positive is usually good, negative is not always bad: The effects of group affect on social integration and task performance. *Journal of Applied Psychology*, *100*(4), 1214-1227.

Kolbe, M., Burtscher, M., & Manser, T. (2013). Co-ACT—A framework for observing coordination behavior in acute care teams. *BMJ Quality & Safety*, *22*, 596–605.

Kolbe, M., Grote, G., Waller, M. J., Wacker, J., Grande, B., Burtscher, M. J., & Spahn, D. R. (2014). Monitoring and talking to the room: Autochthonous coordination patterns in team interaction and performance. *Journal of Applied Psychology, 99*(6), 1254–1267.

Kozlowski, S. W. (2015). Advancing research on team process dynamics: Theoretical, methodological, and measurement considerations. *Organizational Psychology Review, 5*(4), 270-299.

Kozlowski, S.W.J., Gully, S.M., Nason, E.R., & Smith, E.M. (1999). Developing adaptive teams: A theory of compilation and performance across levels and time. In D.R. Ilgen & E.D. Pulakos (Eds.), *The changing nature of work performance: Implications for staffing, personnel, actions, and development* (pp. 240–292). San Francisco, CA: Jossey-Bass.

Lamey, A., Hollenstein, T., Lewis, M.D., & Granic, I. (2004). GridWare (Version 1.1). [Computer software]. http://www.statespacegrids.org.

Larsen, R. J., & Diener, E. (1992). Promises and problems with the circumplex model of emotion. *Review of Personality and Social Psychology*, *13,* 25-59.

Lazar, A. (1999). Deceiving oneself or self-deceived? On the formation of beliefs "under the influence". *Mind, 108*(430), 265–290.

Lazarus, R. S. (1991). *Emotion and adaptation*. New York, NY: Oxford University Press.

Leenders, R. T. A. J., Contractor, N. S., & DeChurch, L. A. (2016). Once upon a time: Understanding team processes as relational event networks. *Organizational Psychology Review*, *6*(1), 92–115.

Lehmann-Willenbrock, N., & Allen, J. A. (2017). Modeling temporal interaction dynamics in organizational settings. *Journal of Business and Psychology*. DOI: https://doi.org/10.1007/s10869-017-9506 -9

Lehmann-Willenbrock, N., Meyers, R. A., Kauffeld, S., Neininger, A., & Henschel, A. (2011). Verbal interaction sequences and group mood exploring the role of team planning communication. *Small Group Research, 42*(6), 639-668.

Lei, Z., Waller, M. J., Hagen, J., & Kaplan, S. (2016). Team adaptiveness in dynamic contexts: Contextualizing the roles of interaction patterns and in-process planning. *Group & Organization Management, 41*(4), 491-525.

LePine, J. A. (2003). Team adaptation and postchange performance: effects of team composition in terms of members' cognitive ability and personality. *Journal of Applied Psychology, 88*(1), 27.

Lewis, M. D., Lamey, A. V., & Douglas, L. (1999). A new dynamic systems method for the analysis of early socioemotional development. *Developmental Science*, *2*(4), 457-475.

Liu, F., & Maitlis, S. (2014). Emotional dynamics and strategizing processes: a study of strategic conversations in top team meetings. *Journal of Management Studies, 51*(2), 202-234.

Lougheed, J. P., & Hollenstein, T. (2016). Socioemotional flexibility in mother-daughter dyads: Riding the emotional rollercoaster across positive and negative contexts. *Emotion, 16*(5), 620-633.

Lyubomirsky, S., King, L., & Diener, E. (2005). The benefits of frequent positive affect: Does happiness lead to success? *Psychological Bulletin, 131*, 803–855.

Magnusson, M. S. (2000). Discovering hidden time patterns in behavior: T-patterns and their detection. *Behavior Research Methods, Instruments, & Computers*, 32, 93–110.

Magnusson, M. S. (2004). Repeated patterns in behavior and other biological phenomena. In D. K. Oller & U. Griebel (Eds.), *Evolution of communication systems: A comparative approach* (pp. 111 – 128). Cambridge, MA: The MIT Press.

Mainhard, M. T., Pennings, H. J., Wubbels, T., & Brekelmans, M. (2012). Mapping control and affiliation in teacher–student interaction with state space grids. *Teaching and Teacher Education, 28*(7), 1027-1037.

Maitlis, S., & Sonenshein, S. (2010). Sensemaking in crisis and change: Inspiration and insights from Weick (1988*). Journal of Management Studies, 47*, 551–580.

Maitlis, S., Vogus, T. J., & Lawrence, T. B. (2013). Sensemaking and emotion in organizations. *Organizational Psychology Review, 3*(3), 222-247.

Manser, T., Howard, S. K., & Gaba, D. M. (2008). Adaptive coordination in cardiac anaesthesia: A study of situational changes in coordination patterns using a new observation system. *Ergonomics, 51*, 1153-78.

Manser, T., Harrison, T. K., Gaba, D. M., & Howard, S. K. (2009). Coordination patterns related to high clinical performance in a simulated anesthetic crisis. *Anesthesia & Analgesia, 108*(5), 1606-1615.

Marks, M.A., Mathieu, J.E., & Zaccaro, S.J. (2001). A temporally based framework and taxonomy of team processes. *Academy of Management Review, 26,* 356–376.

Marks, M. A., & Panzer, F. J. (2004). The influence of team monitoring on team processes and performance. *Human Performance, 17*, 25–41.

McGrath, J. E. (1984). *Groups: Interaction and performance*. Englewood Cliffs, NJ: Prentice Hall.

McGrath, J. E. (1991). Time, interaction, and performance (TIP) A Theory of Groups. *Small Group Research*, *22*(2), 147-174.

McGrath, J. E., Arrow, H., & Berdahl, J. L. (2000). The study of groups: Past, present, and future. *Personality and Social Psychology Review, 4*(1), 95-105.

Metiu, A., & Rothbard, N.P. (2013) Task Bubbles, Artifacts, Shared Emotion, and Mutual Focus of Attention: A Comparative Study of the Microprocesses of Group Engagement. *Organization Science, 24*(2), 455-475.

Okhuysen, G. A., & Waller, M. J. (2002). Focusing on midpoint transitions: An analysis of boundary conditions. *Academy of Management Journal, 45*(5), 1056-1065.

Parke, M. R., & Seo, M. G. (2017). The role of affect climate in organizational effectiveness. *Academy of Management Review, 42*(2), 334-360.

Pearson, C. M., & Clair, J. A. (1998). Reframing crisis management. *Academy of Management Review, 23*(1), 59-76.

Pearson, C. M., & Mitroff, I. I. (1993). From crisis prone to crisis prepared: A framework for crisis management. *Academy of Management Executive, 7*(1), 48-59.

Perrow, C. (1984). *Normal accidents: Living with high-risk technologies*. New York, NY: Basic Books.

Poole, M. S., & Roth, J. (1989). Decision development in small groups IV: A typology of decision paths. *Human Communication Research, 15*, 323-356.

Posner, J., Russell, J. A., & Peterson, B. S. (2005). The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathology. *Development and Psychopathology, 17*(03), 715-734.

Quinn, R. W., & Dutton, J. E. (2005). Coordination as energy-in-conversation. *Academy of Management Review, 30*(1), 36-57.

Rafaeli, A., Ravid, S., & Cheshin, A. (2009). Sensemaking in virtual teams: The impact of emotions and support tools on team mental models and team performance. *International review of industrial and organizational psychology, 24*, 151-182.

Rhee, S. Y. (2007). Group emotions and group outcomes: The role of group-member interactions. In E. A. Mannix, M. A. Neale, & C. P. Anderson (Eds.), *Research on managing groups and teams* (vol. 10, pp. 65–95). San Francisco, CA: JAI Press.

Rico, R., Sánchez-Manzanares, M., Gil, F., & Gibson, C. (2008). Team implicit coordination processes: A team knowledge–based approach. *Academy of Management Review, 33*(1), 163-184.

Roe, R. A., Gockel, C., & Meyer, B. (2012). Time and change in teams: Where we are and where we are moving. *European Journal of Work and Organizational Psychology, 21*(5), 629-656.

Russell, J. A. (1978). Evidence of convergent validity on the dimensions of affect. *Journal of personality and social psychology, 36*(10), 1152-1168.

Russell, J. A. (1980). A circumplex model of affect. *Journal of personality and social psychology, 39*(6), 1161-1178.

Saghafian, M., & Waller, M. J. (2015). Cognitive and Affective Dynamics of Mine Rescue Teams. Poster presentation, *2015 INGRoup Conference*, Pittsburgh, PA.

Salas, E., Rosen, M. A., Burke, C. S., Nicholson, D., & Howse, W. R. (2007). Markers for enhancing team cognition in complex environments: The power of team performance diagnosis. *Aviation, Space, and Environmental Medicine, 78*, B77–B85.

Salas, E., Sims, D. E., & Burke, C. S. (2005). Is there a "Big Five" in teamwork?. *Small Group Research, 36*(5), 555-599.

Sanchez-Burks, J., Bartel, C. A., Rees, L., & Huy, Q. (2016). Assessing collective affect recognition via the Emotional Aperture Measure. *Cognition and Emotion, 30*(1), 117-133.

Sanchez-Burks, J., & Huy, Q. N. (2009). Emotional aperture and strategic change: The accurate recognition of collective emotions. *Organization Science, 20*(1), 22-34.

Sayegh, L., Anthony, W. P., & Perrewé, P. L. (2004). Managerial decision-making under crisis: The role of emotion in an intuitive decision process. *Human Resource Management Review*, *14*, 179–199.

Schachter, S. (1959). *The psychology of affiliation*. Stanford, CA: Stanford University Press.

Schmutz, J., Hoffmann, F., Heimberg, E., & Manser, T. (2015). Effective coordination in medical emergency teams: The moderating role of task type. *European Journal of Work and Organizational Psychology, 24*(5), 761-776.

Schraagen, J. M., Veld, M. H., & De Koning, L. (2010). Information sharing during crisis management in hierarchical vs. network teams. *Journal of contingencies and crisis management*, *18*(2), 117-127.

Smith-Jentsch, K. A., Kraiger, K., Cannon-Bowers, J. A., & Salas, E. (2009). Do familiar teammates request and accept more backup? Transactive memory in air traffic control. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *51*(2), 181-192.

Sohrab, G. (2014). *Patterns of team interaction under asymmetric information distribution conditions* (Doctoral dissertation). York University.

Sommer, S. A., Howell, J. M., & Hadley, C. N. (2016). Keeping positive and building Strength the role of affect and team leadership in developing resilience during an organizational crisis. *Group & Organization Management, 41*(2), 172-202.

Spoor, J. R., & Kelly, J. R. (2004). The evolutionary significance of affect in groups: Communication and group bonding. *Group Processes and Intergroup Relations*, *7*(4), 398–412.

Stachowski, A. A., Kaplan, S. A., & Waller, M. J. (2009). The benefits of flexible team interaction during crises. *Journal of Applied Psychology, 94,* 1536-1543.

Staw, B.M., Sandelands, L.E., & Dutton, J.E. (1981). Threat-rigidity effects on organizational behavior. *Administrative Science Quarterly, 26*, 501–524.

Stubbart, C. I. (1987). Improving the quality of crisis thinking. *Columbia Journal of World Business*, *22*(1), 89-99.

Su, L., Kaplan, S., Burd, R., Hargrove, A., Winslow, C., & Waller, M. (2013). 504: The best trauma teams demonstrate teamwork patterns similar to the best nuclear power plant teams. *Critical Care Medicine, 41*(12), A123.

Sundstrom, E., De Meuse, K. P., & Futrell, D. (1990). Work teams: Applications and effectiveness. *American psychologist*, *45*(2), 120-133.

Thompson, E. R. (2007). Development and validation of an internationally reliable short-form of the positive and negative affect schedule (PANAS). *Journal of cross-cultural psychology, 38*(2), 227-242.

Totterdell, P., Kellett, S., Teuchmann, K., & Briner, R. B. (1998). Evidence of mood linkage in work groups. *Journal of Personality and Social Psychology*, *74*(6), 1504-1515.

Townsend, S. S., Kim, H. S., & Mesquita, B. (2014). Are you feeling what I’m feeling?

Emotional similarity buffers stress. *Social Psychological and Personality Science, 5*(5), 526-533.

Tschan, F., Semmer, N. K., Gurtner, A., Bizzari, L., Spychiger, M., Breuer, M., & Marsch, S. U. (2009). Explicit Reasoning, Confirmation Bias, and Illusory Transactive Memory: A Simulation Study of Group Medical Decision Making. *Small Group Research, 40*(3), 271-300.

Tschan, F., Semmer, N. K., Hunziker, S., & Marsch, S. U. (2011). Decisive action vs. joint deliberation: Different medical tasks imply different coordination requirements. In V. G. Durry (Ed.), *Advances in Human Factors and Ergonomics in Healthcare* (pp. 191-200). London: Taylor & Francis.

Uitdewilligen, S. (2011). *Team adaptation: A cognitive perspective* (Doctoral Dissertation). Maastricht University.

Uitdewilligen, S., Waller, M. J., & Zijlstra, F. R. (2010). Team Cognition and Adaptability in Dynamic Settings: A Review of Pertinent Work. *International Review of Industrial and Organizational Psychology, 25*(2010), 293-353.

Van Katwyk, P. T., Fox, S., Spector, P. E., & Kelloway, E. K. (2000). Using the Job-Related Affective Well-Being Scale (JAWS) to investigate affective responses to work stressors. *Journal of Occupational Health Psychology*, *5*(2), 219-230.

Waller, M. J. (1999). The timing of adaptive group responses to nonroutine events. *Academy of Management Journal, 42*, 127–137.

Waller, M. J., Gupta, N., & Giambatista, R. (2004). Effects of adaptive behaviors and shared mental model development on control crew performance. *Management Science, 50*, 1534-1544.

Waller, M. J., & Kaplan, S. A. (2018). Systematic Behavioral Observation for Emergent Team Phenomena Key Considerations for Quantitative Video-Based Approaches. *Organizational Research Methods*, *21*(2), 500-515.

Waller, M. J., Lei, Z., & Pratten, R. (2014). Focusing on teams in crisis management education: An integration and simulation-based approach. *Academy of Management Learning & Education*, *13*(2), 208-221.

Waller, M. J., Okhuysen, G. A., & Saghafian, M. (2016). Conceptualizing emergent states: A strategy to advance the study of group dynamics. *Academy of Management Annals*, *10*(1), 561–598.

Waller, M. J., & Roberts, K. H. (2003). High reliability and organizational behavior: Fnally the twain must meet. *Journal of Organizational Behavior, 24*, 813-814.

Waller, M. J., & Uitdewilligen, S. (2008). Talking to the room: Collective sensemaking during crisis situations. In R. Roe, M. Waller, & S. Clegg (Eds.), *Time in organizations: Approaches and methods* (pp. 186–203). London: Routledge.

Waller, M. J., & Uitdewilligen, S. (2013). Transition in Action Teams. In G. B. Graen, & J. A. Graen (Eds.). *Management of team leadership in extreme context* (pp. 165–194). Charlotte, NC: Information Age Pub.

Walter, F., & Bruch, H. (2008). The positive group affect spiral: A dynamic model of the emergence of positive affective similarity in work groups. *Journal of Organizational Behavior, 29*(2), 239-261.

Wang, S., & Noe, R. A. (2010). Knowledge sharing: A review and directions for future research. *Human Resource Management Review, 20*, 115–131.

Watson, D., & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological Bulletin, 98*(2), 219-235.

Watson, D., Wiese, D., Vaidya, J., & Tellegen, A. (1999). The two general activation systems of affect: Structural findings, evolutionary considerations, and psychobiological evidence. *Journal of Personality and Social Psychology, 76*(5), 820.

Weick, K. E. (1993). The collapse of sensemaking in organizations: The Mann Gulch disaster. *Administrative Science Quarterly*, *38*(4), 628-652.

Weick, K. E., & Sutcliffe, K. M. (2001). M*anaging the unexpected: Assuring high performance in an age of complexity* (1st edition). San Francisco, CA: Jossey-Bass.

Weiss, H., & Cropanzano, R. (1996). Affective events theory: A theoretical discussion of the structure, causes and consequences of affective experiences at work. In B. Staw & L. Cummings (Eds.), *Research in organizational behavior* (Vol. 18, pp. 1–74). Greenwich, CT: JAI Press.

Wharton, A. S., & Erickson, R. J. 1993. Managing emotions on the job and at home: Understanding the consequences of multiple emotional roles. *Academy of Management*

Review, 18, 457 – 486.

Wickens, T. D. (1989). *Multiway contingency tables analysis for the social sciences*. Hillsdale, NJ: Erlbaum.

Wittenbaum, G. M., Stasser, G., & Merry, C. J. (1996). Tacit coordination in anticipation of small group task completion. *Journal of Experimental Social Psychology, 32*(2), 129-152.

Yoder, P. J., & Symons, F. J. (2010). *Observational measurement of behavior.* New York, NY: Springer.

Yu, T., Sengul, M., & Lester, R. H. (2008). Misery loves company: The spread of negative impacts resulting from an organizational crisis. *Academy of Management Review*, *33*, 452-472.

Zaheer, S., Albert, S., & Zaheer, A. (1999). Time Scales and Organizational Theory. *Academy of Management Review, 24*(4), 725-741.

Zellmer-Bruhn, M., Waller, M. J., & Ancona, D. (2004). The effect of temporal entrainment on the ability of teams to change their routines. In S. Blount, M. A. Neale, & E. A. Mannix (Eds.), *Research on managing groups and teams* (Vol. 6, pp. 135–158). Oxford, UK: Elsevier Science Press.

Zijlstra, F. R., Waller, M. J., & Phillips, S. I. (2012). Setting the tone: Early interaction patterns in swift-starting teams as a predictor of effectiveness. *European Journal of Work and Organizational Psychology, 21*(5), 749-777.

APPENDIX A: CODING SCHEME FOR TEAM COGNITIVE PROCESSES

Category	Definition	Description	Example	kappa
Explicit situation processing				.69
Information request	Coded if one team member directly asks *another member or the whole team* for information about the situation at hand	- acquire task information addressing a particular team member or the room at large - ask questions about anything related to task (i.e., situation) - ask for input and relevant task-related information *with an expectation for an overt reaction from other team members*	"John, what is going on with our stock price?" "Did anyone receive an email from the CEO?"	
Information evaluation	Includes statements verifying information, questioning information, and providing summary about the situation at hand Evaluation between two people, no physical or verbal engagement from other members	- make sense of information about the situation by explicit reasoning - discuss, summarize or interpret the state of affairs - express doubts or assurance regarding the accuracy or source of information (can be between two or more people)	"That means we may lose our client." "Are you sure DoD suspended our contract?"	
Information on request	Coded if a team member answers a task-relevant question asked by another member	- supply information *only in response to direct questions* - answer direct questions about the situation at hand	"Yes, they suspended our contract."	

Category	Definition	Description	Example	kappa
Implicit situation processing				.69
Gathering information	Coded if a team member actively gathers information from the environment (*but not from the actions of other teammates*) without being asked to do so	- obtain *unsolicited* task-relevant Information - monitor the laptop, the cell phone, the memos and other documents looking for task-relevant information - track team resources and environmental conditions as they relate to the task at hand	Reviewing the organization's recent press releases	
Talking to the room (situation-focused)	Coded if a team member addresses a communication *not to a particular team member but to the room at large* in order for the team to gain mutual understanding of the situation and problem	- absence of eye contact with other members - speak relatively loudly - address to the entire team	"We seem to have calmed the client for now."	
Information without request	Coded if a team member provides information to *a particular teammate* without being asked to do so	- provide *unsolicited* task-relevant Information - *proactively* transfer information about the situation at hand - occurs when a team member *anticipates* that a teammate needs a piece of information and provides it without being asked to do so	"A news reporter just contacted us and asked for comments on the DoD's allegations." Answering the question that is addressed to another team member	

Category	Definition	Description	Example	kappa
Explicit action processing				.73
Task distribution (giving instructions)	Includes directives, commands, or assignment of subtasks	- suggest/state a decision about what the team should do - give order or assign tasks to another member - task distribution, delegation - verbalizations of a past action addressed to a particular team member	"I'll write back to the reporter, you email our security team." "We should write a short press release now."	
Action-focused inquiry	Coded when a team member asks questions to seek *verification* or *clarification* about a current decision/action, or *requests feedback* on one's own actions	- seek verification about a decision or task distribution - ask a question to make sure they are about to do the right thing - request feedback from other team members on one's own actions	"I'll explain everything to the client, ok?" "Are you sending the email now?"	
Speaking up	Coded when a team member *challenges* a current decision/action, *corrects* the action of another team member, or *provide feedback* on the action of a *particular team member*	- questions to express *doubt* concerning a current action or a previous task distribution - point out mistakes in decision/action and suggest correct course of action - give feedback to a *particular team member* in a positive/negative manner	"Do we really want to ignore the reporter?" "No, you should take a softer tone with the client at this stage."	
Planning	Includes questions and discussions about the team's *action plan* and verbalizations of *non-immediate* considerations regarding what should be done and when	- evaluate options for decision/action as part of a back-and-forth discussion among team members (when the decision is made, it is coded as task distribution) - consider the *consequences* of an action on other actions or situational factors - prioritization, sequencing - present *if-then scenarios*	"When we finish action A, we can start doing action B." "We have to be careful with our action A because it has an impact on action B".	

Category	Definition	Description	Example	kappa
Implicit action processing				.55
Team member monitoring	Coded when a team member observes the actions of other team members	- observe others' work accomplishment to ensure that everything is running as expected - observe teammates to make certain that they are following procedures correctly	Team member watches what another team member is doing Standing behind active team member, e.g. when they are typing their email	
Talking to the room (action-focused)	Includes comments *addressed to the room at large* on the performance of own current behaviour or team-level performance, as well as brief indications of satisfaction with the team's fulfilment of task	- address *the whole team*, not a specific team member - absence of eye contact with other members - speak relatively loudly - verbalizations of own behaviour or personal need for something *without addressing a particular team member*	"I am contacting the security team." "I have already replied to Chris." (addressed to the room at large)	
Providing assistance without request	Coded when team members provided *unsolicited* help or *anticipated* an action being required for a smooth work process performed by another team member and took this action *without being asked to do so*	- offer assistance (verbally or non-verbally) - *anticipate* another's need for help and offer them this help - fill in for someone else, help a teammate to correct a mistake, provide resources or supplies	"Can I help you with this?" Although a particular team member is responsible for writing the press release, his or her teammate has already created a draft and passes it on to him or her.	

Category	Definition	Description	Example	kappa
Residual				.62
Acknowledgements	Includes verbal statements or nonverbal expressions indicating one has heard or understood given information or instruction	- *repeat or paraphrase* what one just heard from another team member - acknowledge that a message was received - request a message to be repeated - include statements of general agreements	"Ok." "No, please repeat." "Fine." "Sorry, what?"	
Also includes incomplete or inaudible sentences, Utterances that are irrelevant to the task hand, and Multiple cognitive processes occurring simultaneously				

APPENDIX B: CODING SCHEME FOR DISPALYED EMOTIONS

Emotion Category	Behavioural Indicator	Description
Aroused-Positive	Facial cues	F: laugh or smile with teeth showing F: arched eyebrows F: a lot of eye contact
	Vocal cues	V: high pitch V: rapid pace V: loud volume V: animated intonation, rhythmic pattern
	Postural cues	P: exaggerated hand gestures P: constant body movement P: orienting toward team members P: excessive nodding to show agreement
	Verbal cues	B: direct reference to the emotion category; example: “I feel excited”; “this is exciting!”
Aroused-Neutral	Facial cues	F: a lot of eye contact F: open mouth F: arched eyebrows
	Vocal cues	V: rapid pace V: varied inflection V: incredulous tone
	Postural cues	P: poised for action P: startled P: restless
	Verbal cues	B: talking over each other or interrupting one another
Aroused-Negative	Facial cues	F: eyebrows lowered, chin raised, mouth closed F: flushed face F: tight jaws, clenched teeth F: vertical lines appear between eyebrows F: eye roll
	Vocal cues	V: stuttering V: short of breath V: uneven pitch (voice "cracks") V: uneven volume V: mocking or condescending laugh
	Postural cues	P: closed fists, waving fists, hitting motions P: hand tremors P: poised for action P: involuntary twitches or jerks P: nervous habits (rocking, chewing fingernails)
	Verbal cues	B: direct reference to the emotion category; example: “This is disgusting”; “I feel anxious” B: sarcasm, mockery B: verbal cruelty, insults

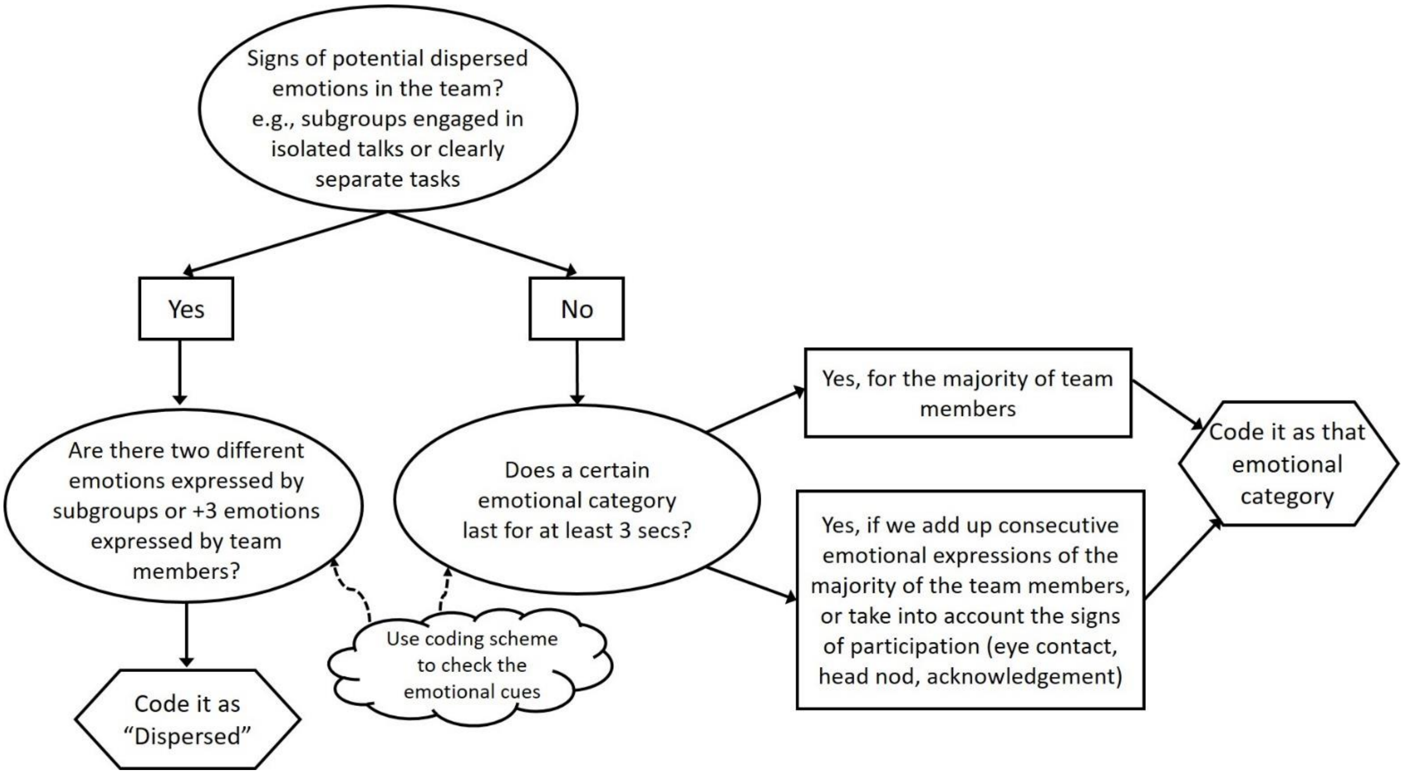
Emotion Category	Nonverbal Cues	Description
Midaroused-Positive	Facial cues	F: slightly raised eyebrows F: closed lip smile (grin), subtle laugh, chuckle F: eyes scan stimuli
	Vocal cues	V: varied inflection V: clearly audible volume V: shared subtle laughter between team members
	Postural cues	P: hands are active during speech P: head tilted toward stimuli P: body poised to include team members P: nodding to show agreement
	Verbal cues	B: an explicit statement of an midaroused-positive emotion; example: “I am happy”; “This feels good” B: direct reference to sb/sth being funny B: joking or good-natured teasing of others relevant to the conversation
Midaroused-Neutral	Facial cues	F: the face is neutral (resting face) F: be careful of wrinkles, pouches and bags that are permanent
	Vocal cues	V: even, relaxed voice V: within comfortable pitch range V: flat or monotone voice quality, but no trace of dejection, sternness or sullenness
	Postural cues	P: torso is stable P: medium-level physical engagement with others or the task P: may have some small hand gestures
	Verbal cues	B: information exchange or question-response exchange without expressing any positive or negative emotion
Midaroused-Negative	Facial cues	F: frown F: eyes avoid stimuli F: blank stare
	Vocal cues	V: average volume V: normal or fast pace V: monotone V: mumbling V: negative tone in utterance
	Postural cues	P: head tilted downward P: resting head on hands P: body slightly poised for action or to exclude group members
	Verbal cues	B: an explicit statement of a midaroused-negative emotion; example: “I am frustrated”; “This is annoying”; “It feels sad”.

Emotion Category		
Dispersed	Definition	In a 4-member team, dispersed collective emotion occurs where the observer can identify two subgroups of 2-member, each of which is expressing a different emotional category. In a 5-member team, dispersed collective emotion occurs when the observer can identify two subgroups of either 2-member or 3-member, each of which is expressing a distinct emotional category. Dispersed collective emotion can also occur when every single member of the team is expressing a different emotional category.
	Cues	When there is an isolated conversation within a subgroup of members and the rest of the team is not directly involved or does not pay attention to it, there is a good chance the team is experiencing dispersed emotions. See the decision flowchart for identifying team-level collective emotions (Appendix C) for more details.

Note:
Kappa values for categories of emotional valence and of emotional arousal are as follows:

High arousal: .63
Medium arousal: .62
Positive valence: .62
Neutral valence: .52
Negative valence: .27
Dispersed: .52

APPENDIX C: DECISION FLOWCHART FOR CODING COLLECTIVE EMOTIONS



Note: This decisions flowchart is specifically developed for coding collective emotions in a 4-member or 5-member team with a coding interval of 10 seconds