

Inter-Organizational Problem Solving Among Disaster Managers:
The Role of Common Ground

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Abstract

Despite disaster managers' best efforts, inter-organizational disaster management suffers from varying levels of success. One factor that is likely to account for these variations is team mutual understanding, also known as common ground. To validate the potential effect of common ground in disaster management, the thesis investigates common ground in several interviews with disaster managers and in an experimental study involving an inter-organizational disaster event scenario. Analysis of interviews revealed that disaster managers perceived gaps in understanding between responders, the importance of mutual understanding, and perceived common ground similarly to depictions in theory with a few exceptions. Analyses of the experimental study indicated that contextual factors of Team composition, Problem solving approach and Type of tasks differently impacted measures of performance and implicit coordination, and that implicit coordination partially mediated and suppressed the relationship between contextual factors and decision quality. Findings suggest the variation in disaster managers' performance can be ascribed to common ground, implicit coordination, and contextual factors. Moreover, results showed the satisfaction with outcome did not correlate with expert rated quality of decision; and that while satisfaction related to consensus and quality of the decision was linked to generating alternative ideas and debate. Collaboration proved to be more effective in public communication tasks, especially for homogenous team composition. The findings support initiatives for more cross-training and further lab and field experiments.

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The most difficult paths are the most worthwhile. “Remember, mountains only become mountains when pushed, when slammed against fierce immovable opposition. The harder they crash, the taller they grow. So too do we.” – Tyler Knott Gregson

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Inter-Organizational Problem Solving Among Disaster Managers:**The Role of Common Ground**

When critically important decisions need to be made in disaster management, it is rare to find only one individual or one organization in control of it all. Important decisions often require inter-organizational problem solving to ensure the best possible outcome. In order to be able to work together under such circumstances, some common understanding is likely to be necessary. What is the nature of the required ‘common ground’ and how is it affected by context? This thesis examined the experience of disaster managers across various disaster responder organizations. After a brief literature review in Chapter 1, two studies documented ‘common ground’ through mixed methods. Chapter 2 presents an article on a qualitative study reporting the content of interviews with disaster managers; while Chapter 3 consists of an article on an experimental simulation scenario manipulating team composition, mode of problem-solving, and type of tasks with experienced disaster managers. Chapter 4 provides a discussion delineating the contributions, limitations, and future avenues for this research.

CHAPTER 1: CONCEPTUAL BACKGROUND

Inter-Organizational Disaster Management

The word disaster is used to identify a crisis which is non-routine in nature and has a major impact on a community including either extensive physical damage or threat to the wellbeing and life of citizens. An example of a famous disaster in eastern Canada was the ice storm of 1998. The ice storm took place for 5 days, where ice accumulated outdoors on power lines and trees. Power outages affected approximately four million households and lasted up to three weeks. Power outages impacted transportation, communication, energy, financial systems, and human vital services. A variety of organizations were involved such as: local, regional, provincial, and federal government, disaster responders (police, fire, and ambulance), local power utilities (Ontario Hydro, Hydro-Quebec, etc.), agriculture and environmental sectors, and the Canadian Forces (Lemyre et al., 2009).

Disaster management usually involves a cycle of phases: 1) disaster preparedness measures (e.g. training), 2) hazard mitigation efforts (e.g. installing levees), 3) disaster response (e.g. search and rescue), and 4) disaster recovery (e.g. restoring basic services) (Waugh Jr. & Streib, 2006).

The word disaster also elicits an inter-organizational context, where different types of organizations must work together. Three types of disaster management organizations are usually identified as: 1) organizations that use an incident command system (ICS) structure (e.g. Police, Fire, EMS). ICS is a hierarchical structure that changes depending on the organizations involved in the event, and leadership is transferred to the most qualified organization. 2) Military organizations that use a fixed hierarchical structure (aka. command and control) that is limited to members within the military. 3) Organizations that use Non-

ICS structures (e.g. public sector government agencies, non-governmental organizations, private sector). This category includes all other organizations that do not follow a formal hierarchical organizational structure (Lemyre et al., 2009).

The various specialized individuals involved need to coordinate, cooperate, and collaborate with one another to make high quality decisions and to perform to the best of their abilities. The multifaceted nature of a disaster requires inter-organizational problem solving among disaster managers. A common obstacle in an inter-organizational environment is the lack of a shared cognition, defined as a mutual understanding, among team members (Carroll, Rosson, Convertino, & Ganoe, 2006). A team is defined as “a distinguishable set of two or more people who interact, dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, who have each been assigned specific roles or functions to perform, and who have a limited life-span of membership” (Salas, Dickinson, Converse, & Tannenbaum, 1992).

Shared cognition also referred to as shared mental models or common ground, between team members is normally considered essential for effective team work. Thus, the research question in this thesis is “Is common ground and the grounding process important to inter-organizational disaster management problem solving teams?”

A review of the research concerning shared cognition and disaster management begins by outlining the disaster management context and positions shared cognition in this context. This is followed by a detailed account of shared cognition in disaster management from a shared mental models perspective. A critique of the shared mental models perspective is presented yielding to the notion of common ground theory.

Disaster Management

Unfortunately, disaster management response suffers from varying levels of success and this is often associated to disaster manager's ability to work together. For example, the unsuccessful response to Hurricane Katrina has often been associated with disaster managers' failure to cooperate with one another (Burns & Thomas, 2006). In addition, disaster managers' success working with one another during the Indian Tsunami was attributed to the effectiveness of the disaster response (Lemyre et al., 2009). These examples demonstrate that inter-organizational team work is not necessarily as straightforward as one may think.

Problem solving approaches that disaster responders implement include coordination, cooperation, and collaboration (Lemyre et al., 2009). Coordination is characterized as a process where individuals with congruent goals work together, communicate, and share information; while cooperation is characterised as a process where individuals with mutual goals work together and share not only information but also resources. Lastly, collaboration is considered to be a process where individuals with a common goal work together and share information, resources, and power, to identify a solution which is beyond their own individual capabilities (Gray, 1989; Lemyre et al., 2009; Taylor-Powell, Rossing, & Geran, 1998). These definitions are appropriate for the current thesis as they operationalize some of the governance literature (Paquet, 1999, 2009).

As seen in Figure 1, these three approaches to problem-solving exist on a continuum that moves from coordination to cooperation to collaboration, building onto one another. Sharing increases across the span of the continuum, where the highest level of sharing at the end of the continuum (See Figure 1) (Lemyre et al., 2009).

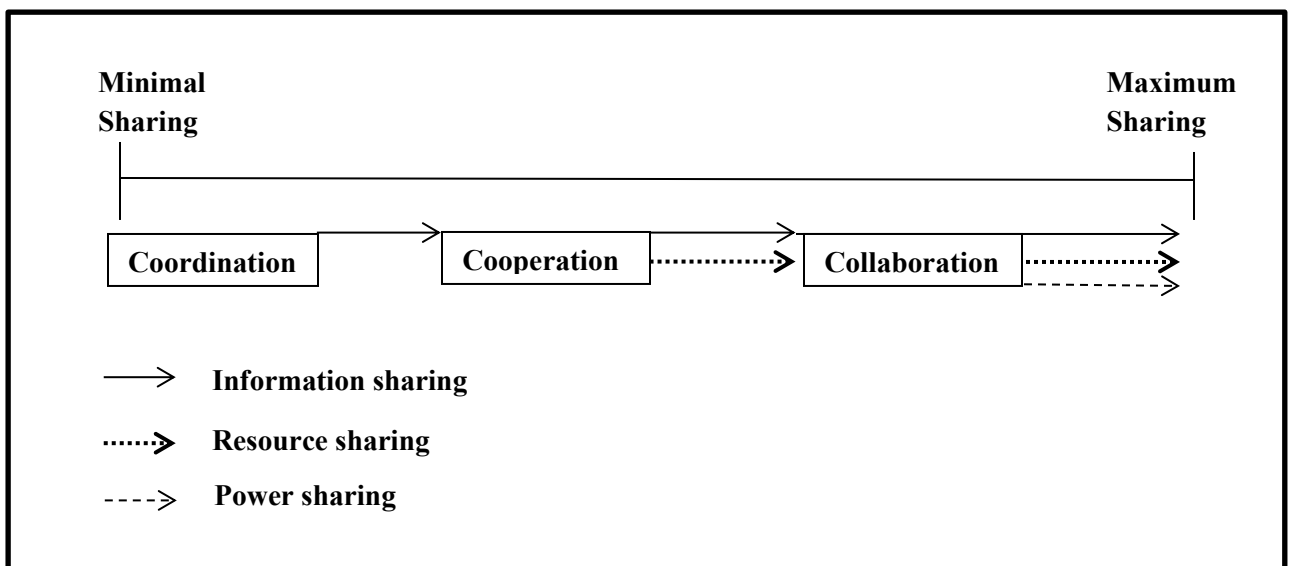


Figure 1. Problem Solving Approach Continuum (adapted from Lemyre, et al. 2009)

Overall, disaster management can be described as inter-organizational problem solving efforts to mitigate, respond to, and recuperate a community from the effects of a non-routine crisis.

Shared Cognition in Disaster Management

As demonstrated in the ice storm example, responding to disasters requires problem solving between many organizations. Inter-organizational problem solving comes with a host of difficulties including mutual understanding, referred to as a shared cognition (Tchouakeu et al., 2011). In a multi-disciplinary team context, shared cognition is defined as compatible perspectives, knowledge, and expectations of the team and task. Compatible refers to the fact that perspectives, knowledge, and expectations must not be identical and that different knowledge (e.g. expertise) is also crucial to task performance (Cannon-Bowers & Salas, 2001).

Shared cognition is often lacking between inter-organizational group members due to team members lack of familiarity with other organizations and the differences between organizations (e.g. organizational structure, cultures, vocabulary, etc.) (Vlaar, Van den Bosch, & Volberda, 2006). It seems that differences between organizations contribute to the development of different perceptions. In fact a study by Sutcliffe and Huber (1998) demonstrated that approximately 40 percent of the variance in executives' perceptions of their environment is explained by organizational and industry membership.

It has been found that greater heterogeneity of perception exists *between* organizations and industries than *within* organisations and industries (Sutcliffe & Huber, 1998). Heterogeneity of cognitive perceptions has been said to causes members from different organizations to develop multiple and potentially conflicting interpretations,

varying expectations, different perspectives of the problem, distinct goals, and dissimilar understandings of the cause-effect relationships, etc. (Sutcliffe & Huber, 1998; Vlaar et al., 2006).

The problems that arise from such varying expectations and interpretations have been demonstrated in a study by Sharma and Kearins (2011). Observational notes and interviews revealed that eight local authorities, engaged in a collaborative relationship, held varying expectations regarding the focus of the task and the collaborative process. Individuals' also experienced conceptual ambiguity. Participants indicated that these issues caused confusion, made communication difficult, wasted a considerable amount of time, and caused participants to consider ending the collaborative relationship (Sharma & Kearins, 2011). These problems are especially problematic between new partners who are unfamiliar with one another, as new relationships are riddled with unknowns and ambiguities concerning interpretations of the situation (Ring & Van De Ven, 1994).

These concerns are relevant in a disaster management context which requires inter-organizational problem solving, and is characterized above by diversity of perspectives, a lack of shared cognition, and problematic outcomes such as frustration and wasted time. Disaster management often involves interactions between organizations with large differences in structure and a lack of familiarity of one another. For example, the Military and the Red Cross are very different organizations and rarely need to interact with one another except in extreme cases. The research associates these characteristics with the exacerbation of cognitive differences within the team and their related problems.

Thus, shared cognition seems to be a legitimate issue for disaster management. When considering the importance of disaster management and the fact that time is often very

constrained in crisis, it seems that shared cognitions in disaster management would be important to mitigate potentially harmful and time consuming confusion. The relevance of shared cognitions brings us to examine shared cognition approaches. The most well-known shared cognition approach is the shared mental models approach.

Mental Models

Individual Mental Model

The idea of mental model first presented itself in the writings of Kenneth Craik (1967), although he did not use the term mental model, he proposed that the mind forms small scale models of reality to anticipate and reason. The term mental model can be found among various disciplines such as cognitive psychology, business systems dynamics research, computer science, and engineering. Generally speaking a mental model is an individual's mental representation of their world. A mental model is composed of the knowledge we extract from the world around us (Johnson-Laird, 1983).

Cognitive perspectives of mental models assume that mental models store knowledge in memory in an organized, structured, and meaningful pattern (Johnson-Laird, 1983; Rouse & Morris, 1986). The organized structured patterns of knowledge (i.e. mental models) facilitate rapid and flexible information processing as they function as a heuristic. When information is sought related information is primed, making related information more easily accessible.

This is very useful in situations where rapid comprehension and response are needed (Cannon-Bowers, Salas, & Converse, 1993). However, a mental model is not composed of just any knowledge in general but rather knowledge that has predictive value (Rouse & Morris, 1986). There seems to be a general consensus across fields that mental models are

composed of knowledge which enables individuals to understand, explain, and make predictions about their surroundings (Johnson-Laird, 1983; Markman & Gentner, 2001; Rouse & Morris, 1986).

Mental models are a product of and use both top down and bottom up processing. Bottom up processing involves identifying, combining, and using important knowledge from stimuli in the environment. Top down processing is less explicit in the majority of mental model definitions; it refers to mental models extracting and utilizing knowledge from short and long-term memory (Kolkman, Kok, & van der Veen, 2005; Wickens, 1984).

Shared Mental Models

Shared mental models are an extension of individual mental model and can be defined as “organized knowledge that is shared by team members” (Orasanu & Salas, 1993 p.8). It has been suggested that performing teams hold shared mental models of the task and of the team (Orasanu & Salas, 1993). Team and task knowledge consist of declarative knowledge, procedural knowledge, and explanations. This knowledge can be specific and concrete or general and abstract (Rouse, Cannon-Bowers, & Salas, 1992).

Team knowledge consists of information about the team members of the group; this includes having knowledge about the other members’ skills, abilities, preferences, experiences, tendencies and information about what their roles entail (Cannon-Bowers et al., 1993; Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995). Task knowledge is specific to the task at hand; this includes having information regarding procedures, strategies, and environmental constraints. Team and task knowledge is important in being able to form shared expectations (shared cognition) of one’s team and the task, and the ability to explain the task and explain the team’s behaviour (Cannon-Bowers et al., 1995).

Shared team and task mental models are of importance as shared knowledge structures allow a team to develop compatible expectations (Wickens, 1984). They also enable team members to implicitly coordinate and improve team performance (Cannon-Bowers et al., 1993; Entin & Serfaty, 1999). Specifically, implicit coordination is a process which requires a shared common ground to enable members to anticipate one another's needs before a request is made. This is in contrast to explicit coordination, which is a process where team members plan together by using verbal communication and using verbal requests and instruction (Cannon-Bowers et al., 1993; Entin & Serfaty, 1999). Effective teams are said to be able to switch from explicit to implicit coordination during times of stress (e.g. times of high workload) (Entin & Serfaty, 1999). To enable implicit coordination a shared mental model can be developed through social interactions (familiarity) and prior experience (Blickensderfer, Reynolds, Salas, & Cannon-Bowers, 2010) as well as through cross-training exercises.

Cross-training. Cross training is “an instructional strategy in which each team member is trained in the duties of his or her teammates” (Volpe, Cannon-Bowers, Salas, & Spector, 1996). Cross-training introduces team members to each other's roles and responsibilities to foster basic knowledge concerning teammate's inter-personal activities (Cannon-Bowers, Salas, Blickensderfer, & Bowers, 1998). Cross-training is useful for teams which face complex tasks which require a team to provide expertise, experience, and multiple perspectives while working towards a common goal (Mohammed & Ringseis, 2001).

There are three types of cross-training which vary in intensity and methods. The first type of cross-training is positional *clarification*; positional clarification involves learning

information about each teammate's job and responsibilities using discussion methods. The second type is positional *modeling*; it begins by using positional clarification methods and follows this by allowing teammates to learn about one another's roles through observational methods (e.g. informative film). The last type of cross-training is positional *rotation*.

Positional rotation begins with positional clarification and modelling, and builds onto this by allowing team members to actively learn how to carry out other team members' jobs (Blickensderfer, Cannon-Bowers, & Salas, 1998). Researchers often follow these cross-training methods by measuring the shared knowledge within a team to assess the level of knowledge overlap (aka: sharedness).

Measurement. Measurement of shared mental models is referred to as cognitive mapping. Cognitive mapping involves identifying overlapping concepts and relationships (e.g. causality, proximity, resemblance, etc.) which are of importance to individuals' knowledge in a certain domain; and graphically representing them. There are two types of cognitive mapping. The first type of cognitive mapping is interactively elicited cause mapping (IECM). IECM involves obtaining information from participants by using questionnaires or interviews. Participants are asked whether one concept influences the other, if so whether the influence is positive or negative and whether the relationship is weak moderate or strong (Bougon, Weick, & Binkhorst, 1977; Mohammed, Klimoski, & Rentsch, 2000).

Multiple IECM mapping methods exist. For example, the pairwise comparisons method uses questionnaires to evaluate relationships between paired concepts on a likert scale (Langan-Fox, Code, & Langfield-Smith, 2000; Mohammed et al., 2000). These ratings can be used to calculate mental model similarity scores through the use of multidimensional

scaling (MDS) or pathfinder (PF) software. Another commonly used method is the visual card sorting technique. In this technique participants are asked to sort concepts on cards to represent the proximal relationships between them, and explain the card arrangement (Langan-Fox et al., 2000; Mohammed et al., 2000). Also, a frequently used method is content analysis, which involves coding text (interview transcripts, speeches, etc.) and identifying concepts that are of importance to the domain of interest.

The second type of cognitive mapping is text-based cause mapping (TBCM) (Langan-Fox et al., 2000) which involves post-hoc analysis of data (transcripts, documents). Concepts and the relationships between concepts are coded. The data obtained using cognitive mapping methods is graphically mapped and can be compared to one another to create a shared mental model map by identifying overlapping concepts and relationships. (Carley, 1997; Crandall, Klein, & Hoffman, 2006; Mohammed et al., 2000).

Measurements of implicit coordination, such as anticipation ratios, are also used as an indicator of shared mental models. To obtain anticipation ratios, coding matrices are used to code communication (request information, request action and task, transfer information, transfer action and task, acknowledgement) and its destination (leader to all, leader to second in command, etc.). Anticipation ratios are calculated by dividing the number of transfers to a single individual by the number of requests made by that individual. A ratio greater than 1.0 indicates that the individuals' needs are being anticipated, or that information transfer is changing from explicit to implicit coordination (Entin & Serfaty, 1999).

The literature recommends using multi-method approaches to measuring shared mental models, as there is a wide disagreement among the field regarding which method is the best.

This completes the description of a mental model and the shared mental models approach.

Now that the reader has an understanding of the shared mental models approach, the review can evaluate the literature on shared mental models in a disaster management context.

Shared mental models in disaster management. To date there has been very little shared mental models research in disaster management teams. One exception to this is a study by Smith & Dowell (2000), who interviewed first responders (fire, police, ambulance) involved in a railway accident. The study found that responders held shared mental models of general priorities and specific responsibilities, which allowed the responders to work around one another at the disaster site. First responders also held weak shared mental models of the overall inter-organizational structure of those involved in decision making. This caused problems in coordination between managers at different locations. Overall, this research demonstrates that shared mental models are important for coordination in disaster management.

The benefit of shared mental models has also been demonstrated in research containing elements of the disaster situation: High workload, Time pressure, and Risk.

High workload context. Shared mental models beneficial effect on disaster team decision making can be demonstrated through its benefits in high workload environments. Cannon-Bowers et al. (1998) varied some or no cross-training and high and low workload conditions among decision making teams of navy recruits and trainees. Results found that cross-trained groups performed significantly better in high workload conditions. In addition, teams who were cross-trained partook in more implicit coordination behaviour than did teams who were not cross trained. Other studies have also found similar results (Stout, Cannon-Bowers, Salas, & Milanovich, 1999).

Research has also demonstrated that teams trained to implicitly coordinate perform significantly better than those who did not receive any training during times of high workload (Entin & Serfaty, 1999). Thus, the beneficial direct effect of shared mental models and indirect effect by implicit coordination on teams persists even in high workload conditions.

Time pressure. Shared mental models beneficial effect on disaster management teams can be demonstrated through its benefits in situations characterized by time pressure. Schaafstal and Bots (1997) varied high and low time pressure and types of cross-training among decision making teams. Results established that groups with more similar mental models perform significantly better no matter the level of time pressure (Schaafstal and Bots study 1997 as cited in McCann, Baranski, Thompson, & Pigeau, 2000). Thus, the study demonstrates that the valuable effects of shared mental models on teams persist even in situations characterized by time pressure.

Risk management. Shared mental models beneficial effect on disaster management team decision making can be demonstrated through its benefits in high risk situations. Mathieu, Rapp, Maynard, and Mangos (2009) measured team mental models, collective efficacy, team effectiveness, and peer ratings of effectiveness among air traffic controller teams. Results indicated that the level of mental models “sharedness” positively correlated with the level of team effectiveness and collective efficacy within air traffic control teams (Mathieu et al., 2009). The benefit of shared mental models has also been demonstrated in operation procedures, where collective cognitive briefing made a significant effect on team performance (Einav et al., 2010). Thus, the beneficial effect of shared mental models on teams has been demonstrated to persist in high risk situations.

The research has demonstrated that the benefits of a shared mental model prove to persist in a disaster management context. It has also demonstrated that performance and team problem solving quality vary depending on level of the shared mental model. These results suggest that shared mental models may account for the past varied successful teamwork and performance among inter-organizational disaster managers.

Critique of the Shared Mental Models Approach Applicable to Disaster Management

The studies above demonstrate that a shared mental model provides an explanation as to the varied behaviour and performance observed among disaster managers in past events. However, critiques of shared mental models also point out that this approach may not be ideal for the current study, as the approach overemphasizes shared knowledge, does not consider the impact of contextual factors on shared knowledge, and does not recognize the importance of shared beliefs. The current section will summarize critiques on the shared mental model approach and explain its relevance for disaster management.

Shared Knowledge

The shared mental models approach has been critiqued for its simplicity as the theory only considers knowledge in common and overlooks the benefit of diverse knowledge among team members. Often diverse knowledge is the reason for team coordination, cooperation, and collaboration. Teams come together so that their diverse knowledge can be pooled and a multifaceted decision can be made to solve complex problems.

The shared mental models approach also overlooks the limits of shared knowledge (Carroll et al., 2006). A literature review on information sharing found that teams tend to focus on shared knowledge and often neglect to combine their diverse knowledge. Failing to combine diverse knowledge may cause the group to overlook important information and

make a faulty decision (Carroll et al., 2006; Mohammed & Dumville, 2001). This research demonstrates that certain levels of shared knowledge could hurt rather than help group performance. This suggests that there may be an optimal balance of shared knowledge that would facilitate group performance. It seems reasonable to assume that not all information is relevant to all participants and that team members should only share critical information.

In the context of disaster management it would seem that both shared and diverse knowledge are important. The research on mental models above demonstrated that shared knowledge enables implicit coordination and improves team performance. It also seems reasonable to assume that diverse knowledge is important in disaster management, as problems are beyond the scope of one organizations knowledge. Rather, multiple actors from various organizations must work together to pool their diverse knowledge and perspectives and decide on the best course of action.

Context

The shared mental models approach has been critiqued for its simplicity, as the approach fails to account for the importance of the cultural and physical context surrounding shared knowledge. An individual's cultural context can impact shared knowledge (Carroll et al., 2006). As discussed earlier, Sutcliffe and Huber (1998) demonstrated that organizational culture fosters different cognitive perspectives among managers. Although individuals share the same knowledge it is very possible for individuals from different fields of study to come to very different conclusions.

One's physical context is also important in the development of shared knowledge (Carroll et al., 2006). For example, physical distance plays a role in how individuals share knowledge. Technology mediated communication can become a barrier as individuals may

not be able to read one another's body language, read environmental cues, visually assess an individual's understanding, efficiently clear up miscommunication. These are just some examples, but it is obvious that different modes of communication may delay or prevent certain knowledge from passing from one individual to the next (Clark & Brennan, 1991).

In disaster management the cultural and physical context is indeed important. Culture is an important factor as disaster managers often come from various organizational backgrounds and international backgrounds. The physical context also plays a role as it is quite common for disaster managers to communicate through telephone, e-mail, and video conferencing as they are often in distributed teams. This may impact the level of knowledge that is transmitted between various team members.

Shared Beliefs

The shared mental models approach has been critiqued for its simplicity as the approach does not consider the importance of shared beliefs within a team (Carroll et al., 2006; Mohammed & Dumville, 2001). Shared beliefs have demonstrated to be quite important for team performance.

Edmondson (1999) analyzed the shared belief that the team is safe for interpersonal risk taking (psychological safety beliefs) and its relation to team learning and performance. Results revealed a positive relationship between psychological safety beliefs and team learning. Results also revealed that team learning behavior mediates the positive relationship between team psychological safety beliefs and team performance. These results demonstrate that beliefs are important for team learning as well as for team performance.

In addition, Walsh, Henderson, & Deighton (1988) found that the range of belief structures discussed and the amount of shared belief structures were positively related to

performance. This study demonstrates that both sharing beliefs and diversity of beliefs within a team is important for student team performance. The balance between shared knowledge and diverse knowledge also seems to apply to beliefs. Divergent beliefs are important for divergent perspectives on the problem at hand, and shared beliefs are important for team understanding in order to avoid miscommunication (Mohammed & Dumville, 2001).

In a disaster management context it seems that shared and diverse beliefs are relevant for team work. One's beliefs about teammates' expertise on certain topics may impact whether information is taken seriously, or who is sought out for additional information. Both diverse beliefs and shared beliefs seem relevant in a disaster management context. Diverse beliefs contribute to different perspectives which are valuable when dealing with multifaceted problems that require comprehensive solutions, and shared beliefs help individuals understand one another and avoid confusion.

Summary

Overall, it seems that the mental models approach is too simple of an explanation for describing the varied behaviour and performance observed among disaster managers in past events. An approach that is an evolved version of the mental models approach is the common ground approach. The common ground approach is more suitable for describing disaster managers' past varying behaviour and performance, as it emphasizes the importance of essential shared knowledge, shared expectations, and shared beliefs, and considers the social, physical, and cultural context in the formation of common ground (Carroll et al., 2006; Mohammed & Dumville, 2001).

Common ground

Common ground was proposed by Clark and Brennan (1991) as an alternative, defined as shared knowledge as well as shared beliefs and assumptions. It has also been defined as a mutual understanding between individuals, is not fixed in nature but flexible, and is shaped by the social, cultural, and physical context (e.g. familiarity, heterogeneous terminology, use of technology mediated communication, etc.) (Carroll et al., 2006).

Two types of common ground have been identified: 1) content common ground, and 2) process common ground. Content common ground can be defined as “the shared understanding on the subject and focus of work” (Convertino, Mentis, Rosson, Slavkovic, & Carroll, 2009, p.2340). For example, one needs to understand the topic of discussion, why this topic is being discussed, and have a general sense of what information is known by others to participate in the team work. Process common ground can be defined as a “shared understanding of rules, procedures, timing, and manner in which the interaction will be conducted” (Convertino et al., 2009, p. 2340). For example, individuals need to understand how the group is working to complete their objective in order to share information effectively (Convertino et al., 2008, 2009).

Common ground develops through the grounding process, which consists of team members interacting with the purpose of reaching the shared belief that they understand one another adequately enough to work together and complete their purpose (Clark & Brennan, 1991). Common ground is important as it provides mutual understanding between actors, which is essential for effective communication, coordination, and collaboration (Carroll et al., 2006; Convertino et al., 2008).

Common ground is formed through team interaction as the grounding process involves verbal communication and non-verbal interactions. Team members may build common ground by exchanging information on available resources, voicing their perceptions, participating in debates, participating in negotiations, etc. Common ground is also built through non-verbal interactions including contextual cues and body language (Carroll et al., 2006; Clark & Brennan, 1991; Convertino et al., 2008).

Depending on one's familiarity (social context) with the individuals or the task one may possess even more mutual understanding. The means of communication (physical context) may also impact the development of common ground, as the use of e-mail or teleconferencing may facilitate or hinder communication. Additionally, common ground may be hindered or facilitated by the heterogeneity or homogeneity of the team (cultural context), as communication is often more difficult in heterogeneous teams (Carroll et al., 2006; Clark & Brennan, 1991; Convertino et al., 2008).

Measurement

Measures of common ground attempt to assess the level of shared understanding that exists between team members.

Qualitative interviews/focus groups. Common ground can be measured through the use of qualitative interviews and focus groups. One on one interviews often involve having the participant recall a specific incident and to identify where team problem solving broke down and why. On the other hand, focus groups are often given a hypothetical situation and group discussion centres on what actions should be taken (Reddy et al., 2009).

Agreement in recall. Another measure of common ground involves rating the agreement in recall. If group communication has been effective and team members

understood one another all participants share a similar perception of the discussion and agreed upon solutions. Without a good level of common ground, individuals recall differs. Agreement in recall can easily be measured using interviews or questionnaires that ask participants to list solutions and supporting arguments following a decision making task (Convertino et al., 2008; McCarthy, Miles, & Monk, 1991; Monk, McCarthy, Watts, & Daly-Jones, 1996).

Scores of common ground are calculated by counting the unique recollections, where smaller numbers indicate higher levels of common ground (McCarthy et al., 1991; Monk et al., 1996) Alternatively, when the number of items correctly recalled is counted, larger numbers indicate higher levels of common ground (Convertino, Mentis, Ting, Rosson, & Carroll, 2007).

Subjective rating scales. Studies have also measured common ground using subjective rating scales in questionnaire formats. Participants are asked to rate their agreement on a 7 point likert scale on items asking about ease of communication, development of understanding, understanding and expression, environmental awareness, and interpersonal awareness (Computer Supported Collaboration and Learning Lab, 2006; Convertino et al., 2009; Monk et al., 1996). Decreases of scores on items that measure ease of communication (e.g. “it was very hard to converse effectively”) are interpreted as an increase of common ground. As effortful communication, such as detailed explanations, is not needed the more the team understands one another.

Questions concerning the development of understanding (e.g. “my teammates and I developed more shared understanding about the task over time”) reflect levels of common ground relating to elements of the task. Lastly, queries on understanding and expression and

awareness or interpersonal awareness (e.g. “I was able to understand my teammates with no difficulty”) signify levels of common ground relating to the teammates. Higher scores among these measures signify higher levels of common ground (Computer Supported Collaboration and Learning Lab, 2006; Convertino et al., 2009).

Communication structure. Common ground is also measured by looking at the communication structure. Increases in common ground are characterized by an increase in efficiency of communication, as conversation topics need fewer introductions and explanation. Efficiency in communication is marked by more frequent conversational turns, decreases in the time per conversational turn, and decreases in words per turn. Measures of common ground often code for these changes across tasks to assess whether common ground has increased (Convertino et al., 2008).

Changes in dialogue acts. Gains in common ground also lead to changes in dialogue acts including clarifications acts, process management acts, and information transfer acts. The changes in these acts can be accounted for by levels of content common ground, process common ground, and implicit coordination. Specifically, gains in content common ground are said to lead to decreases in clarification acts (e.g. statements to verify a partners understanding), as individuals need less and less additional information to understand ongoing interactions (Convertino et al., 2008; Veinott, Olson, Olson, & Fu, 1999).

Gains in process common ground are said to lead to the decrease of process management acts (e.g. statements that direct the group on how to perform the work), as individuals who share an understanding of the process (how the task should be completed) no longer need to overtly voice their management preferences or give specific instructions. Gains in acts which provide new information without elicitation paired with a decrease in

queries and their replies across tasks indicate that information transfer is changing from explicit to implicit coordination. Measures of implicit coordination are also frequently used to as indicators of common ground (Convertino et al., 2008).

The measures listed above are often used in various combinations to demonstrate converging results. Both qualitative and converging quantitative measures are used in common ground disaster management research.

Common Ground in Disaster Management

Common ground literature can provide a description for inter-organizational disaster managers' behaviour and performance. Overall, little research has been conducted on common ground in a disaster management context. Within this limited literature, results have found that disaster managers share little common ground which is due to their limited shared experiences working together and the lack of information sharing (Reddy et al., 2009).

Similar findings are also revealed in research that has analyzed the development of common ground in repetitive disaster management planning tasks among graduate student teams. Results found that common ground, performance, and implicit coordination increased across shared experiences (across number of tasks). In addition, the results suggest a potential positive relationship exists between common ground, performance, and implicit coordination (Carroll et al., 2007; Convertino et al., 2008, 2007).

These changes have also been shown to be influenced by the means of communication, as software which enables revisability and reviewability of shared information facilitates the development of more shared knowledge (common ground), implicit coordination, and increases the quality of team performance (Convertino, Mentis,

Slavkovic, Rosson, & Carroll, 2011). Thus, the study demonstrates that the valuable effects of common ground on teams persist in disaster management tasks.

The benefit of common ground in disaster management teams has also been demonstrated in research containing elements of a disaster context: high workload, high risk, and time pressure. The benefit of common ground in disaster management teams has been demonstrated in an observational study of the field operations of special weapons and tactics (SWAT). The study concluded that common ground was important for coordination among SWAT teams, and that it was fostered through training exercises, briefings before the mission, and re-calibration during the mission (Jones & Hinds, 2002).

SWAT training fostered common ground as team members hold the same understanding of standard procedures. Common ground was also fostered through briefings before the mission by supplying situation specific knowledge (e.g. number and description of suspects, team member roles, etc.). Additionally, common ground was fostered by re-calibration a process where individuals update one another on their position; this maintains a common understanding of where all team members are located and the status of the mission. The common ground that was built through each of these methods allows team members to use their knowledge, beliefs, and assumptions to act in unison and coordinate effectively throughout the task (Jones & Hinds, 2002). Thus, this study demonstrates the value of common ground on teams persists even in situations characterized by high workload, high risk, and time pressure.

The benefit and importance of common ground in disaster management teams has also been demonstrated in research that links a lack of common ground with a breakdown in coordination in situations characterized by high workload, high risk, and time pressure.

Weick (1993) conducted a case study of the Mann Gulch disaster in Montana which resulted in the deaths of 13 firefighters. Analyses revealed that there was a lack of common ground among the group of fire fighters.

The first indicator that common ground did not exist among the firefighters was that there was confusion as to whether the fire was serious or not. The body language of the senior firefighters seemed to suggest that the fire was not serious, as they ate lunch and took pictures while hiking toward the river. However, the instincts of the firefighters were telling them that the fire was serious as the flames looked intense. The second indicator was that the firefighters were not clear on who was in charge of the team and yet felt compelled to follow orders (Weick, 1993).

The third indicator was that individuals did not understand the actions of the foreman due to a lack of shared knowledge. For example, when the team was hiking toward the river for safety the foreman turns them away from the river, as he is the only member of the team that sees the fire jump ahead of them. This causes confusion among the team but they continue to follow him. The fourth indicator was that verbal orders from the foreman are not understood by team members. For example, when the fire has almost surrounded the team the foreman lights a fire and yells “join me” pointing at the fire he has lit. The team is confused as they are unaware that he wants them to lie and take shelter in the grass that has already burnt. At this point the firemen abandon the team and begin to act independently. Unfortunately, 13 of the firemen perished in the fire (Weick, 1993).

The investigation following the incident concluded that if the firemen had followed the foreman’s orders to shelter in the burnt grass that they all would have lived (Weick, 1993). Overall, it seems that lack of common ground between the firemen built confusion to

the point where individuals abandoned the team and put their lives at risk. This study demonstrates that common ground is important for proper coordination and decision making and that a lack of common ground in a team can lead to unfortunate outcomes.

Overall, this research demonstrates common ground can provide a description for inter-organizational disaster managers past varied behaviour and performance. First, it demonstrates that the beneficial effects of common ground persist in a disaster management context. In addition, it demonstrates that performance and the quality of the team work depend on team common ground.

Summary

Overall, the literature on shared cognition has demonstrated to provide a description for inter-organizational disaster managers past varied behaviour and performance. Shared cognition has shown to be vital to the development of implicit coordination and is vital to quality team work and performance. Both the shared mental model research and the common ground research demonstrate that shared cognition can be fostered within disaster management teams to improve team work, team performance, and implicit coordination.

Based on the critique of the mental model approach this research has chosen to follow the common ground approach, as it seems to be an evolved version of the shared mental models approach. However, this does not negate what has been learned in the shared mental model literature. The current study considers the reviewed literature in its entirety when the term common ground is used. A model of common ground extracted from the literature and theory is presented in Figure 2 to give the reader a holistic view of common ground and its relationship to performance and various contextual elements.

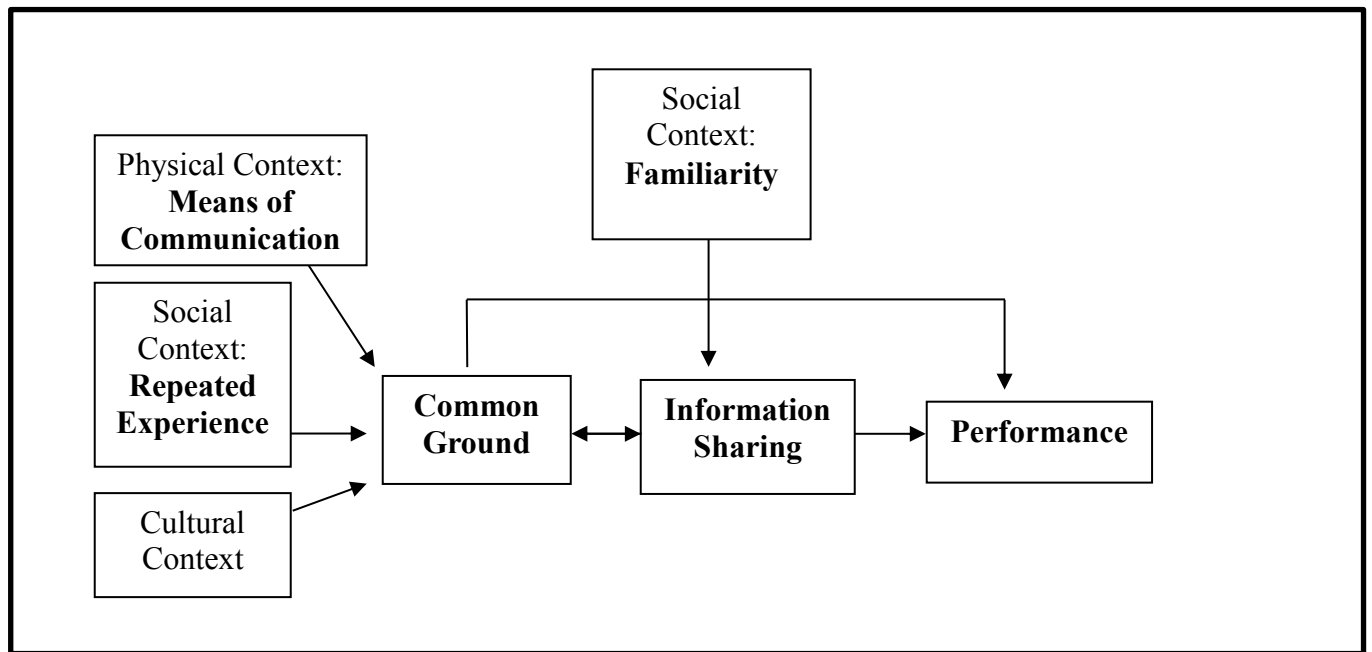


Figure 2. Model of common ground derived from disaster management literature and common ground theory.

The literature review has also highlighted gaps within the common ground and disaster management research. First, the research suffers from a lack of studies that involve true inter-organizational disaster manager teams and considered the true inter-disciplinary disaster environment. Up until now, the majority of the research focuses on homogenous work teams or student teams involved in routine tasks. In addition, the research analyzing the role of social, cultural, and physical context are also very limited in the literature. With a few exceptions, the majority of the research focuses in on the relationship between common ground and performance.

Overall, the generalizability of the existing literature to inter-organizational disaster management context is weak. Further research is required to firmly conclude that common ground accounts for the past varied successful teamwork and performance among inter-organizational disaster managers.

Thesis Goal and Objectives

The current thesis addresses how common ground and the grounding process are important to inter-organizational disaster management problem solving teams. This thesis attempts to establish whether common ground and the relationships in the literature are recognized as important by emergency managers themselves; as well as whether quantitative effects can be established. This will be carried out in two studies.

The first study's objective was to describe the experience of common ground in inter-organizational disaster management through the analysis of interviews with senior disaster managers. The second study was an experimental quantitative study where senior disaster managers participated in table top tasks, where team composition and problem solving approach was varied. This study sought to demonstrate how some contextual elements such

as team composition (organizational cultural context), problem solving approach (social context), and task type (social context) impact the development of common ground, impact performance, and a hypothetical causal sequence between these factors in inter-organizational disaster management.

CHAPTER 2:
THE EXPERIENCE OF COMMON GROUND IN DISASTER MANAGEMENT

Running Head: DESCRIBING COMMON GROUND

Common Ground in Inter-Organizational Disaster Management:

A Qualitative Analysis of Senior Disaster Manager Interviews

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Abstract

Disasters worldwide are calling for an inter-organizational approach to disaster management. Unfortunately, disaster managers' performance in inter-organizational environments has been inconsistent. One factor that seems likely to account for these variations is misalignment of mutual understanding, referred to as common ground. In order to describe the experience of common ground in inter-organizational disasters, a series of qualitative interviews were carried out with senior disaster managers. Qualitative content analysis revealed that participants perceived gaps in understanding between disaster managers. Disaster managers reported specific contextual barriers and facilitators to inter-organizational understanding such as the lack of familiarity and regular interactions. These results varied according to structure of hierarchy and incident command systems, which can be attributed to the distinctions in work environments. These findings suggest that the variation in disaster managers' ability to work with one another require a minimum of mutual understanding, and that this can and should be fostered through intersectoral exercises and training.

Common Ground in Inter-Organizational Disaster Management:**A Qualitative Analysis of Senior Disaster Manager Interviews**

Worldwide the number of natural and man-made disasters is ever increasing and calling for a multisectoral whole of government and whole of society approach to disaster management (World Health Organization, 2013). Unfortunately, coordination and collaboration between multiple disaster management organizations is not without its challenges. In fact, successful and unsuccessful disaster management outcomes are often attributed to managers' ability to work together. For example, the response to Hurricane Katrina has often been considered a failure and has been attributed to stakeholders' inability to cooperate with one another (Burns & Thomas, 2006). Furthermore, the successful response to the Indian Tsunami was credited to stakeholders' capacity to work with one another and address multiple issues (Lemyre et al., 2009). Overall, these examples illustrate that disaster managers' ability to work with one another is crucial to the quality of the response.

One factor that may account for the variation in inter-organizational disaster managers' ability to work with one another is mutual understanding, often referred to as common ground. Theory suggests that common ground builds between team members through interaction with one another. In addition, it is said that social, physical, and cultural contextual factors impact its development (Carroll et al., 2006). Common ground has shown to be essential for team work and performance (Carroll et al., 2006; Convertino et al., 2008). Thus, the research questions addressed in this study is: To what extent is common ground important to inter-organizational disaster management problem solving teams? This study

attempts to establish whether common ground and the relationships in the literature are recognized as important by emergency managers themselves.

Previous literature suggests that common ground is an important issue for inter-organisational disaster managers. This is supported by the fact that the beneficial effects of common ground have shown to persist in disaster management and in situations with disaster characteristics such high workload, risk, and time pressure. In addition, common ground studies have demonstrated that performance and how well the team works together is dependent upon levels of common ground.

Few studies have explored common ground with real disaster managers and have considered the multifaceted disaster environment. Additionally, the majority of the research focuses on common ground's relationship with performance, and tends to overlook the contributing contextual factors. Lastly, to date the very limited inter-organizational disaster management research on common ground has mainly focused on homogenous teams with only one type of responder such as police, or fire, or paramedics.

The current study seeks to add to the limited literature on common ground and disaster management. It also attempts to fulfill the goal of the study by demonstrating the importance of common ground in disaster management, by providing a detailed description of common ground in disaster management from the perspective of disaster managers. This objective will be fulfilled using four steps. The first step is to identify what topics disaster managers perceive to understand and not understand about other disaster management organizations. The second step is to identify what information is essential for common ground among inter-organizational disaster managers. The third step is to describe disaster managers' perceptions of how inter-organizational understanding is connected to

performance, information sharing, implicit coordination, and contextual factors in disaster management. The fourth and last step is to identify contextual (social, cultural, and physical) barriers and facilitators.

Common Ground

Common ground is defined as shared knowledge, beliefs, and assumptions (Clark & Brennan, 1991), and more recently as a shared understanding of content and process (Carroll et al., 2006). Common ground is considered essential for performance (Carroll et al., 2006; Convertino et al., 2008), specifically a shared understanding concerning the topic of work (content common ground) and a shared understanding concerning how the task is to be performed (process common ground) (Convertino et al., 2009).

Common ground is considered to be flexible and is shaped by the social, cultural, and physical context (Carroll et al., 2006); by way of the grounding process which involves verbal and non-verbal interaction between individuals (Clark & Brennan, 1991). Common ground is said to be essential for effective communication, which is often referred to as implicit coordination: as individuals with a shared knowledge are able to anticipate each other's needs and volunteer information. Common ground is also said to be essential to team coordination, and collaboration outcomes (Carroll et al., 2006; Convertino et al., 2008).

Problems with common ground present themselves more extensively in diverse teams with little familiarity (Sutcliffe & Huber, 1998; Vlaar et al., 2006), which is common in disaster management. Disaster managers rarely interact with one another, except in large disasters where they do not have time to get to know one another and must be performing at their best. In addition, disasters often bring together disaster managers who differ in terms of their organizational structure.

Disaster management organizations can be subdivided into three categories based on organizational structure: 1) organizations that use an incident command system (ICS) structure (e.g. Police, Fire, EMS). ICS is a hierarchical structure that changes depending on the organizations involved in the event, and leadership is transferred to the most qualified organization. 2) Military organizations that use a fixed hierarchical structure (aka. command and control) that is limited to members within the military. 3) Organizations that use Non-ICS structures (e.g. public sector government agencies, non-governmental organizations, private sector). This category includes all other organizations that do not follow a formal hierarchical organizational structure (Lemyre et al., 2009).

Considering that inter-organizational disaster managers often lack familiarity with one another and that large differences exist between organizations, common ground seems relevant for disaster management.

Research on Common Ground in Disaster Management

The demonstrated relevance of common ground in disaster management prompts further investigation, as to whether common ground may account for the past varied behaviour and performance among inter-organizational disaster managers.

An evaluation of the literature revealed that the bulk of research on common ground and disaster management problem solving has focused on the relationship between common ground and performance. It has been demonstrated that shared understanding/shared knowledge is essential to effective coordination (Jones & Hinds, 2002; Smith & Dowell, 2000). For example, basic agreement concerning priorities and responsibilities allowed disaster managers to work around one another at the disaster site of a derailed train (Smith & Dowell, 2000).

Additionally, it has been established that teams who undergo training to improve shared knowledge and shared understanding, outperform teams who do not undergo similar training. The benefits gained from this training persists in situations characterized by risk, high workload, and time pressure (Cannon-Bowers et al., 1998; Einav et al., 2010; Mathieu et al., 2009; Schaafstal & Bots study 1997 as cited in McCann et al., 2000; Stout et al., 1999).

Lack of common ground has also been linked to poor outcomes. Research has demonstrated that lack of shared understanding/shared knowledge has been linked to poor coordination in emergencies (Smith & Dowell, 2000). Additionally, a qualitative study on the Mann Gulch disaster revealed that confusion (lack of common ground) concerning the severity of the fire, confusion on who was leading, and confusion about the actions of the foreman, led firemen to disregard the foreman's orders which would have saved their lives had they followed them (Weick, 1993).

Research has also demonstrated that common ground is impacted by shared experiences. For example, research has revealed that disaster managers share little knowledge which is due to their limited shared experiences working together (Reddy et al., 2009). In addition, a small number of studies have shown that shared knowledge in teams increased across shared experience of three consecutive disaster management table top exercises (Carroll et al., 2007; Convertino et al., 2008, 2007).

Investigation into common ground and disaster management has also shown that common ground impacts implicit coordination. For instance, high workload teams who are trained to improve their shared knowledge implicitly coordinate more in comparison to groups who did not have a similar training (Cannon-Bowers et al., 1998; Stout et al., 1999).

Furthermore, studies have demonstrated that as shared knowledge increases across disaster management planning tasks, so does implicit coordination and performance. Researchers have assumed that this pattern reflects common grounds impact on implicit coordination as well as common ground's and implicit coordination's effect on performance (Convertino et al., 2008).

Additionally, it has been demonstrated that common ground is impacted by information sharing. This is illustrated by a study that found that disaster personnel share little with one another during a disaster because of the nature of the event. The lack of information sharing was found to decrease the shared knowledge between responders (Reddy et al., 2009). Moreover, research on common ground has demonstrated that familiarity is also related to information sharing. Specifically, in research involving high workload teams the level of team familiarity was significantly related to the amount of implicit coordination (Cannon-Bowers et al., 1998).

Lastly, common ground also seems to be impacted by the means of communication. In particular, research has focused on improving remote team problem solving by offering and testing various types of software. It has been shown that software which enables revisability and reviewability of shared information allows participants to develop more shared knowledge. In addition, the varying increases of shared knowledge caused by different means of communication are also mimicked by implicit coordination and performance. Although there is no direct link between these variables, theory would suggest that changes in shared knowledge impacted implicit coordination; and both shared knowledge and implicit coordination impacted performance (Convertino et al., 2011).

Overall, the research has demonstrated that common grounds beneficial effect persists in disaster management and in situations with disaster characteristics. In addition, common ground studies have demonstrated that performance and how well the team works together is dependent upon levels of common ground. This suggests that common ground may account for past behaviour and performance among inter-organizational disaster managers.

Critique. While only a small amount of research has focused on how context plays a role in the development of common ground and how that may impact the relationship between common ground and performance, the literature begs for a more detailed description of contextual factors that may influence common ground and by proxy influence disaster management performance.

Another gap in the literature is that research on inter-organizational disaster management has mainly been conducted on homogenous groups of disaster managers, such as a specific group of first responders. Results on homogenous groups of responder may be representative for more routine emergencies, but may not accurately describe common ground in large scale disasters where heterogeneous groups of disaster managers must interact with one another (e.g. first responders working with the Military, such as against major flooding's).

Goal and Objectives

The goal of this study was to examine the extent to which common ground and the grounding process were important to inter-organizational disaster management problem solving. A specific objective was to describe the experience of common ground in inter-organizational disaster management, and answer the research question “Is common ground

and the grounding process important to inter-organizational disaster management problem solving teams?”

To capture the multifaceted environment that exists within disaster management the current study looked contextual factors as well as the differences between three types of disaster managers: a) those who come from organizations that use an incident command system (ICS) structure (e.g. fire, police, EMS), b) organizations that use a Non-ICS structure (e.g. public sector government agencies, non-governmental organizations, private sector), and c) Military organizations.

Interviews were conducted as part of a larger project on meta-organizational problem solving and decision making (Lemyre et al., 2011; Lemyre, Pinsent, Boutette, Corneil, Johnson, et al., 2010; Lemyre, Pinsent, Boutette, Corneil, Riding, et al., 2010). The study was carried out in four steps. The first step identified what topics disaster managers perceived to understand and not understand about disaster managers from other organizations. The second step identified what information was essential for common ground among inter-organizational disaster managers. The third step described disaster managers' perceptions of how inter-organizational understanding was connected to performance, information sharing, implicit coordination, and contextual factors in disaster management. The fourth and final step explored contextual (social, cultural, and physical) barriers and facilitators.

Method

Design

Qualitative methods allow the researcher to draw out explanations, find patterns, and understand relationships from a set of interviews. A phenomenological approach seemed

suitable for this type of enquiry as it is meant for research on how people experience those phenomena as members who have lived that experience (Creswell, 2007; Dukes, 1984). In this research we are interested in the lived experience of common ground in disaster management.

In addition to a qualitative phenomenological approach, the interviews were designed as an adapted version of the Critical Decision Method to interviewing. The method allows researchers to elicit data on the underlying cognitive origins of decision making (Crandall et al., 2006; Klein, Calderwood, & MacGregor, 1989). This method focuses on questions that ask about incident identification, time-line and decision point verification, questions that explore alternatives and questions that probe deeper into the origins and connections of details in order to elicit domain specific knowledge (Crandall et al., 2006; Klein et al., 1989).

The interviews followed an adapted version of this method: interviews began with the interviewees providing an account of the events while the interviewer tracked key information (main events, situation appraisals, and decisions) recalled by the interviewee. The interviewee's account of events was reviewed through the use of follow-up questions and probes to deepen the understanding of the main topic area.

Participants

The project used a purposive sampling strategy, where interviewees were selected for their role as a senior disaster professional. Three inclusion criteria were used to identify desirable participants: 1) interviewees must have been in a senior decision making position for their organization during a disaster within the past ten years , 2) interviewees must have had experience managing disaster events over long durations, and 3) interviewees must have had the authority to make decisions regarding allocation of resources during disasters.

Recruitment was directed at senior disaster professionals from organizations with different command structures: 1) the Military; 2) organizations that use the incident command system (ICS) in managing and responding to emergencies; and 3) organizations that do not typically use ICS in emergencies. Recruitment was conducted through existing professional networks due to the inherent challenge of identifying and approaching senior professionals. No demographics details, other than gender and organizational structure, were collected as per the agreement with the participants to ensure a higher level of confidentiality.

A total of 9 English interviews were analyzed, one in each of the three possible organization types (Military, ICS and Non-ICS), and at different levels (Federal, Provincial, and Municipal). The nine interviews (3 males, 6 females) were chosen based on a senior interviewer's evaluation of the quality of the interviews.

Materials

The semi-structured interview guide consisted of open-ended questions and probes which were designed to extract information from the interviewee about planning for, responding to, and managing a specific disaster. A practise run was conducted to assess the phrasing and sequence of the questions (see Appendix A for the final qualitative interview guide).

Interview questions were designed to gain insight into elements of the decision making process during disaster events. To gain such an insight participants were asked to give an overview of a disaster event and to select a challenging inter-organizational situation within that event. Questions then focused in on this situation and inquired about details relating to different problems solving stages (e.g. "How did the group generate various

potential solutions?) and different problem solving methods (e.g. “What types of things were shared across organizations?”).

During the interviews questions did not always adhere to a strict order, were paraphrased when necessary, and new questions were asked when necessary in order to facilitate a smooth conversational flow that stimulated an open conversation around the desired topics.

Procedure

Following ethics approval from the University Tri-Council Research Ethics Board, interviewees were recruited through existing networks and scheduled over the phone. Interviews were conducted by a senior researcher from the Gap Santé Team in person at the interviewee’s office. The interview began with an explanation of the purpose, focus, and general guidelines for the interview process. This was followed by obtaining informed consent from the interviewee. Each interview took approximately one hour to complete and was tape recorded. All audio recordings of interviews were transcribed verbatim and entered into QSR International’s NVivo (version 9.0), a qualitative data analysis software that was used to organize the data.

Analysis

Transcripts were analyzed using qualitative content analysis (QCA) methods. QCA is designed to systematically describe the meaning of the material by ascribing categories of the coding frame to portions of the interview transcripts. What makes qualitative content analyses different from other qualitative methods is that it adheres to specific research parameters set by the research question(s). In other words, QCA allows description of the data under specific predefined characteristics. It does not allow the researcher to describe the

entire meaning of the material in every way. This makes it an appropriate tool for rich data with descriptive and focused research question(s), as it reduces data into a smaller and more focused piece of research (Scherier, 2012).

The researcher followed the steps required to successfully carry out a qualitative content analysis (Neuendorf, 2002; Scherier, 2012). First the researcher decided on a research question and selected the material (nine interviews). As a next step, the researcher built a coding frame by choosing several main categories and subcategories by drawing upon theory and prior research. Additionally, other categories and subcategories were included into the coding frame through data driven strategies. Data driven categories and subcategories were added following an initial reading of the interviews to aid in the development of the coding frame.

Subsequently the researcher divided the material of one interview into units of coding. The researcher began this process by marking relevant sections of the material. This included sections of the material that discussed interactions between organizations rather than within organizations, as the goal of the research focused on the inter-organizational disaster management context. The researcher took these relevant sections and segmented them into even smaller sections using a thematic criterion dictated by the categories of the coding frame.

Afterwards the researcher tested the coding frame on the segmented interview along with a second researcher. The two researchers discussed the differences in coding and their operational definitions. A few operational definitions were altered to increase the specificity of the codes. Following the required changes both researchers independently recoded the interview. The final coding frame was evaluated by assessing reliability and validity. An

acceptable level of reliability is considered to be above 80% on a minimum of 10% overlap of material coded by both coders (Neuendorf, 2002). In this study an inter-rater reliability of 80.5% with an 11% overlap was achieved.

Additionally, validity is just as important as reliability in QCA. The current study uses a concept-driven coding frame as the majority of codes were derived by drawing upon theory and prior research. The type of validity that is of importance to a concept-driven coding frame is content validity. It has been suggested that a good way to assess content validity is through expert evaluation (Scherier, 2012). To ensure content validity the coding frame was developed alongside an expert social psychologist and additional feedback was sought from the research team who also specializes in various aspects of social psychology. Given the fact that this coding frame was developed using constant feedback from expert evaluation the coding frame is considered to have content validity.

Results

Within the nine interviews the disaster events included the Toronto Sunshine Propane explosion, Toronto 200 Wellesley fire, H1N1 pandemic, Japan nuclear event, Cholera outbreak in Haiti, 2010 Canadian G-8 Toronto Summit, 2010 Canadian G-20 Toronto Summit, Vancouver 2010 Olympic Games, and briefly the 2015 Toronto Pan American Games. The last four events, G-8, G-20, Olympics, and the Pan American Games are not normally considered in the disaster category. However these events were acceptable topics as disaster managers played a crucial role in preparing for potential disasters and mitigating potential risks during these events. Inclusion of these events allowed the results to speak to disaster management as a whole cycle as opposed to simply the reactive aspects.

The first disaster event discussed by each interviewee provided the bulk of the conversation within each interview. Additionally, most interviewees introduced additional events (up a maximum of two additional events from the list above) to provide examples and raise additional details concerning inter-organizational interactions during disaster management.

To answer the research question “How does common ground theory reveal itself in inter-organizational disaster managers’ description of events?” four steps were carried out.

Reported Perceived Inter-Organizational Understanding and Lack of Understanding

To describe common ground theory from inter-organizational disaster managers’ perspective a grasp of the topics of shared or lack of shared knowledge/understanding which exists among disaster managers was sought.

Both understanding and lack of understanding were coded. Looking at the final coding it appeared that both understanding between organizations and a lack of understanding between organizations were important themes within the inter-organizational disaster management context. Statements of understanding and lack of understanding were be categorized by 1) who is understanding or not understanding (interviewee or other organizations), and 2) whom are they understanding or not understanding (other organizations from the same organizational structure (e.g. ICS perceives to understand other ICS organizations), other organizations from a different structure (e.g. ICS perceives to understand other Non-ICS organizations)). A general description of the emerging topics and their categories is given below.

General description of topics. Overall, 16 topics were found to exist within the combination of understanding and lack of understanding statements, fitting into two categories: 1) content, and 2) process.

Content. The three emerging topics that fit into this category include: Expertise, Perspective, and Terminology.

The topic of Expertise arose as participants indicated that they understood other organizations area of expertise. For example, “We recognized that we had experts in the field there”. Participants also reported their own perceived inter-organizational lack of understanding concerning detailed information about other organizations expertise. For example, “We were accepting a lot of their recommendations because we simply didn’t know any different and we weren’t in a position where we were going to say okay, let me check that”.

Within the interviews participants also expressed an understanding of other individual’s perspective. For example, “The sort of more [Organization 1] types; when they think of health systems they think ambulances and maybe hospitals.” Furthermore, participants also reported that they were aware that other organizations understood the perspective of external organizations. For example: “They understood our position”.

Lastly, participants reported their own perceived inter-organizational understanding of other organizations terminology. For example “I will say that the relationship between [Organization 1] and [Organization 2] is probably easier than it is between [Organization 1] and [Organization 3] because we actually are almost of the same language. We understand each other a little better.” Interviewees also reported their own perceived inter-organizational

lack of understanding regarding other organizations terminology. For example, “Issues that pertain mostly between [Organization 1] and [Organization 2] [is] the language issue again.” Participants also stated that they were aware of other organizations lack of understanding concerning the terminology of external organizations. For example, “Some confusion about terminology there as it was reported as a lockdown. And what the [Organization 1] people mean when they say lockdown isn’t the same thing that [Organization 2] mean when they say lockdown.”

It seemed that within the category of content, disaster managers perceived to understand one another’s perspective. However, they did not perceive to fully understand other organizations area of expertise and terminology. This suggests that inter-organizational disaster managers perceive to have an incomplete understanding of content which will hinder their ability to understand conversation about the topic of work.

Process. The category of process contained 13 topics that facilitated team members understanding of how to work with one another and what type of information to share. The topics within this category have been subcategorized into two categories: 1) organizational characteristics, and 2) individual characteristics.

Organizational characteristics. Disaster managers reported 8 topics that they perceived to understand or fail to understand about the process of work that specifically related to the features of other organizations. These 8 topics include: Business practices and protocols, Roles, Capabilities, Dependencies, Resources, Needs, Others place in the overall disaster, and Downstream effects.

First, the topic of business practices and protocols arose as participants reported that they understood other organizations business practices and protocols. For example: “Both

organizations, [Organization 1] and ourselves, have shops that manage the provincial-territorial relations.” Interviewees also reported their own lack of understanding concerning business practices and protocols of other organizations, for example: “You have to learn how somebody else does business.” Additionally, interviewees were also aware that other organizations understood the business practices and protocols of external organizations in certain cases while they did not understand in other cases. For example: “[Individual from Organization 1] knows what the [Individual from Organization 2] in British Columbia knows what the IMS is” and “They’re not understanding our incident management structure”.

Within the interviews participants also expressed a perceived understanding of inter-organizational roles. For example: “This was never their formal role, but the role has kind of developed with [Organization 1] that they’re a very good source of information about the people who may need extra help.” Additionally, interviewees were aware that other organizations had inter-organizational understanding and lack of understanding concerning the roles of external organizations. For example: “I mean they recognized that this was a [Organization 1] driven event, a [Organization 1] led event” and “I think it was a level of confusion about what our role at the ministry level was.”

The topic of business dependencies arose as participants reported their own perceived inter-organizational understanding regarding organizational dependencies. For example, “I think we have a pretty good understanding of why and how we need to work together.” Furthermore, interviewees also expressed that they were aware that other organizations have inter-organizational understanding regarding dependencies. For example, “[Organization 1] themselves said the degree of success that they had in decanting patients and freeing up beds they could not have done without [Organization 2] and [Organization 3] folks at the table.”

Within the interviews participants also expressed a perceived understanding of inter-organizational needs. For example, “They needed access, and they needed to get their trucks in and out”. Participants also reported that they did not understand the needs of other organizations. For example, “What do you need from us? How can we support you in that mission?” Furthermore, interviewees indicated that they were aware that other organizations at times understood and at other times lacked understanding of inter-organizational needs. For example: “The person in charge of the critical infrastructure project understood that there was an importance to [Organization 1] and said if something important happens, I will share with you” and , “[Organization 1] had to keep going to [Organization 2] and trying to explain why it was important for them to be sharing information.”

Participants also reported their own perceived understanding on inter-organizational resources. For example: “They’re not resourced to provide facilities. They’re not resourced to provide I think more than five or six kids at a time.” Moreover, participants reported that other organizations had inter-organizational lack of understanding concerning the resources of other organizations. For example, “Although at one point to say there’s not a tap that you can turn on and [people] come out, like we only have so many.”

Interviewees also reported their own perceived inter-organizational understanding concerning downstream effects on other organizations. For example, “It would cost the company zillions of dollars.” Additionally, participants were aware that other organizations had inter-organizational lack of understanding concerning downstream effects. For example, “But once you start getting into the downstream effect on these other parts of the [Organization 1], that’s just kind of outside of their ken.”

Participants also reported their own perceived understanding of other organizations place in the overall disaster. For example, “I’ve got that global picture now from monitoring all three of those guys”. Interviewees also reported that they did not understand other organizations place in the overall disaster. For example, “There wasn’t, I think, a clear picture from the larger sense, too, of what everybody was doing.” Furthermore, participants reported to be aware of other organizations understanding and lack of understanding on other organizations place in the overall disaster. For example, “We all know each other, so we know where we fit in the bigger picture”, and “Well, they didn’t seem to get, as a [Organization 1] community, they didn’t seem to understand that there’s value in letting the [Organization 2] know that this plan might be coming down in this area and that the [Group 1] are going to have to be there and clean it up.”

Lastly, participants also reported their own perceived inter-organizational understanding regarding organizations’ capabilities. For example, “[Organization 1] didn’t have the capacity or the classification system in place for the asset owners to be confident in them holding their information.” Furthermore, interviewees were aware that other organizations had inter-organizational understanding regarding inter-organizational capabilities.

Overall, it appears that within the subtopic of organizational characteristics in the category of process, disaster managers’ report understanding and a lack of understanding within the majority of the topics. This suggests that inter-organizational disaster managers perceive to have an incomplete understanding of one another’s organizational process.

Individual characteristics. Disaster managers reported 5 topics that they perceive to understand or fail to understand about the process of work that specifically relate to the

features of individuals from other organizations. These 5 topics include: Actions, Relationships, Information sources, How to work with others, and Competencies.

First, the topic of actions arose as participants reported their own perceived understanding regarding the actions and inactions of individuals from other organizations. For example: “[Organization 1] folks up in the [event] whose clients were quite impacted by events like this, and they did quite a lot of kind of off-screen work with them and their clients.” Participants also reported their own perceived lack of understanding concerning actions of individuals from other organizations. For example: “We sort of didn’t know that was happening.” Additionally, participants reported that they were aware that other organizations had inter-organizational understanding as well as a lack of understanding regarding others actions. For example, “They know what’s happening.”, and “Didn’t have a structure, a function, understand what we were doing.”

Within the interviews participants also expressed a perceived understanding of which individuals from other organizations hold information and can share it. For example, “If I need to know something about what’s going on in [Organization 1] or what’s going on in [Organization 2]; I go to the respective team leader and ask him.” Additionally, participants also reported that they were aware of other organizations inter-organizational understanding regarding information sources. For example, “Those three service team leads are sitting there next to one another, and you see them leaning over and they talk to one another if they want to know something.”

Interviewees also reported that they understood how to work with individuals from other organizations. For example, “So I have a good sense, once you get to know them, what they like, what works for them and how you work with them.” Additionally, interviewees

reported that other organizations have inter-organizational understanding regarding how to work with individuals from other external organizations. For example, “I think we have a pretty good understanding of why and how we need to work together.”

The topic of competencies emerged as participants reported that they understood the competencies of individuals from other organizations. For example, “So there was a bit of disconnect there I think when you have [Organization 1] wanted to say no, we want to do it this way, and not having the experience.” Furthermore, participants also expressed that they were aware that other organizations had inter-organizational understanding concerning individuals’ competencies. For example, “They knew that I had come in as a colonel, and that I’d been deployed, and had lots of experience.” Lastly, within the interviews participants also expressed a perceived understanding of the ongoing relationships between individuals from different organizations. For example: “That’s an ongoing relationship. They talk directly all the time”.

Overall, it appears that within the subtopic of individual characteristics in the category of process disaster managers’ report understanding in the majority of the topics. This suggests that inter-organizational disaster managers perceive to have an almost complete understanding of one another’s individual process.

Summary. Overall, a total of 16 topics were found to exist within the understanding and a lack of understanding statements which were categorized into the subcategories of content and process. Results suggested that disaster managers’ perception of inter-organizations subject matter (content) was inadequate. Results also suggested that disaster managers perceived to have an incomplete understanding of one another’s organizational process, but seemed to perceive to have a decent understanding of the individuals’ process.

These results contribute to the objective of this study as they give a good description of how disaster managers perceive common ground in an inter-organizational disaster management context. In addition, these results begin to demonstrate that issues around understanding one another (common ground) do reveal themselves within disaster management. This is the first step to identifying whether disaster managers perceive common ground and the grounding process as important to disaster management; and whether common ground can account for past disaster management teams varied ability to work with one another and varied performance.

These general results are followed by more specific results where comparisons are made across disaster manager type.

Comparison between types of disaster managers. Now that topics of shared or lack of shared knowledge/understanding among disaster managers has been revealed; this description will explore one aspect of the multifaceted disaster environment by comparing understanding and lack of understanding topics across the three disaster manager types: ICS, Non-ICS, and Military.

Perceived topics of understanding among disaster managers. Understanding statement topics categorized by disaster manager type are presented in the following tables. Table 1a identifies topics that the interviewees perceive to understand about disaster managers from other organizations with the same structure. At a glance, it is seen that Both ICS and Non-ICS interviewees reported understanding other organizations with the same structure on several topics, while Military interviewees reported understanding other organizations with the same structure on only two topics.

Table 1a. Topics Covered in the Interviewees' Understanding Between Organizations of Similar Organizational Structure.

Between Organizations of Similar Structure	Type of Disaster Manager		
	ICS	Non-ICS	Military
Perceived Understanding	1. Aware of <i>business practices/protocols</i> 2. Aware of <i>roles</i> 3. Aware of <i>actions</i> 4. Aware of <i>capabilities</i> 5. Understands the <i>perspective</i> 6. Aware of <i>place in the overall disaster</i> 7. Aware of <i>information sources</i> 8. Aware of <i>how to work with</i> organizations 9. Aware of <i>dependencies</i>	1. Aware of <i>business practices/protocols</i> 2. Understands <i>roles</i> 3. Aware of <i>actions</i> 4. Aware of <i>capabilities</i> 5. Understands the <i>perspective</i> 6. Aware of <i>area of expertise</i> 7. Aware of <i>resources</i> 8. Understand the <i>downstream effects</i> of their actions 9. Aware of <i>competencies</i> 10. Aware of <i>relationships</i> 11. Aware of <i>needs</i>	1. Aware of <i>business practices /protocols</i> 2. Understands <i>terminology</i>

This suggests that ICS and Non-ICS disaster managers understand other organizations with a similar organizational structure with more detail in comparison to Military disaster managers.

Table 1b identifies topics that the disaster manager interviewees perceive to understand about disaster managers from other organizations with a different organizational structure. Looking at this table, ICS and Non-ICS individuals understand very little to no information about Military organizations, but Military organisations seem to understand Non-ICS and ICS on a number of topics. This suggests that organizations do not hold equal amounts of understanding/shared information about one another.

Table 2 identifies topics that interviewees perceived that other disaster managers from other organizations inter-organizationally understood. ICS interviewees reported a fair number of different topics while Non-ICS and Military interviewees reported only a few or no topics at all. This suggests that ICS organizations have a more detailed perceived understanding of other similar and different structured organizations in comparison to Non-ICS and Military organizations.

Perceived topics of a lack of understanding among disaster managers. Lack of understanding topics found in the interviews is presented in the following tables. Table 3 identifies topics that the interviewees perceived not to understand about disaster managers from other organizations. ICS, Non-ICS, and Military interviewees all reported not to understand other organizations with the same structure and different structure on only one or two topics. One should not necessarily come to the conclusion that disaster managers do not lack inter-organizational understanding. Rather, it is likely that disaster managers avoid reporting what they do not know about other organizations.

Table 1b. Topics Covered in the Interviewees' Understanding Between Organizations of Different Organizational Structure

Between Organizations of Different Structure	Type of Disaster Manager		
	ICS	Non-ICS	Military
Perceived Understanding	1. Aware of Non-ICS organizations' <i>business practices/protocols</i> 2. Aware of Non-ICS <i>roles</i> 3. Aware of Non-ICS <i>actions</i> 4. Understands the <i>perspective</i> of Non-ICS 5. Aware of the <i>competencies</i> of Non-ICS 6. Aware of Non-ICS <i>area of expertise</i> 7. Aware of Non-ICS <i>resources</i> 8. Aware of Non-ICS <i>needs</i> 9. Aware of Non-ICS <i>capabilities</i> 10. Understand the <i>downstream effects</i> of their actions on Non-ICS 11. Aware of <i>how to work with</i> Non-ICS	1. Aware of ICS organizations' <i>business practices/protocols</i> 2. Understands ICS <i>roles</i> 3. Aware of ICS and Military <i>actions</i> 4. Aware of ICS <i>area of expertise</i> 5. Aware of Military <i>relationships</i>	1. Aware of Non-ICS and ICS <i>business practices/protocols</i> 2. Understands ICS and Non-ICS <i>roles</i> 3. Aware of Non-ICS and ICS <i>actions</i> 4. Understands the <i>perspective</i> of ICS and Non-ICS 5. Aware of the <i>competencies</i> of Non-ICS 6. Aware of ICS and Non ICS <i>resources</i> 7. Aware of ICS <i>needs</i> 8. Aware of ICS <i>capabilities</i>

Table 2. Topics Covered in Interviewees' Perception of what Other Organizations Inter-Organizationally Understand.

Between Organizations	Type of Disaster Manager		
	ICS	Non-ICS	Military
Perceived Understanding	<u>Similar structure</u> 1. Aware of roles 2. Aware of actions 3. Aware of place in the overall disaster 4. Aware of members capabilities 5. Understands the perspective 6. Aware of information sources 7. Aware of how to work with others 8. Aware of business practises/protocols <u>Different structure</u> 1. Non-ICS aware of ICS actions 2. Non-ICS understand perspective of ICS 3. Non-ICS aware of ICS members capabilities	<u>Similar structure</u> 1. Understand roles 2. Aware of their dependency on other organizations <u>Different structure</u>	<u>Similar structure</u> <u>Different structure</u>

Table 3. Topics Covered in the Interviewees' Perceived Lack of Understanding Between Organizations

Between Organizations	Organizational Structure		
	ICS	Non-ICS	Military
Perceived Lack of Understanding	<u>Similar structure</u> 1. Do not understand ICS actions	<u>Similar structure</u> 1. Unaware of Non-ICS actions	<u>Similar structure</u> 1. Not aware of Military business practices and protocols 2. Unaware of Military terminology
	<u>Different structure</u> 1. Unaware of Non-ICS area of expertise 2. Unaware of the needs of Non-ICS organizations	<u>Different structure</u> 1. Unaware of Military actions	<u>Different structure</u> 1. Unaware of ICS and Non-ICS business practices 2. Unaware of ICS and Non-ICS terminology

Table 4 identifies topics that interviewees perceived that other disaster managers do not inter-organizationally understand. In the section concerning organizations with a similar structure, Non-ICS interviewees' statements fell into a number of different topics while Military participants and ICS interviewees' statements fell into one topic. These results suggest that non- ICS organizations perceive that Non-ICS organizations do not understand one another on many topics. Lastly, Non-ICS, ICS, and Military interviewees did not differ in the amount of detail with which they perceived a lack of understanding among organizations of a different structure.

Summary. Overall, the results revealed similarities and differences between the three types of disaster manager interviewees. Differences and similarities revealed themselves in terms of the amount of detail the interviewees reported about their own inter-organizational understanding and lack of understanding and their perception of other organizations inter-organizational understanding and lack of understanding. Overall, it was found that ICS and Non-ICS disaster managers perceive a detailed understanding of organizations with a similar organizational structure.

Additionally, the three types of organizations did not seem to hold equal amounts of understanding about one another. Furthermore, ICS organizations have a detailed perceived understanding of other organizations. Lastly, results found that Non-ICS organizations perceive a lack of understanding from organizations with a similar organizational structure. These results give a good description of how disaster managers differ from one another, in terms of the detail in which they perceive to understand one another. In addition, these results also demonstrate that the initial assumptions that variations in inter-organizational understanding (common ground) exist among disaster managers.

Table 4. Topics Covered in Interviewees' Perception of what Other Organizations Inter-Organizationally Fail to Understand.

Between Organizations	Organizational Structure		
	ICS	Non-ICS	Military
Perceived Lack of Understanding	<u>Similar structure</u> 1. Unaware of needs	<u>Similar structure</u> 1. Do not understand roles 2. Do not understand terminology 3. Do not understand business practices/protocols 4. Unaware of resources 5. Do not understand the downstream effects of their actions 6. Unaware of place in the overall disaster	<u>Similar structure</u> 1. Unaware of terminology 2. Unaware of business practices/protocols 3. Unaware of capabilities
	<u>Different structure</u> 1. Non-ICS is unaware of ICS business practices/protocols 2. Non-ICS do not understand ICS actions	<u>Different structure</u> 1. Non-ICS does not understand the needs of ICS	<u>Different structure</u> 1. Non-ICS and ICS not aware of business practices/protocols 2. Non-ICS and ICS Unaware of Military terminology

The varying detail in disaster managers perceived understanding and lack of understanding leads the researcher to question what amount of detail is required for disaster managers to understand one another? Which topics are truly critical?

Reported Desired Inter-Organizational Critical Information

To further describe common ground theory from inter-organizational disaster managers' perspectives, an account of the topics of shared knowledge/understanding which disaster managers deem critical was sought.

Critical information statements were coded by focusing on information that interviewees expressed as needing or wanting. The critical information statements fell into various topics and were categorized by 1) organizational structure of the interviewees organization (ICS, Non-ICS, Military), and 2) who the interviewee believed the information was critical for (critical for the Interviewee, critical for Others and critical for Everyone). A general description of the emerging topics and their categories is given below.

General description of critical topics. Overall, interviewees revealed 11 topics as critical. These 11 topics were categorized into two topics: 1) content, and 2) process. A general description of each of these categories and their topics is provided below.

Content. The category of content contains topics that enable team members understanding of the topic of work being discussed. The two emerging topics that fit into this category included: Perspective and Terminology.

The topic of perspective arose as participants indicated that it was critical for other organizations to understand inter-organizational perspectives of the crisis. For example: "They need to know it's about more than just the fire. It's about people." Additionally, interviewees indicated that it is important for themselves and others to understand inter-

organizational perspective of regulations. For example: “A little bit more upfront kind of general discussion would have been good to clarify a whole range of things, like assumptions, expectations around roles or responsibilities, understanding of different legislation.” In addition, within the interviews participants also expressed that it was critical for themselves and other organizations to understand inter-organizational terminology. For example: “Getting to know each other’s’ lingo is important.”

It seems that within the category of content, disaster managers perceive that knowledge on inter-organizational topics of perspective and terminology are important for both themselves and others. This suggests that disaster managers perceive the importance of mutual understanding on areas of subject matter (content).

Process. The category of process contains topics which enable team members understanding of how to work with one another and understand what type of information to share. The topics within this category have been subcategorized into two categories: 1) organizational characteristics, and 2) individual characteristics.

Organizational characteristics. Disaster managers reported 7 organizational characteristics as critical, these include: Business practices and protocols, Roles, Capabilities, Dependencies, Resources, Needs, and Others place in the overall disaster.

First, the topic of business practices and protocols arose as interviewees reported that it was critical for other organizations to understand inter-organizational business practices and protocols, for example: “I guess they need to know all the other services there, what their mandate, what their clear focus is, and to be of a very clear idea of what our parameters are.”

Additionally, interviewees also expressed that it was important for themselves as well as other organizations to understand inter-organizational business practices and protocols, for

example: “So not only do you have to learn how somebody else does business, but you have to teach them as well how you do your business.” Furthermore, within the interviews participants also reported that it was critical that they themselves understand the roles of other organizations, for example: “But I have to have a fair understanding of what they do.” Interviewees also reported that it was critical that they themselves as well as other organizations understand inter-organizational roles, for example: “Having a clear understanding of why other people are there is absolutely critical.”

Interviewees also reported that it was critical for other organizations to understand inter-organizational capabilities. For example: “To let them understand that we’re not everything.” Additionally, participants indicated that it was critical for both themselves and other organizations to understand inter-organizational capabilities. For example: “A smaller disaster to become integrated into it so that when the big one happens, you’re already familiar with what everyone can do and what the capabilities are.”

Moreover, participants indicated that it was critical for the interviewees themselves to understand others place in the overall disaster. For example: “But I have to have a fair understanding of what they do and where they fit into that global picture.” Additionally, participants also indicated that that it was critical for both the interviewee themselves and other organizations to understand others place in the overall disaster. For example: “So it’s everyone knowing what the plan is, what everyone is doing, and how they fit into that.”

The topic of dependencies arose as interviewees reported that it is critical for other organizations to understand inter-organizational dependencies. For example: “Recognizing that up front and reflecting it and all of those processes seems important and the recognition of again, that interdependency.” In addition, within the interviews participants also reported

that it was critical for themselves and other organizations to understand inter-organizational resources. For example: “You have to know what the other services are bringing to the table.” Lastly, interviewees indicated that it is critical for themselves to understand other organization’s needs. For example: “I need to understand what other people’s needs are.”

It seems that within the subcategory of organizational characteristics disaster managers perceive that knowledge on the majority of the topics is important for both themselves and others. This suggests that disaster managers perceive the importance of mutual understanding on topics of organizational characteristics.

Individual characteristics. Disaster managers reported 2 individual characteristics that they perceive as critical, these include: Actions and Competencies.

First, the topic of actions arose as participants reported that it was critical for themselves to understand the actions of other organizations. For example: “But I have to understand that process. I have to understand how that flows.” Additionally, participants reported that it was critical for other organizations to understand inter-organizational actions. For example: “Because you should really know that this is happening.” Lastly, interviewees indicated that it was critical for both themselves and other organizations to understand inter-organizational actions. For example: “Everyone knowing what the plan is, what everyone is doing.”

Additionally, interviewees indicated that it was critical for themselves to understand other organizations competencies. For example “There’s a couple of things I’m looking for. I need to work in any type of critical incident situation; I need to work with people that know what they’re doing. So clearly their professional qualifications.”

It seems that within the subcategory of individual characteristics disaster managers perceive that knowledge on the topic of actions is important for themselves and others.

Summary. Overall 11 of the previous topics were found to exist within the critical information statements. Disaster managers perceived that knowledge on the majority of the topics was important for themselves and others. Suggesting that disaster managers recognize that a mutual understanding (common ground) among inter-organizational disaster managers should exist.

These results give a description of the topics disaster managers perceive as critical knowledge. Furthermore, these results contribute to the goal of the study as they demonstrate that disaster managers perceive the necessity of mutual knowledge (common ground) in disaster management.

These general results are followed by specific comparisons across disaster manager type.

Comparison Between Types of Disaster Managers

Now that disaster managers perceived critical topics of shared knowledge have been identified, this study moves forward by comparing topics of critical knowledge across disaster manager type (ICS, Non-ICS, and Military). Comparisons across disaster manager type were made in order to demonstrate and explore the variability that exists in at least one aspect of the multifaceted disaster environment. The subsequent tables allow for comparisons of critical information topics across type of disaster manager.

Table 5a identifies topics of the interviewees' inter-organizational desired critical information. The first half of this table lists the critical information topics that interviewees desire for themselves.

Table 5a. Topics Covered in Interviewees' Perception of Desired Critical Information Between Organizations for Themselves and Others.

Between Organizations	Organizational Structure		
	ICS	Non-ICS	Military
Desired Critical Information:	It is critical for the Interviewee to: 1. Understand others <i>actions</i> 2. Understand others <i>needs</i> 3. Understand others <i>competencies</i> 4. Understand others <i>roles</i> 5. Understand others <i>place in the overall disaster</i> It is critical for others to: 1. Understand others <i>actions</i> 2. Understand the interviewees' <i>perspective</i> of the crisis 3. Understand the interviewees' <i>capabilities</i>	It is critical for the Interviewee to: 1. Understand others <i>actions</i> It is critical for others to: 1. Understand the interviewees' organization's <i>actions</i> 2. Understand others <i>business practice and protocols.</i> 3. Recognize their <i>Dependencies</i> with the interviewees organization	It is critical for the Interviewee to: It is critical for others to: 1. Understand others <i>business practices and protocols.</i>

The second half of the table lists critical information topics that interviewees deem as critical for other organizations' knowledge. Table 5b identifies topics the interviewees' deemed as critical for themselves and others, essentially information that interviewees felt that everyone should know.

Looking at the tables, it can be seen that within all three types of organizations the majority of topics listed in Table 5a as important for the interviewee or as important for others is also listed in Table 5b as important for everyone. These findings suggest that ICS, Non-ICS, and Military organizations are all aware that a mutual understanding (common ground) among inter-organizational disaster managers needs to exist.

Additionally, the tables reveal that there is very little overlap of topics across ICS, Non-ICS, and Military interviewees within the two tables. This suggests that ICS, Military, and Non-ICS disaster managers do not perceive the same types of information to be critical.

Summary. Overall, the comparison between types of disaster managers has revealed that ICS, Non-ICS, and Military all perceive that knowledge on the majority of the critical topics was important for themselves and others. In addition, results found that there is little agreement concerning what topics are critical across the three types of disaster responders. These results suggests that disaster managers all recognize the importance of mutual knowledge; however, they may have a difficult time sharing the right type of information to one another due to their varied perception of which information is critical.

These results give a description of the similarities and differences that exist among the three types of disaster managers' perception of critical mutual knowledge.

Table 5b. Topics Covered in Interviewees' Perception of Desired Critical Information Between Organizations for Everyone.

Between Organizations	Organizational Structure		
	ICS	Non-ICS	Military
	It is critical for everyone to: 1. Understand one another's <i>roles</i> 2. Understand one another's <i>actions</i> 4. Be aware of one another's <i>resources</i> 5. Understand one another's <i>capabilities</i> 6. Be aware of one another's <i>perspective</i> 7. Understand one another's <i>place in the overall disaster</i>	It is critical for everyone to: 1. Understand one another's <i>roles</i> 2. Understand one another's <i>actions</i> 3. Understand one another's perception of <i>business practices and protocols</i>	It is critical for everyone to: 1. Understand one another's <i>roles</i> 3. Understand one another's <i>perception of business practices and protocols.</i> 4. Understand one another's <i>business practices.</i> 5. Understand one another's <i>terminology</i>

Moreover, these results contribute to the goal of the study as they demonstrate that all three types of disaster managers perceive the importance of mutual knowledge (common ground) in the disaster management. Lastly, these findings suggest that variations in mutual understanding on the identified critical topics may be accountable for past disaster management teams varied ability to work with one another and varied performance.

This naturally leads to the need to explain what impacts disaster managers' understanding/ knowledge about each other and does mutual understanding/knowledge impact disaster management performance?

Reported Perceived Linked Concepts Between Organizations

To describe the experience of common ground from an inter-organizational disaster management context, the third step seeks to describe disaster managers' perceptions of how inter-organizational understanding is impacted by and influences factors of interest. The factors of interest have been taken from the literature and theory. Specifically, the factors of interest are: 1) level of understanding (understanding, lack of understanding), 2) social context (familiarity, frequency of interaction), 3) cultural context (homogenous environment, heterogeneous environment), 4) physical context (physical distance, physical proximity), 5) information sharing (sharing (implicit coordination, explicit coordination), no sharing), and 6) performance (outcomes, group process). This objective is meant to describe how disaster managers perceive these factors to impact one another. Various links between these concepts were revealed by the interviewees.

General description of linked concepts. Perceived linked concept statements were expressed by the interviewees, an outline of each of the type of link along with a quote from the interviews can be found in the following section.

Level of understanding and level of performance. Participants linked a lack of understanding to poor performance. For example: “And my own staff sometimes not knowing what everybody else does. And then it creates some conflict.” Additionally, participants linked understanding to good performance. For example “And after they got through the fact of understanding that, yes, they understood our position that it may in fact take place, things became easier” It seems that participants perceived the level of understanding to impact the level of team performance. It should be noted that performance was only expressed in terms of team process.

Information sharing and level of understanding. Interviewees linked information sharing to understanding, for example: “We had to teach [Organization 1] about our rules of engagement and that kind of helped [them] to see where we were coming from.” Additionally, interviewees linked lack of information sharing to a lack of understanding. For example: “Decisions being made that maybe weren’t communicated with each other that had an impact on us because we’re seeing different things happening and were a little confused about that.” Findings indicate that participants perceive information sharing to impact level of understanding.

Social context and level of understanding. Participants linked familiarity to level of understanding, for example: “So I have a good sense, once you get to know them, what they like, what works for them and how you work with them.” Participants also linked frequent interactions to understanding, for example: “But because we have worked together, we know what each other’s skill and ability is.” Additionally, participants linked infrequent interactions to a lack of understanding, for example: “I think that people who haven’t worked

with us much still have that perception.” Overall, results revealed that social contextual factors such as familiarity and frequent interactions impact level of understanding.

Social context and information sharing. Participants indicated that familiarity was linked to information sharing, for example: “When we were driving to the scene we already had a [individual] in that forward command post. And we were getting information directly, just because of personal relationships, because I knew the guy that was in there.” It seems that interviewees perceive that social contextual factors such as familiarity impact information sharing.

Cultural context and level of understanding. Interviewees indicated that heterogeneity of organizations is linked to a lack of understanding, for example: “I think there was some confusion about terminology there as it was reported as a lockdown. And what the hospitals mean when they say lockdown isn’t the same thing that security folks mean when they say lockdown.” Additionally, participants indicated that homogeneity of organizations was associated with understanding, for example: “I will say that the relationship between [Organization 1] and [Organization 2] is probably easier than it is between [Organization 1] and [Organization 2] because we actually are almost of the same language. We understand each other a little better.” Findings indicated that interviewees perceive that cultural contextual factors such as organizational homogeneity and heterogeneity impact the level of understanding.

Summary. Overall a total of five links were expressed by disaster manager interviewees: between level of understanding and performance, information sharing and level of understanding, social context and level of understanding, social context and information sharing, cultural context and level of understanding.

These results give a description of the links disaster managers perceive to exist among important common ground concepts: level of understanding, performance, and context. These results contribute to the goal of the study as it demonstrates that similarly to common ground theory and literature, disaster managers perceive that common ground is of importance to disaster managers' performance working with one another. This suggests that disaster managers perceive common ground as accountable for their varying ability to work with other team mates.

These five emerging links perceived by interviewees were used to create a model in order to provide a description of how disaster managers perceive these links, and how the level of inter-organizational understanding is important in disaster managers' perceived links.

Comparison between two models. A model of common ground derived from common ground theory and disaster management literature is compared to the model created from the interviewee's perceived links (See Figure 3). This allows for the identification of similarities and differences between the literature/theory and how disaster managers actually conceptualize these concepts in the disaster management context.

In order to compare the common ground models inclusively, the differences between the two models are first assessed by ignoring the differences by type of disaster manager. Overall, the two models are very similar. Connections exist between context and perceived understanding in disaster managers perceptions similarly to the link between context and common ground in the literature/theory. Both figures have social and cultural context, while the interviewees model is missing physical context. This suggests that physical context is not a salient issue for disaster managers; this is likely due to the fact that more than often disaster

managers are distributed in location and rarely have the chance to see the benefits of communicating in person.

Additionally, the links between perceived understanding and performance in disaster managers' model is also reflected in the link between common ground and performance in the model of the literature/theory. Also, both figures demonstrate to have a link between social contextual factors and information sharing. Both figures also indicate that information sharing impacts perceived understanding (common ground).

However, the two figures differ in the fact that the model created by disaster managers perceptions does not demonstrate that a shared understanding impacts how information is shared and does not acknowledge that information sharing impacts performance. Some links are missing as disaster managers only discussed whether information is shared or not and did not touch on how information was shared (explicit and implicit coordination).

Summary. Overall, many similarities and a few differences were found between the two models. The many similarities between the two models indicate that disaster managers saw the relationships between common ground, context, and information sharing in disaster management. The few differences however are striking: disaster managers did not perceive that understanding impacted information sharing and that information sharing impacted performance. This difference most likely arose from the fact that disaster managers did not discuss how information was shared (implicit and explicit coordination). This suggests that how disaster managers share information may be an unconscious process.

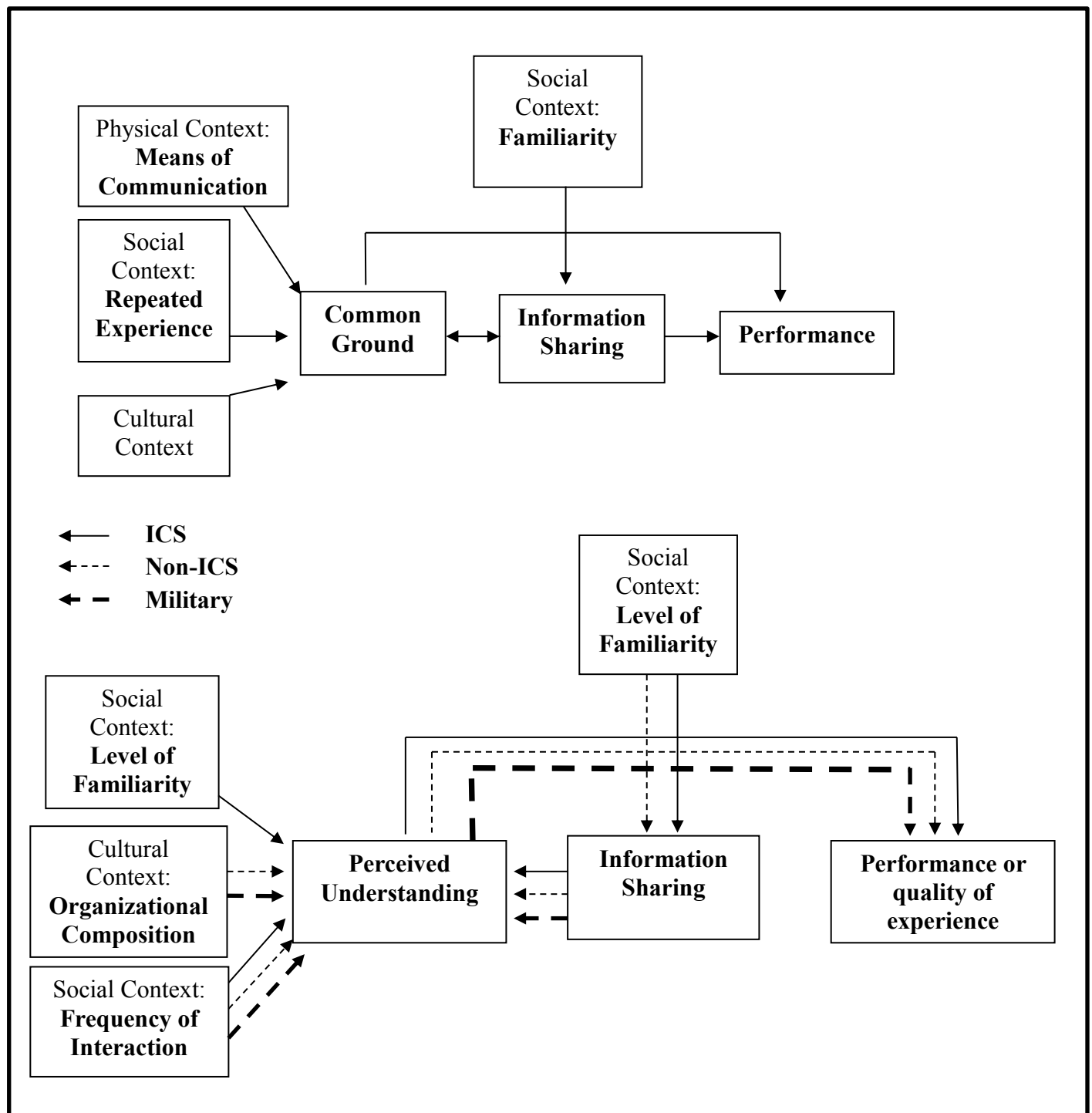


Figure 3. Comparison of two models of common ground. The top model features common ground as derived from the common ground theory and disaster management literature. The second model (bottom) is the observed model of perceived linked concepts in inter-organizational disaster management in experienced disaster management interviews.

These results contribute to the objective of this study as they describe how disaster managers' perspective is similar and different to the established relationships in common ground research. These results contribute to the goal of the study as it demonstrates the importance of understanding among disaster managers, as it is perceived to directly impact the way disaster managers work together. In addition, results also revealed the importance of the grounding process, as contextual factors are perceived to impact the level of understanding among disaster managers. These results indicate that disaster managers perceive common ground as accountable for their varying ability to work with other team mates, similarly to how the literature has portrayed common ground in disaster management.

Comparisons are made across type of disaster manager in the following section in order to complete the third step and to fully describe disaster managers' perceived links.

Comparison between types of disaster managers. Comparisons of disaster managers' perceived links across disaster manager type were made in order to demonstrate and explore the variability that exists in at least one aspect of the multifaceted disaster environment. Looking at Table 6, ICS organizations reported a link between familiarity and level of understanding while Non-ICS and Military did not. This suggests that familiarity is an important contributing factor to the level of understanding for ICS and Non-ICS interviewees.

Findings also revealed that ICS and Non-ICS interviewees reported a link between familiarity and information sharing, while Military organizations did not. This suggests that familiarity is an important contributing factor to information sharing for ICS and Non-ICS interviewees, but not for Military.

Table 6. Perceived Linked Concepts Between Organizations.

Linked Concepts Between Organizations	Organizational Structure		
	ICS	Non-ICS	Military
Level of Understanding and Level of Performance	1. Understanding is associated with good performance. Lack of understanding is linked to poor performance.	1. Lack of understanding is linked to poor performance.	1. Lack of understanding is linked to poor performance.
Information sharing and Level of Understanding	1. Information sharing is associated with understanding	1. Information sharing is associated with understanding. Lack of information sharing is associated with lack of understanding	1. Information sharing is associated with understanding
Social Context and Level of Understanding	1. Familiarity is associated with perceived understanding 2. Frequent interactions is associated with understanding	2. Frequent interactions is associated with understanding	2. Frequent interactions is associated with understanding and infrequent interactions is associated with a lack of understanding
Social Context and Information Sharing	1. Familiarity is associated to sharing information	1. Familiarity is associated to sharing information	
Organizational Composition and Level of Understanding		1. Heterogeneity is associated with a lack of understanding	1. Homogeneity is associated with understanding

Results also revealed that Non-ICS and Military participants reported a link between organizational composition and level of understanding, while ICS participants did not. This suggests that organizational composition is an important contributing factor to level of understanding for Non-ICS and Military interviewees.

Summary. Overall, these results indicate that disaster managers do not perceive the same contextual factors to be important to the development of perceived understanding and information sharing among disaster managers. These results also suggest that disaster managers may not understand why certain organizations may prefer certain contexts (heterogeneity and homogeneity of teams) for the sake of avoiding difficulty and obtaining ease. In addition, results suggest that if disaster managers may want to foster a certain context (familiarity) not all disaster managers see the importance of the approach.

These results contribute to the objective of this study as they describe how disaster managers' perceived links differ by the type of disaster manager. Additionally, these results contribute to the goal of the study as it demonstrates that the link between understanding among disaster managers and performance is perceived by all disaster managers. Furthermore, it has been demonstrated that all types of disaster managers perceive common ground as accountable for their varying ability to work with other team mates, and differently perceive how the context influences this relationship.

Now that a general model of how disaster managers perceive concepts of interest to influence one another has been established, a remaining question is what are specific contextual barriers and facilitators to inter-organizational understanding?

Reported Perceived Direct and Indirect Contextual Barriers and Facilitators

To complete the current study's description of common ground from an inter-organizational disaster managers' perspective, the fourth and last step sought to identify contextual (social, cultural, and physical) barriers and facilitators to understanding.

The last section on perceived links touched on the barriers and facilitators within Table 6. To build on the content of Table 6, this step takes a more detailed look at the contextual links mentioned above. The specifics of the direct facilitators and barriers are identified within the link *social context and level of understanding* as well as the link *organizational composition and level of understanding*. Additionally, the specifics of the indirect effects and facilitators are identified within the link *information sharing and level of understanding*. Various direct facilitators, indirect facilitators, and direct barriers were revealed by interviewees.

General description of facilitators and barriers. A general description of what was found to be a direct facilitator, indirect facilitator, and a direct barrier follows.

Direct facilitators. Participants reported being familiar with others was a direct facilitator of understanding, for example: "We all know each other, so we know where we fit in the bigger picture." Interviewees also reported frequent interactions as a facilitator of understanding. For example: "So right from the get go we're getting the perspective of the other organizations, because we do a lot of our training jointly." Participants listed frequent training, briefings, and employment related interactions as examples of instances of frequent interactions.

Additionally, interviewees indicated that homogeneity of terminology was a facilitator to inter-organizational understanding. For example: "I will say that the relationship between

[Organization 1] and [Organization 2] is probably easier than it is between [Organization 1] and [Organization 3] because we actually almost speak the same language. We understand each other a little better.” It appears that interviewees believe that familiarity, frequent interactions, and homogeneity between inter-organizations to be direct facilitators of inter-organizational understanding.

Direct barriers. Participants felt that heterogeneity of terminology was a direct barrier to inter-organizational understanding: “I think there was some confusion about terminology there as it was reported as a lockdown. And what the hospitals mean when they say lockdown isn’t the same thing that security folks mean when they say lockdown.”

Additionally, participants also felt that heterogeneous decision making procedures were a direct barrier to inter-organizational understanding. For example : “I think one of the other things that ended up being a learning piece for all of us involved was again, trying to communicate to people who do work in a command and control, very hierarchal structure the way the decision-making in [field 1] works because it is really never that direct. So we were getting calls from [Organization 1] or from people in [Organization 2] saying okay, is [Organization 3] going to cancel [group 1] holidays during this time to keep staffing up? And we had to say well, that’s not how we work.”

Lastly, interviewees also felt that infrequent employment related interactions were a direct barrier to inter-organizational understanding: “I think that people who haven’t worked with us much still have that perception.” It appears that interviewees believe that heterogeneity of terminology and decision making procedures, as well as infrequent interactions to be direct barriers of inter-organizational understanding.

Indirect facilitator via information sharing. Indirect facilitators to understanding also existed. Specifically, in disaster managers perceived links model (seen in Figure 3) contextual factors impact information sharing which impacts inter-organizational understanding. Thus, in this portion we look at what contextual factors impact information sharing as the impact on information sharing will impact inter-organizational understanding.

Overall, participants expressed that being familiar with others was a facilitator of information sharing: “The relationships were there to get that information flowing.” These results indicate that interviewees perceive that being familiar with others to be an indirect facilitator of inter-organizational understanding as familiarity impacts information sharing.

Summary. Overall, three direct facilitators, two direct barriers and one indirect facilitator were identified. These results contribute to the objective of this study as they describe specific barriers and facilitators to understanding that are important to disaster managers. Furthermore, these results contribute to the goal of the study as it demonstrates that the grounding process exists in disaster management through various contextual facilitators and barriers. Lastly, these results also provide specific contextual factors that disaster managers perceive to impact varying levels of common ground, that have influenced their past varying ability to work with one another.

These facilitators and barriers are not compared and contrasted across type of disaster manager as these comparisons have already been made in Table 6 among links between context and understanding where the facilitators and barriers were extracted from.

Discussion

The common ground literature has produced little research which focuses on the disaster management context. Within this limited research the majority of attention has been allocated to common ground's relationship to performance; and little attention has been paid to the various contextual factors, the use of real disaster managers in heterogeneous settings, and how elements of the disaster management context may impact these relationships. Overall, the literature is somewhat limited in its representativeness of the common ground process in inter-organizational disaster management. Further research was required to confidently conclude that common ground explains the past varied successful teamwork and performance among inter-organizational disaster managers.

In response to this need the current study's goal was to reveal whether common ground and the grounding process were important to inter-organizational disaster management problem solving teams by testing the model.

Perceived Inter-Organizational Understanding and Lack of Understanding

The first step identified topics disaster managers perceived to understand and not understand about disaster managers from other organizations. Results revealed a total of 16 topics that documented participants perceived an inadequate understanding of one another's subject matter and how to work with one another's organizations. However, it was also identified that participants perceived that disaster managers had an almost complete understanding of how to work with specific individuals from different organizations.

When these topics were compared across type of disaster manager the amount of detail that disaster managers inter-organizationally perceived to understand varied across the three types of disaster managers. Specifically, it was found that ICS and Non-ICS

organizations had a very detailed understanding of other organizations of a similar organizational structure, while this was not the case for Military participants. Common ground theory would suggest that Military organizations likely don't have a detailed understanding of one another, as they only interact in rare international disasters which reduce their chances to build a mutual understanding. Secondly, Military organizations reported a very detailed understanding of ICS and Non-ICS organizations, while ICS and Non-ICS organizations' perceived understanding of Military organizations was very limited. This pattern could be attributed to the fact that Military organizations come in to support other organizations, while the reverse is not true. Thus, Military organizations gain a substantial amount of information as they need to know how to aid these other organizations. This suggests that not only is the number of interactions important for the development of common ground, but also the task may foster different levels of common ground.

Results also revealed that ICS organizations have a detailed perceived understanding of what other organizations with a similar structure understand, while Non-ICS and Military organizations do not. Common ground theory would suggest that ICS disaster managers know one another very well as they interact on a daily basis during routine crisis, which likely allows them to gain a deeper understanding of one another. Non-ICS and Military organizations lack this deeper understanding.

Lastly, results also revealed that Non-ICS interviewees perceive that other Non-ICS organizations have a detailed lack of understanding of organizations with a similar structure; this is not the case for Military and ICS organizations. If we consider common ground theory these result suggest that this may be due to the heterogeneity found among Non-ICS organizations. Specifically, organizations within the Non-ICS grouping are characterized by

many more differences than those within the ICS and Military groupings. Unlike ICS and Military organizations, Non-ICS organizations hold various types of decision making structure. Thus, ICS organizations cannot draw on their knowledge of their own organization to understand other organizations in their own category.

The fact that these results have been explained using contextual factors, most of which were identified from theory; suggest that context is quite important for the development of understanding among disaster managers. It seems that the specific nature of work that disaster managers are involved in influences the understanding that they have for other disaster management organizations.

Desired Inter-Organizational Critical Information

The second step of the study identified what information was essential for common ground among inter-organizational disaster managers. Findings revealed that 11 of the original 16 topics were perceived as critical for inter-organizational understanding. Within the majority of these 11 topics, disaster managers expressed the importance of the knowledge of these topics for themselves and others. Similarly, when these topics were compared across type of disaster manager it was found that all three types of disaster managers reported almost all of the topics as critical knowledge for themselves and others. Results across the three types of disaster managers also revealed that there was little overlap in terms of topics of critical information reported between the three types of disaster managers.

Overall, results propose that disaster managers may acknowledge the importance of mutual knowledge (common ground) but may not share the proper information with one another as they deem different topics as critical information. This could lead to conflict as

organizations may not understand why requests are coming in for information they consider to be unimportant.

Linkages in Factors of Interest Relevant for Inter-Organizational Disaster

Management

The third step described disaster managers' perceptions of how inter-organizational understanding is connected to performance, information sharing, implicit/explicit coordination, and contextual factors in disaster management. Findings revealed a total of five perceived links between the concepts of interest within the current study. These links were used to create a model which was compared to a model which was derived from the common ground and disaster management literature/theory.

The majority of both models appeared to be very similar, suggesting that disaster managers have a good sense of how common ground is developed and how it impacts the disaster management environment. Two main differences between the models were identified. First, the lack of physical context in the disaster management model suggests that that physical context is not a salient factor for disaster managers in the formation of common ground. This could be due to the fact that disaster managers are accustomed to working in distributed settings and are not aware of the benefits of working closer together. The second difference was that the model did not capture how information was shared (implicit and explicit coordination). This suggests that implicit coordination may be an unconscious process among disaster managers.

When the perceived links were compared across type of disaster manager it was found that the majority of the five links were perceived by all three types of disaster

managers. This suggests that the majority of the factors of interest in common ground theory are salient to all disaster managers.

A few noteworthy differences did exist between disaster managers. The first difference is the fact that the link between familiarity and level of understanding was only reported by ICS participants. This is most likely due to the fact that ICS participants have the opportunity to interact on a daily basis during routine events and build familiarity with one another, unlike Non-ICS and Military organizations. A second noteworthy difference across disaster manager type was that ICS and Non-ICS interviewees reported a link between familiarity and information sharing; while Military participants did not. This is likely due to the fact that Military organizations do not rely on social networks to gain information. Rather, Military organizations are often brought onto the scene as a last resort and other organizations are obligated to share with Military individuals. The third and last difference across disaster manager type was that Non-ICS and Military participants reported a link between organizational composition and level of understanding, and ICS participants did not. This could be due to the fact that ICS organizations foster familiarity during recurrent training and routine crisis. A high level of familiarity has been linked to better understanding, which may suggest that familiarity mitigates the problems that come with organizational differences as organizations are able to work around one another's differences.

Perceived Barriers and Facilitators to Inter-Organizational Understanding

The fourth and last step sought to identify contextual (social, cultural, physical) barriers and facilitators. This objective essentially expanded on the links between context and inter-organizational understanding found in the previous objective. Findings revealed that

disaster managers perceived familiarity, frequent interactions, and homogenous terminology as direct facilitators of inter-organizational understanding. Direct barriers included heterogeneous terminology and decision making procedures, as well as infrequent interactions. Lastly, indirect facilitators included familiarity.

Overall, it is right to assume that familiarity and frequent interactions are beneficial to inter-organizational disaster managers. However, one should not interpret homogeneity as strictly good and heterogeneity as strictly bad. Homogeneity may be perceived as a facilitator as it makes team work a smoother process; however, homogenous teams lack the ability to perceive and address all aspects of the disaster. A specific quote from the interviews expresses the benefit of heterogeneity: “So now you’ve got three different organizations or more there, whether it’s NGOs or whatever is there, identifying risks from three or four or five different perspectives. So now it’s like oh, okay, now I have a much better picture of what’s going on here, and what the risk is.” When differences between organizations become known (shared knowledge) individuals are able to utilize these differences and work with one another efficiently. The facilitators to common ground shed light on how these differences can become known, which is through frequent interaction and the development of familiarity. This concludes the review and interpretation of results, the implications of the results are discussed in the following section.

Implications

The results of the current study have implications for policy. The results demonstrated that disaster managers perceive insufficient understanding on subject matter and organizational process among disaster managers, suggesting a lack of common ground in these areas. In order to improve the levels of common ground the researcher would suggest

following the advice that has been revealed in disaster managers' interviews. Specifically, frequent interactions and development of familiarity would facilitate the development of common ground among inter-organizational disaster managers.

The best way to bring senior disaster managers together is mandatory frequent inter-organizational training. Training would need to involve all three types of organizations and scenarios would involve inter-organizational interaction within each of the types of disaster organizations as well as between. Of course, frequent and mandatory training seems somewhat unrealistic as disaster managers are often busy and cannot travel to the same location. However, training integrated into software programs could be utilized in dispersed situations, as this would allow for disaster managers from different cities to interact with one another on a frequent basis.

Training sessions should also begin with a briefing session where open communication allows individuals to introduce themselves, their organizations, and what they do. This would ensure that individuals have at least a sense of others roles and their place in the overall disaster. Additionally training sessions should end with an educational debrief. Debriefs should be educational in the sense that they focus on learning from mistakes and expressing ones opinions and needs, etc. Educational debriefs would help disaster managers learn what information others deem as critical and the reasons behind confusion and conflict.

Limitations and Future Directions

This study offered a description of common ground theory from Ontarian inter-organizational disaster managers' perspectives that were recruited through a purposive sampling strategy. The description revealed information about this specific groups' shared

perceptions of common ground. Due to the context specific nature of the study it is not generalizable to the disaster manager population outside of Ontario. The goal of this research was not to generalize to a larger population, but to identify information that can help future research. The findings in this research should be explored quantitatively in order to control for potential confounding variables and allow for generalizability.

Another limitation of the current study concerns the methods used to identify common ground in disaster managers' interviews. Common ground was identified by focusing on coding of inter-organizational understanding of interviewees perceptions about other disaster managers. This method is limited as there is no way to confirm that the information is truly shared, in addition one cannot ensure that the perceptions are in fact accurate. Recommendations for future studies include the use of focus groups, with disaster managers from a single event in order to properly identify what is known and not known between participants.

The results within this study have shown the kind of variability that exists across type of disaster manager, which is only one aspect of the complex disaster management context. It is recommended that future studies also explore other aspects of the disaster management context, such as the differences that may exist between disaster management time phases (e.g. preparedness, rescue, and recovery). Lastly, these results can only speak to the variation in disaster managers' ability to work with one another as disaster managers only spoke of performance in terms of team process. Future studies should attempt to explore disaster management outcomes and their link to common ground.

Conclusion

Overall, this study has described common ground theory from inter-organizational disaster managers' perspectives. Results revealed that participants perceive that there are gaps in understanding among disaster managers. Results also found that the context of work that disaster managers are involved in influences the understanding that they have for other disaster management organizations. Findings indicated that disaster managers perceive the importance of having mutual knowledge about other organizations. However, it was also discovered that organizations deem different topics as important, suggesting that this may hinder organizations ability to share and receive the information they need.

Additionally, results suggest that disaster managers' perception of common ground theory is very similar to the model provided by the literature, with a few notable exceptions. Results also indicate that physical context may not be salient to disaster management understanding and that implicit coordination may be an unconscious process. Lastly, disaster managers reported an assortment of contextual facilitators and barriers to inter-organizational understanding, for which cross-training appeared to be a key feature.

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**CHAPTER 3: CONTEXT AND COMMON GROUND IN DISASTER
MANAGEMENT: AN EXPERIMENTAL SIMULATION**

Running Head: EXPERIMENTAL SIMULATION AND COMMON GROUND

The Role of Problem Solving Approach, Group Composition, Organizational Structure and

Common Ground: An Experimental Simulation in Inter-Organizational Disaster

Management

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Abstract

Effective disaster management is critical for the quality of disaster aftermaths. Unfortunately, disaster management suffers from varying levels of success; which is attributed to inter-organizational disaster managers' inconsistent performance. Common ground among team members, defined as shared understanding, may describe these variations. Based on an inter-organizational disaster event scenario, an experiment with senior disaster responders was performed to determine the potential impact of contextual factors (problem-solving approach, team composition) on implicit coordination, decision quality, satisfaction with the outcome, and to confirm a hypothetical causal sequence among these factors. Using an experimental design and a lab scenario in pods, results indicated that problem-solving approach and team composition differently impacted measures of satisfaction with the outcome, decision quality, and implicit coordination. A series of interactions showed how contextual factors impacted common ground. Lastly, results revealed that implicit coordination mediated and suppressed the relationship between contextual factors and expert ratings of decision quality. These findings suggest that the variation in disaster managers' decision quality is attributable to contextual factors and implicit coordination (influenced by common ground). Implications are to foster cross-training across sectors of ICS, Non-ICS and Military structure.

**The Role of Problem Solving Approach, Group Composition, Organizational Structure
and Common Ground: An Experimental Simulation in Inter-Organizational Disaster
Management**

The human, social, economic, and environmental outcomes resulting from a disaster is largely dependent on disaster management (UN/ISDR, 2004). Unfortunately, disaster management response suffers from varying levels of success. The successfulness of a response is often attributed to disaster managers' ability to work together. This leads one to question "what can be done to improve inter-organizational coordination and collaboration among disaster managers?"

One factor that influences how team members work together is a mutual understanding between team members, often referred to as common ground (Carroll et al., 2006). Research has demonstrated that common ground between team members is important for team communication, coordination, collaboration, and performance (Carroll et al., 2006; Convertino et al., 2008). Common ground theory also suggests that contextual factors influence the development of common ground among team members (Carroll et al., 2006).

For example, one's familiarity (social context) with the individuals or the task may facilitate mutual understanding. In addition, types of tasks or problem solving approaches (social context) also alter how individuals interact and share information and likely impact team common ground. Means of communication (physical context) such as the use of e-mail or teleconferencing may facilitate or hinder communication, thus impacting common ground. Lastly, common ground may be impacted by the heterogeneity or homogeneity of the team composition (cultural context), as communication is often more difficult in heterogeneously composed teams (Carroll et al., 2006; Clark & Brennan, 1991; Convertino et al., 2008). It has

often been suggested that inherent organizational differences and lack of familiarity between team members impedes common ground development (Sutcliffe & Huber, 1998; Vlaar et al., 2006).

Common ground seems rather relevant for disaster managers as inter-organizational problem solving often involves interactions between organizations characterized by large differences and a lack of familiarity. Thus, the research questions addressed in this study is “To what extent is common ground important to inter-organizational disaster management problem solving?” The specific intention is to identify whether common ground may account for the successful teamwork and performance among inter-organizational disaster managers.

This question has partially been answered by a qualitative study which revealed that disaster managers themselves recognized the importance of common ground and recognized that common ground accounts for the disaster managers’ varied successful teamwork (Blust, Lemyre, & Gagnon, 2013). However, the relationships found in disaster managers’ reports have yet to be established in observable action. In addition, common ground has yet to be linked directly to decision making performance.

Quantitative studies to date on common ground have been quite limited. First, studies relevant to disaster management have yet to explore common ground as a mediator between context and performance. Secondly, these studies are also quite insufficient in terms of the number of contextual factors that have been explored in relation to common ground. Most have been run within one single organization. Lastly, the studies that do exist are restricted by their level of generalizability to inter-organizational disaster management. In response to this need the current study’s objective is to demonstrate how contextual elements such as team composition, type of task, and problem solving approach impact common ground,

performance, and their relationship to one another in inter-organizational disaster management. This objective will be completed in three steps 1) identify whether social and organizational contextual factors act together or independently in their effect on performance, 2) identify whether social and organizational contextual factors act together or independently in their effect on common ground, and 3) ascertain whether the hypothetical causal sequence between contextual factors, common ground, and performance exist.

Common Ground

Background information on common ground is presented to enable comprehension of the subsequent literature review of contextual factors and common ground in disaster management. Common ground, also referred to as a shared understanding (Carroll et al., 2006), is defined as shared knowledge, beliefs, and assumptions (Clark & Brennan, 1991). Specifically two types of common ground, Content common ground and Process common ground have been identified (Convertino et al., 2008, 2009).

Common ground between team members has been linked to team performance, specifically it is said to be essential for efficient team problem solving (Carroll et al., 2006; Convertino et al., 2008). Three main problem solving approaches have traditionally been identified: Coordination, Cooperation, and Collaboration. The main distinctions between them are that coordination involves sharing information; cooperation involves sharing information and resources, and collaboration implies sharing information, resources, and power. These three approaches can be put on a continuum that moves from coordination to cooperation to collaboration, building onto one another. Sharing increases across the span of the continuum, where the highest level of information sharing, resource sharing, and power sharing exist at the end of the continuum (See Figure 4) (Lemyre et al., 2009).

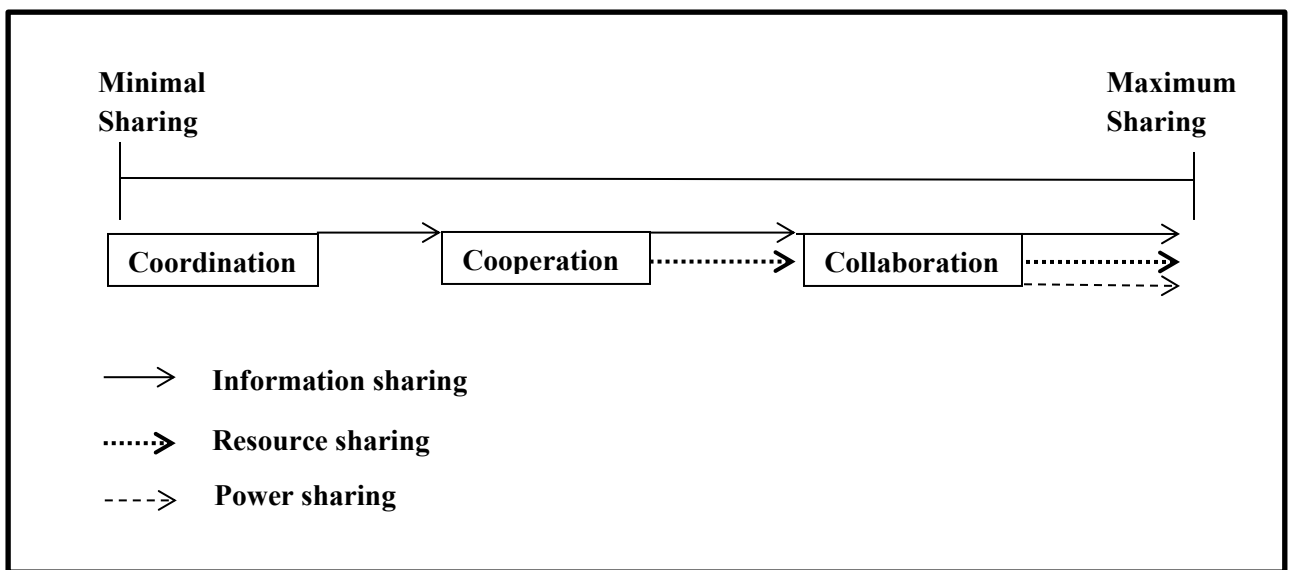


Figure 4. Problem Solving Approach Continuum (adapted from Lemyre, et al. 2009)

Common ground has been discussed as essential for efficient team problem solving since it is required for implicit coordination. Common ground enables teams to move from explicit coordination to implicit coordination: To shift from asking for one's information needs to be met to having ones information needs anticipated (Carroll et al., 2006; Convertino et al., 2008). Thus, common ground is important for all three types of problem solving as coordination (information sharing) is present in all three types of problem solving approaches.

Common ground is said to emerge from the grounding process which consists of verbal and nonverbal interaction (Clark & Brennan, 1991); and is influenced by the social, cultural, and physical context (Carroll et al., 2006). Contextual factors such as the lack of familiarity and large differences between team structures represent challenges to reach common ground (Sutcliffe & Huber, 1998; Vlaar et al., 2006). These characteristics describe inter-organizational disaster management teams, as organizations in these teams often differ greatly from one another (e.g. terminology, management style, etc.) and these organizations often do not have the opportunity to develop familiarity beforehand. This suggests that the disaster management context is important to the development of common ground, which may account for the past varied behaviour and performance among inter-organizational disaster managers.

Contextual Factors and Common Ground in a Disaster Management Context

Research on common ground specific to disaster management has revealed two important contextual factors. The first important contextual factor for common ground in a disaster management context is the social contextual factor of shared experiences. Inter-organizational disaster managers have reported that little shared experiences working

together restricts their ability to communicate and share information with one another, which limits their shared knowledge (Reddy et al., 2009).

Additionally, experimental research has demonstrated that shared knowledge among student teams increased across three similar disaster management table top exercises. This suggests that common ground increases across the number of shared experiences, due to ongoing communication and learning among team members (Carroll et al., 2007; Convertino et al., 2008, 2007). Overall, these studies demonstrated that the social factor of shared experiences impacted team common ground in disaster management.

The second contextual factor for common ground found in the disaster management literature relates to a physical contextual factor: Means of communication. Experimental research has shown that software which enabled reviewability of shared information allowed participants to develop more shared knowledge across similar tabletop exercises, in comparison to face to face interactions and interactions using other software. The changes in shared knowledge were also mimicked by the measures of implicit and explicit coordination and performance. It suggests that physical context impact levels of common ground, which in turn impact implicit and explicit coordination and performance among team members (Convertino et al., 2011).

This literature demonstrates that the physical factor of means of communication is linked to the level of shared knowledge that is essential for common ground. It has also indirectly revealed that hypothetical causal sequences between context, common ground, and performance may exist in disaster management.

Critique. This literature seems nevertheless quite limited as it has only explored two contextual elements, has not explored any cultural contextual elements, and has not explored

the interactions that may exist between contextual elements. This is quite inadequate if one considers the fact that disaster managers work in extremely complex contexts where a large number of contextual factors and interactions most likely exist.

The literature is also restricted, as it has only explored how performance is impacted by context through common ground, and has failed to consider that context may impact performance directly. Additionally, the literature has also failed to directly link the hypothetical causal sequence between contextual factors, common ground, implicit coordination, and performance. Only indirect links have been made, as similar changes caused by contextual factors in common ground and in performance are suggestive of a direct effect between these factors.

The literature that does exist does offer a good starting point. Unfortunately, it is also somewhat limited as the experimental studies presented are restricted in terms of their generalizability. One element that limits generalizability is that the experimental research is based on studies where participants work on three similar table top tasks. This is not representative as it is unlikely that disaster managers are involved in the repetition of similar tasks. Disasters are dynamic and continually changing events that involve new and altering tasks (Farazmand, 2007).

Another element that limits generalizability of the experimental research presented is the fact that participants are undergraduate and graduate students. Students are certainly easier and more affordable to find and recruit than non-student samples, however they do not bring the validity such research requires. Research has shown that student populations differ from the larger population on a number of social psychological factors (Henrich, Heine, & Norenzayan, 2010). Disaster managers are a specialized group who differ largely from

undergraduate populations in their experience, specific training, and ability to strive in stressful situations.

Overall, the literature concerning contextual factors and common ground in disaster management seems therefore to be quite limited in terms of content and in terms of its generalizability to disaster management. Further research is required to document that contextual elements in the disaster environment impact common ground, and that this explains performance among inter-organizational disaster managers.

Goal and Objectives

The current study will address some of the limitations mentioned above, with the specific objective of demonstrating how contextual elements impact common ground, performance, and the relationship to one another in inter-organizational disaster management. This study will be completed in three steps 1) identify whether social and organizational contextual factors act together or independently in their effect on performance, 2) identify whether social and organizational cultural contextual factors act together or independently in their effect on common ground, and 3) ascertain whether the hypothetical causal sequence between contextual factors, common ground, and performance exist.

This will be achieved by analyzing data obtained through an experimental component conducted as part of a larger project on meta-organizational problem solving and decision making (Lemyre, Pinsent, Boutette, Corneil, Johnson, et al., 2010; Lemyre, Pinsent, Boutette, Corneil, Riding, et al., 2010), testing three contextual factors: Team composition (cultural context), Problem solving approach (social context), and Type of task (social context).

Hypotheses

It is hypothesized that:

H1: Levels of performance and common ground differ according to team composition and the problem solving approach the team uses.

H2: Levels of performance and common ground differ according to combinations of type of task, the problem solving approach the team uses, and the teams' composition.

Interaction effects yield to:

H2a. Differences exist between coordination and collaboration

H2b. Differences exist between public communication task and responder health and safety task.

H2c: Differences exist between homogenous coordinative and homogenous collaborative teams

H2d: Differences exist between mixed coordinative and mixed collaborative teams

H2e: Differences exist between homogenous collaborative and mixed collaborative teams

H2f: Three way interaction differences exist between task, team composition, and problem solving approach.

H3: Common ground partially mediates the relationship between context and performance.

Methods

Participants

The sample consisted of 27 senior disaster managers (20 Males, 7 Females) between the ages of 38 and 66 years (mean= 49.7) and on average hold an undergraduate education.

Participants were chosen based on three inclusion criteria: 1) participants have had authority and experience to make strategic and operational decisions in at least one previous disaster, 2) participants must have had the authority to make decisions for their organization about the distribution of resources during disasters, and 3) participants must have been in travelling distance of the study site and able to communicate in English.

Participants were recruited from different sectors of different organizations. Specifically, recruitment was focused on seeking individuals from three types of organizations: 1) Military, 2) organizations that use an Incident Command System (ICS) structure (e.g. Police, Fire, Ambulance), and 3) organizations that use non ICS structures (e.g. public sector government agencies, non-governmental organizations, private sector). In addition, the study also sought individuals in these organizations who were involved in planning, responding, and/or managing extreme events at different levels (municipal, regional, and national). This allowed for the reproduction of the diverse collection of individuals involved in disaster management. Recruitment was conducted through existing professional networks.

Procedure

Following ethics approval, recruitment was initiated by e-mailing potential participants (see Appendix B for recruitment e-mail). Interested participants were contacted and scheduled into one of the experimental sessions. A brief email reminding participants of their scheduled session was sent out about one week before the session date (See appendix C for the study reminder e-mail). Sessions were randomly assigned to be either Coordinative or Collaborative sessions as Problem Solving Approach, and either Homogenous or Mixed pod sessions in terms of team composition, with a total of four possible combinations. The

procedure for each session included: obtaining informed consent, a briefing session, completion of two tasks (a Public Communication task or a Responder Health and Safety task) related to a disaster scenario, and followed with a debriefing session.

Upon participants' arrival to the experimental session at the University of Ottawa the researcher asked participants to fill out an informed consent form and a background information questionnaire. This was followed by a short briefing session where general details about timing and general description of tasks was presented. The briefing sessions introduced participants to the hypothetical city of Gapville by using a short video and handing out large laminated maps of Gapville to each participant.

Prior to the beginning of the session participants were divided into a maximum of three separate pods (teams), with approximately three people per pod. Group composition was varied across sessions by Homogenous and Mixed pods whether participants belonged to the same type of organization or across diverse types (ICS, Non-ICS, and Military). Once participants were assigned to their pod, each pod was escorted to their separate pod room. Each of the three pod rooms contained a workstation and an online conferencing station.

Within each pod room all participants were assigned a binder labelled with a participant identifier to uphold confidentiality. A session "controller" of the video conferencing software directed the pods through the simulation scenario and two tasks using slides, videos, and scripted controller voice-overs. Participants were informed of an ongoing radiological disaster scenario in Gapville with short videos that preceded each task. Inside the binders' participants found summary information about the scenario and details concerning their tasks. During the first 10 minutes of each task inter-pod communication was limited to the use of CB radios and the chat function. For the final 20 minutes of each task

the video conferencing function was made available. Once the final 20 minutes were over participants were given 15 minutes to complete a few questionnaires. A 20 minute break was provided after the completion of the first task and its questionnaires.

At the conclusion of the sessions, participants were brought back to the briefing room where a senior researcher debriefed participants on the theoretical background of the study as well as the experimental design. Comments and discussion were welcomed.

Materials

Paper work. Participants were given an informed consent form before their participation (see Appendix D for the informed consent form).

Video conferencing station. A video conferencing station was located in each of the three pod rooms; it was composed of a computer, a keyboard, a microphone/speaker, and a computer mouse. Video conferencing software was installed on the computer which allowed participants to communicate with one another through a chat function and through video conferencing. Also, the software enabled the session “controller” to regulate the communication between pods and send information to the participants through power point slides and videos.

PowerPoint deck. The PowerPoint presentation consisted of slides that presented text to prompt the participants to move onto the next step (e.g. open envelope 2).

Videos. A total of three videos were presented to the participants. The first of the three videos introduced participants to Gapville, a fictional city based on an average Canadian city. The last two videos presented information concerning the radiological disaster scenario occurring in Gapville.

Work station. A work station was located in each of the three pod rooms. The work station consisted of a desk, multiple chairs, pens, a dry erase board, dry eraser markers, and a CB radio.

Binders. Each participant was given a task binder. Binders contained envelopes with information about a complex dirty bomb incident in “Gapville”, instructions regarding two tasks, a black and white map of Gapville, and questionnaires. In addition to the binders, each participant was given a large laminated colour map of Gapville.

Tasks. Participants were presented with two tasks (See Appendix E for task instructions). Task 1 was a public communications task requiring participants to identify three main priority messages to relay to the public and to decide how these messages would be delivered. Task 2 was a responder health and safety task in which participants had to identify the two most significant responder occupational health and safety issues, to identify potential actions to address these issues and ways to implement these actions, and to decide how their actions had to be implemented.

Independent variables. Two independent variables were used in this study: Problem solving approach, and Pod (team) composition.

Problem solving approach. In this study, the first independent variable was a social contextual factor: Problem solving approach. Sessions were involved in either Coordination or Collaboration modes. These conditions were varied through the use of the task instructions. 1) The coordination instructions focused on individual decision making for one’s own organization, while taking into consideration other organizations priorities and the overlap, contradictions, and gaps that may exist within and between the organizations. 2) The

collaborative instructions focused on group decision making and coming to a consensus among all the organizations involved (See Appendix E for instructions).

Pod (team) composition. In this study, the second independent variable was an organizational contextual factor of pod composition. Sessions were varied by pod composition through the use of mixed and homogenous teams. Homogenous teams were composed of individuals with similar hierarchy structures of incident command, while mixed teams were composed of individuals with dissimilar hierarchy structures of incident command. Whether participants are similar or dissimilar in their decision making strategy is determined from which type of organization they come from: ICS, Non-ICS, and Military. A mixed pod was composed of individuals from different categories (e.g. ICS, Military, and Non-ICS), while a homogenous pod consisted of individuals from only one of these categories (e.g. all ICS).

Dependent measures. Dependent measures include measures of common ground and performance as reported and as judged by a panel of raters.

Common ground indicators. In the current study, a change in implicit and explicit coordination was used as a common ground indicator. Specifically, an anticipation ratio was used. Observers coded for information transfers of “add info”, and “reply” on the video recordings of the experimental sessions and the corresponding transcripts. A matrix was used by researchers to code who the new information was transferred to (See appendix F for the coding matrix). The anticipation ratio was calculated by dividing the number of total transfers an individual received (number of add info + number of replies) by the total number of replies an individual received. An anticipation ratio larger than 1 indicated that team members were anticipating one another’s information needs, in other words a ratio larger

than 1 indicated a shift from explicit coordination towards implicit communication. This is an indicator of common ground often used as individuals rely on common ground in order to anticipate other's needs (Cannon-Bowers et al., 1993; Entin & Serfaty, 1999).

The method applied was an adjusted version of the method used by Entin & Serfaty (1999) who, originally, coded "requests for information" and "information transfer" by using a grid which identified who the information was being transferred to. The anticipation ratio was calculated by dividing the total number of transfers received by an individual by the number of requests made by the individual. Adjustments to the coding and calculation of the ratio was needed to account for the fact that teams in the current study were involved in group discussion and were not restricted to communicating to only one individual at a time. In a group discussion setting a query will often prompt many replies from different parties. The original calculation method would be skewed in favour of anticipatory behaviour, hence correcting by dividing by the number of replies as opposed to the number of requests allowed proper representation of the data, and prevented over-representation of anticipatory information transfer.

The implicit coordination measure was also transformed into a bivariate variable using a median split. Those who were at or above the median were coded as high implicit coordination and those below the median were coded as low implicit coordination. A bivariate measure of implicit coordination was needed for our investigation into mediation.

Performance. Two types of performance measures were used in this study: Satisfaction with the outcome, as well as Decision quality.

Perceived satisfaction with outcome. Self-reported perceived satisfaction with the outcome was assessed through the use of a single item taken from the participant

questionnaires: “I am satisfied with the overall quality of the outcome from the task.” This item was rated on a five point likert scale, from strongly disagree (0) to strongly agree (4).

Decision quality. A blind rating of the quality of participants’ decisions was conducted with a panel of experts blind to the experimental conditions. Each participant’s final decision was rated using the decision quality rating questionnaire developed by the research team. This questionnaire has criteria rated on a five point likert scale from strongly disagree (0) to strongly agree (4) (see Appendix G for the decision quality rating grid). The decision quality rating grid was found to have good internal consistency for both tasks. A Cronbach alpha of .90 to .92 was found among the three raters for the public communications task and a Cronbach alpha of .80 to .94 was found among the three raters for the responder health and safety task. In addition, inter-rater reliability was found to have good internal consistency with a Cronbach alpha of .84. In response to these results the five items were combined into a single index of decision quality.

Perceived team process. Various self-report measures of perceived team process were used from the experimental component questionnaire. The questions encompassed topics such as frustration, engagement, difficulty, difference of opinion, communication, personality, motivation, focus, generation of ideas, and active participation. Questions asked about the participant’s own participation, participation of the other team members within the participant’s pod, and participation of the other pods (See Appendix H for the participation and perspectives task questionnaire). The items used in the current study were rated on a five point likert scale, from strongly disagree (0) to strongly agree (4).

Results

Analyses were conducted using IBM SPSS Statistics 21. Variables were screened for missing data, outliers and normality. Homogeneity of variance and homogeneity of inter-correlations was assessed for ANOVA analyses.

Performance

To test whether independent factors in context acted together or independently in their effect on performance (decision quality and perceived satisfaction with outcome) during two tasks, two mixed between-within subjects 2X2 ANOVAs were conducted. Planned paired comparisons were conducted on significant interactions.

Data cleaning of decision quality and satisfaction with outcome met assumptions of homogeneity of inter-correlations and revealed no missing data, no outliers, and some skew and kurtosis issues among both dependent variables when splitting by pod composition and problem solving approach. Since transformation can alter interpretability of data, the researcher decided not to transform the data to uphold the ability to interpret the data in the context in which it was extracted (Tabachnick & Fidell, 2007). Both dependent variables were also found to violate assumptions of homogeneity of variance. In response to these findings a more stringent alpha level will be used as suggested by Tabachnick and Fidell (2007). A cut off alpha level of .10, which is appropriate for exploratory research was reduced by .04 (Tabachnick & Fidell, 2007) to a more stringent level of .06.

Planned paired comparisons based on the hypotheses were made for significant interactions for both performance measures. A Holm's sequential Bonferroni correction was applied to control for family wise error rate for both measures.

Decision quality. Following the data cleaning a mixed between-within subjects ANOVA ($n=27$) was conducted to assess the impacts of contextual factors (Problem Solving Approach, Pod Composition) on participants' decision quality scores across the two tasks (Public Communications Task, Responder Health and Safety Task). Table 7 reports specific means and their standard deviations. A significant interaction between Task type and Problem solving approach was found, Wilks Lambda = .84, $F(1, 23) = 4.29$, $p < .06$, partial eta squared = .16 (See Figure 5).

Planned paired comparisons with a Holm's sequential Bonferroni correction revealed significantly higher scores among collaborative sessions in the public communications task when compared to coordinative sessions in the public communications task, $F(1, 25) = 8.3$, $p < .01$. In addition, results also revealed a non-significant pattern where collaborative pods decision quality was better in the public communications task ($M=2.66$, $SD=0.72$) when compared to the responder health and safety task ($M=2.27$, $SD=0.79$), $t(11) = 2.53$, $p < .05$ (two tailed). Although not significant following the Holm's sequential Bonferroni correction, this pattern is mentioned as it may have been impeded by the study's lack of statistical power. These results suggest that collaboration is a superior problem-solving approach if and when teams are involved in public communications tasks.

Analyses on decision making also revealed a significant interaction between problem solving approach and pod composition, $F(1, 23) = 17.46$, $p < .001$, partial eta squared = .43 (See Figure 6). Table 7 reports specific means and their standard deviations. Planned paired comparisons with a Holm's sequential Bonferroni correction were made using ANOVA analyses to identify what means significantly differ within this interaction.

Table 7. Decision Quality Scores for Two Tasks across Problem Solving Approach and Pod Composition Categories

Decision Quality		Task				
		Task 1: Public Communications			Task 2: Responder Health and Safety	
Problem Solving Approach	Pod Composition	N	Mean	SD	Mean	SD
Coordination	Homogenous	10	1.53	0.80	1.72	0.64
	Mixed	5	2.26	0.81	2.42	0.71
Collaboration	Homogenous	7	3.19	0.24	2.69	0.38
	Mixed	5	1.92	0.40	1.68	0.88

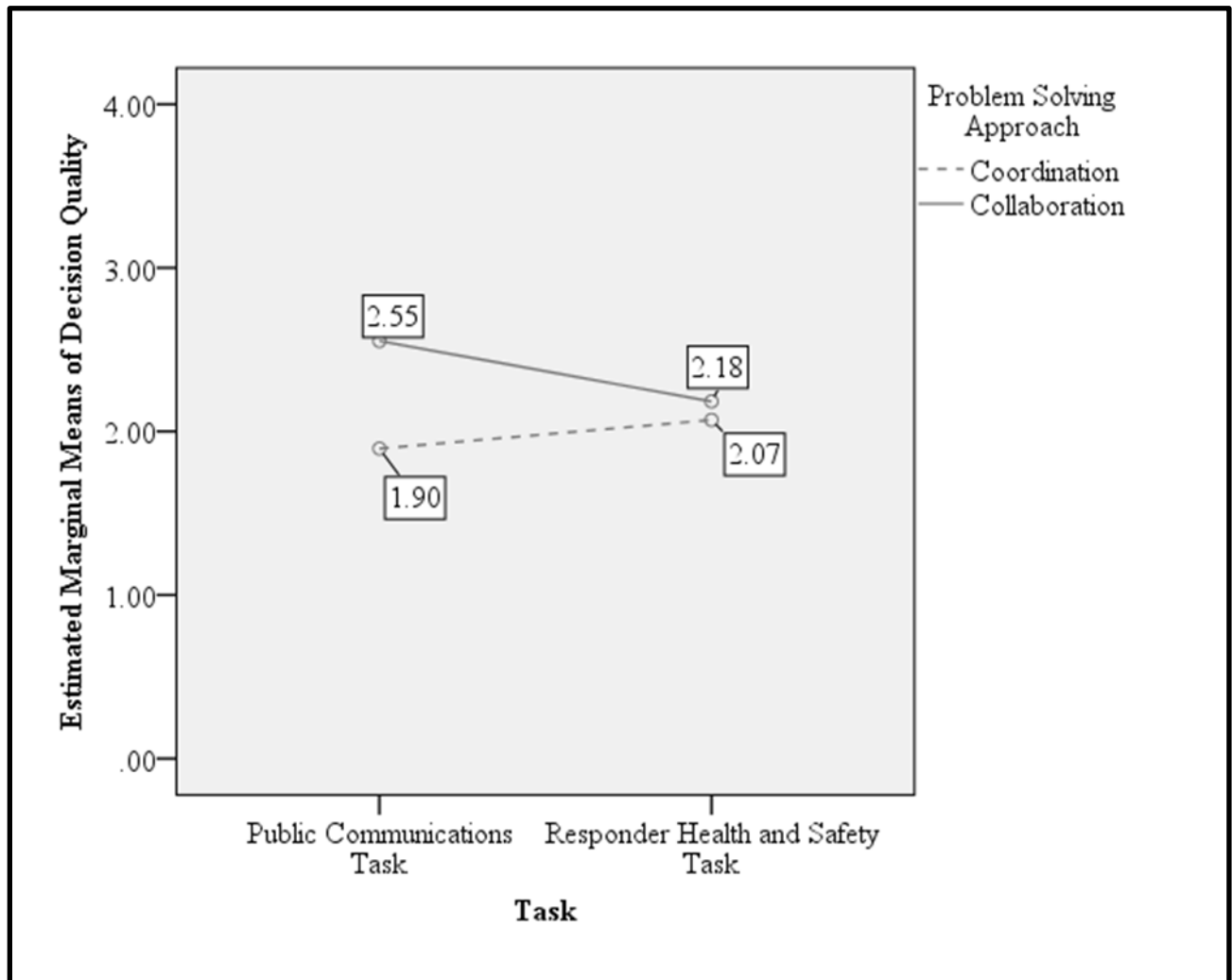


Figure 5. Decision quality scores plotted by the two problem solving categories and the two types of tasks independently from Pod composition. The figure displays a significant 2x2 interaction ($p < .06$) where collaborative sessions decision quality is significantly higher than coordinative sessions for the public communications task. Patterns also suggest that collaborative pods decision quality is superior during the public communications task when compared to the responder health and safety task.

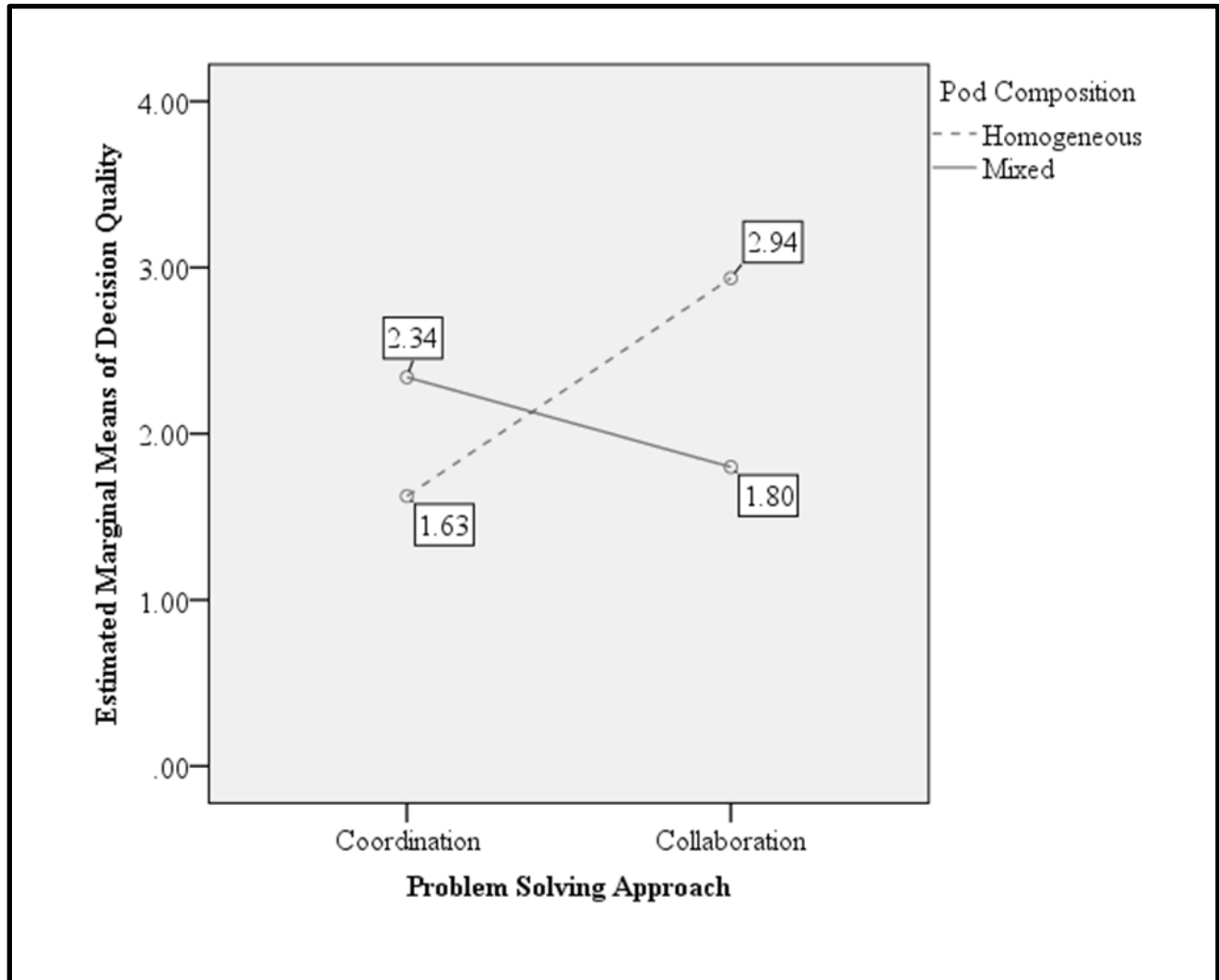


Figure 6. Decision quality scores plotted by the two Pod composition categories and the two problem solving approach categories independently of Tasks. The figure displays a significant 2x2 interaction ($p < .001$) where homogenous collaborative pods decision quality was significantly higher in comparison to mixed collaborative pods. In addition, homogenous collaborative pods were found to significantly outperform homogenous coordinative pods.

Results revealed that homogenous collaborative pods decision quality was significantly higher in comparison to mixed collaborative pods, $F(1, 10) = 21.58, p < .01$. In addition, results revealed that homogenous collaborative pods significantly outperformed homogenous coordinative pods, $F(1, 15) = 26.70, p < .001$. These results suggest that for homogenous teams a collaborative approach is superior to a coordinative approach. Collaboration seems to perform better in homogenous teams than in mixed teams.

Other results were found to be non-significant. Overall, results have demonstrated that contextual factors act together to impact decision quality among disaster managers. These results begin to give us insight into the objective of our study, as they demonstrate how contextual elements impact performance. Results also fulfill the goal of the study as they demonstrate that contextual factors are important to team work as suggested in common ground theory. The results suggest that context may account for some of the successful teamwork and performance among inter-organizational disaster managers. Additional analyses are required to complete the first step of the study, and to see whether contextual factors act together or independently in their effect on perceived satisfaction with outcome.

Perceived satisfaction with outcome. Similarly a mixed between-within subjects ANOVA ($n=27$) was conducted to assess the impacts of two different contextual factors (Problem Solving Approach, Pod Composition) on participants' perceived satisfaction with outcome across the two tasks (Public Communications Task, Responder Health and Safety Task). Table 8 presents specific means and their standard deviations. Results revealed a significant three way interaction between task type, problem solving approach, and pod composition, Wilks Lambda = .80, $F(1,23)=5.72, p < .05$, partial eta squared=.20 (See Figures 7 and 8).

Table 8. Perceived Satisfaction with Outcome for Two Tasks across Problem Solving Approach and Pod Composition Categories

Perceived Satisfaction with Outcome		N	Task			
			Task 1: Public Communications		Task 2: Responder Health and Safety	
Problem Solving Approach	Pod Composition		Mean	SD	Mean	SD
Coordination	Homogenous	10	3.20	0.63	3.20	0.63
	Mixed	5	3.20	0.45	3.00	0.00
Collaboration	Homogenous	7	3.29	0.49	3.29	0.49
	Mixed	5	2.80	0.45	3.40	0.55

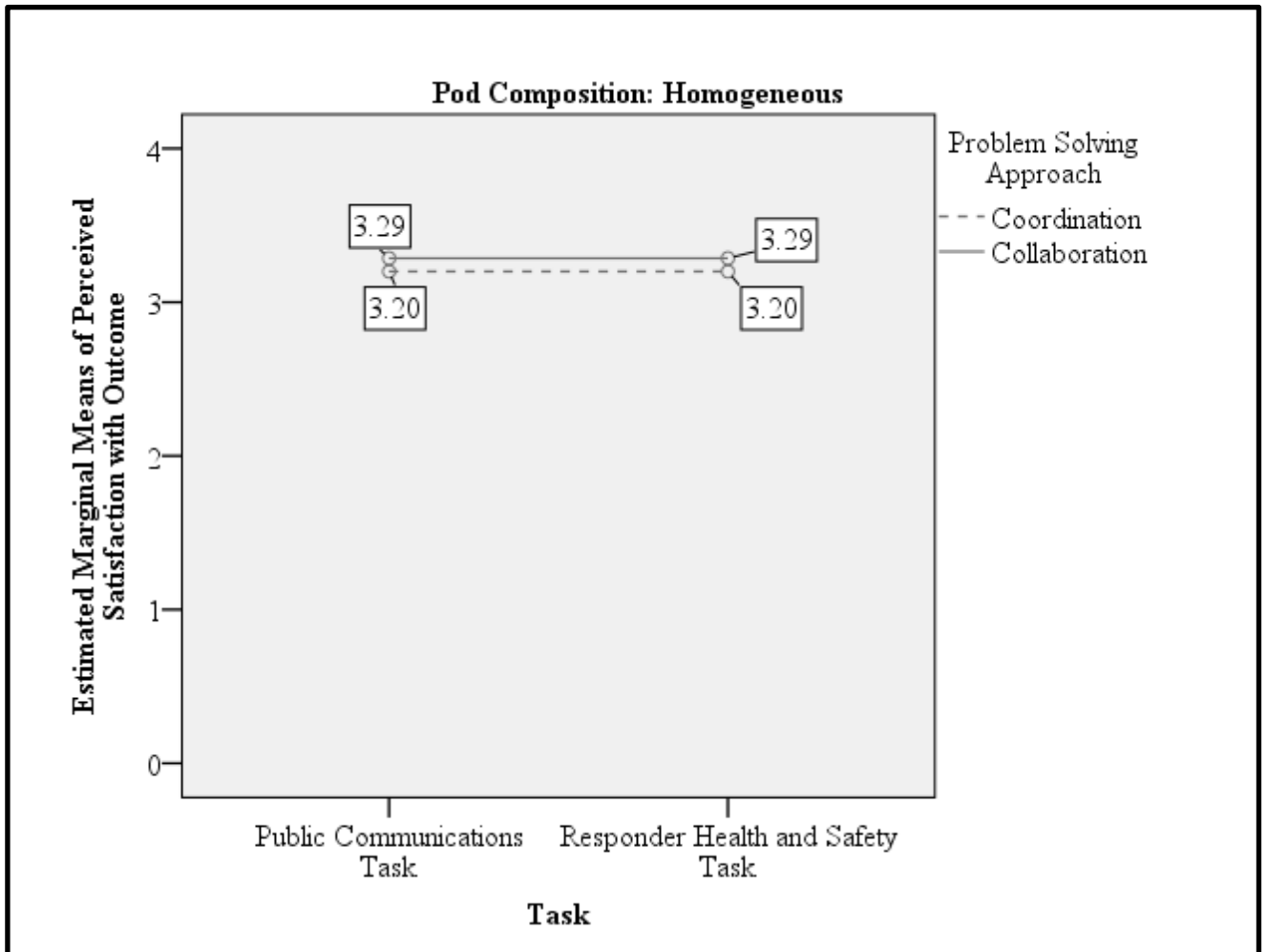


Figure 7. Perceived satisfaction among homogenous pod composition groups plotted by the two problem solving approach categories and the two types of tasks. The figure displays the first half of a significant three way interaction ($p < .05$). No significant differences were identified in the homogenous side of the three way interaction.

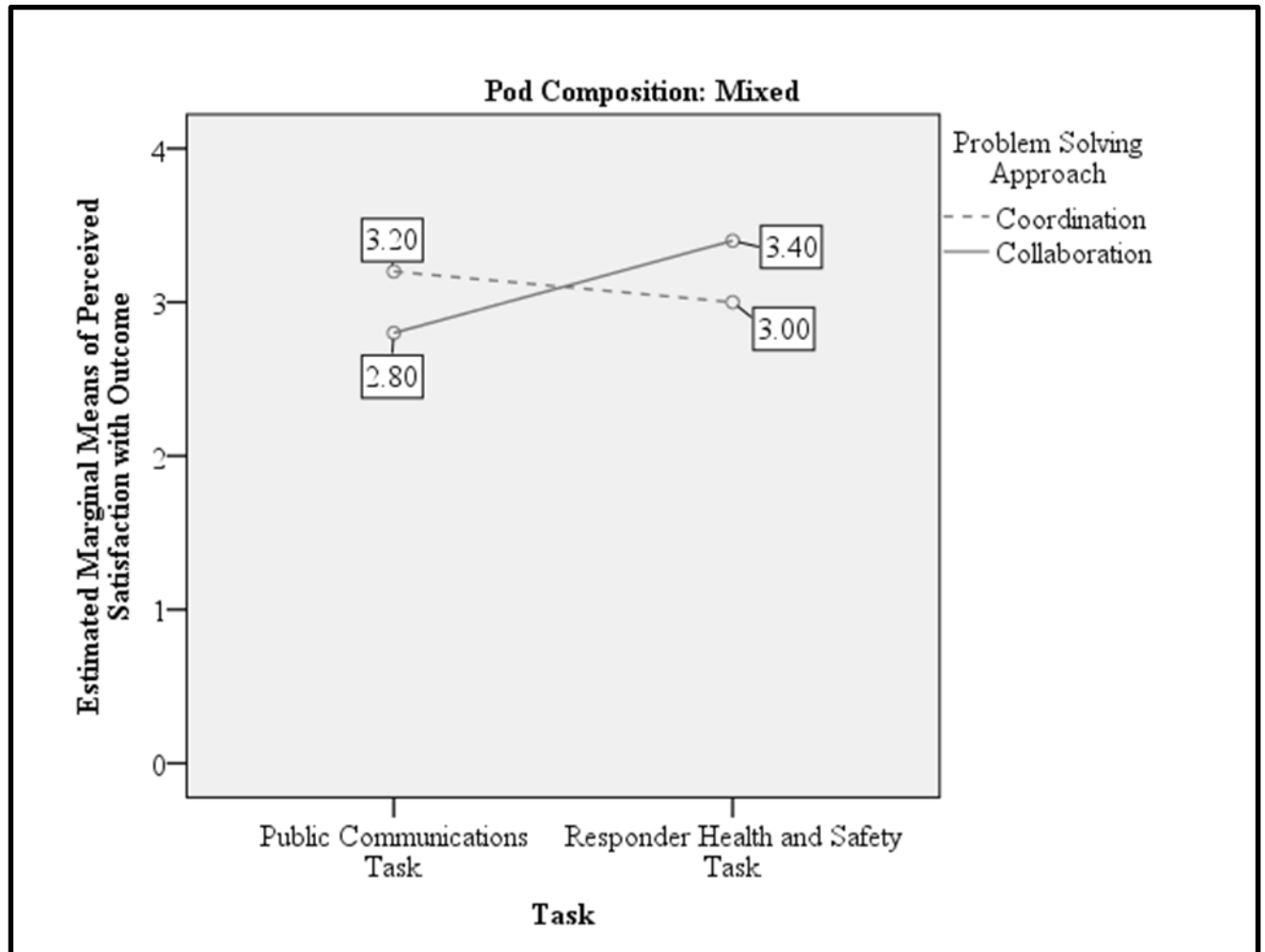


Figure 8. Perceived satisfaction among mixed pod composition groups plotted by the two problem solving approach categories and the two types of tasks. The figure displays the second half of a significant three way interaction ($p < .05$). Planned comparisons did not reveal any significant results. Patterns suggest that mixed collaborative teams feel best about their performance during the responder health and safety task.

Planned paired comparisons with Holm's sequential Bonferroni correction were made using t-tests and ANOVA analyses to identify what means significantly differ within this interaction. None of the comparisons were significant after the Bonferroni correction. However, one comparison was at the $p < .10$ level. Specifically, mixed pods using the collaborative approach had higher scores during the responder health and safety task ($M=3.40$, $SD=.55$) in comparison to the public communications task ($M=2.80$, $SD=.45$), $t(4) = -2.45$, $p < .10$ (two tailed). Even though statistical power was low, this pattern is of interest as it contributes to a significant three way interaction suggesting that there is something of importance here. The pattern suggests that mixed collaborative teams feel best about their performance during the responder health and safety task.

ANOVA findings also revealed a significant interaction between task type and problem solving approach, Wilks Lambda = .80, $F(1,23)=5.72$, $p < .05$, partial eta squared=.20 (See Figure 9). Table 8 presents specific means and their standard deviations. Planned paired comparisons with a Holm's sequential Bonferroni correction were made using t-tests and ANOVA analyses to identify what means significantly differ within this interaction. As with the three way interaction all pair wise comparisons were not significant, likely related to lack of statistical power. A single pair wise comparison did reach the $p < .10$ level. Specifically, pods using the collaborative approach reported higher satisfaction during the responder health and safety task ($M=3.33$, $SD=.49$) in comparison to the public communications task ($M=3.08$, $SD=.52$), $t(11) = -1.92$, $p < .10$ (two tailed).

This non-significant result is of interest as it contributes to a significant two way interaction suggesting that there is something of importance here.

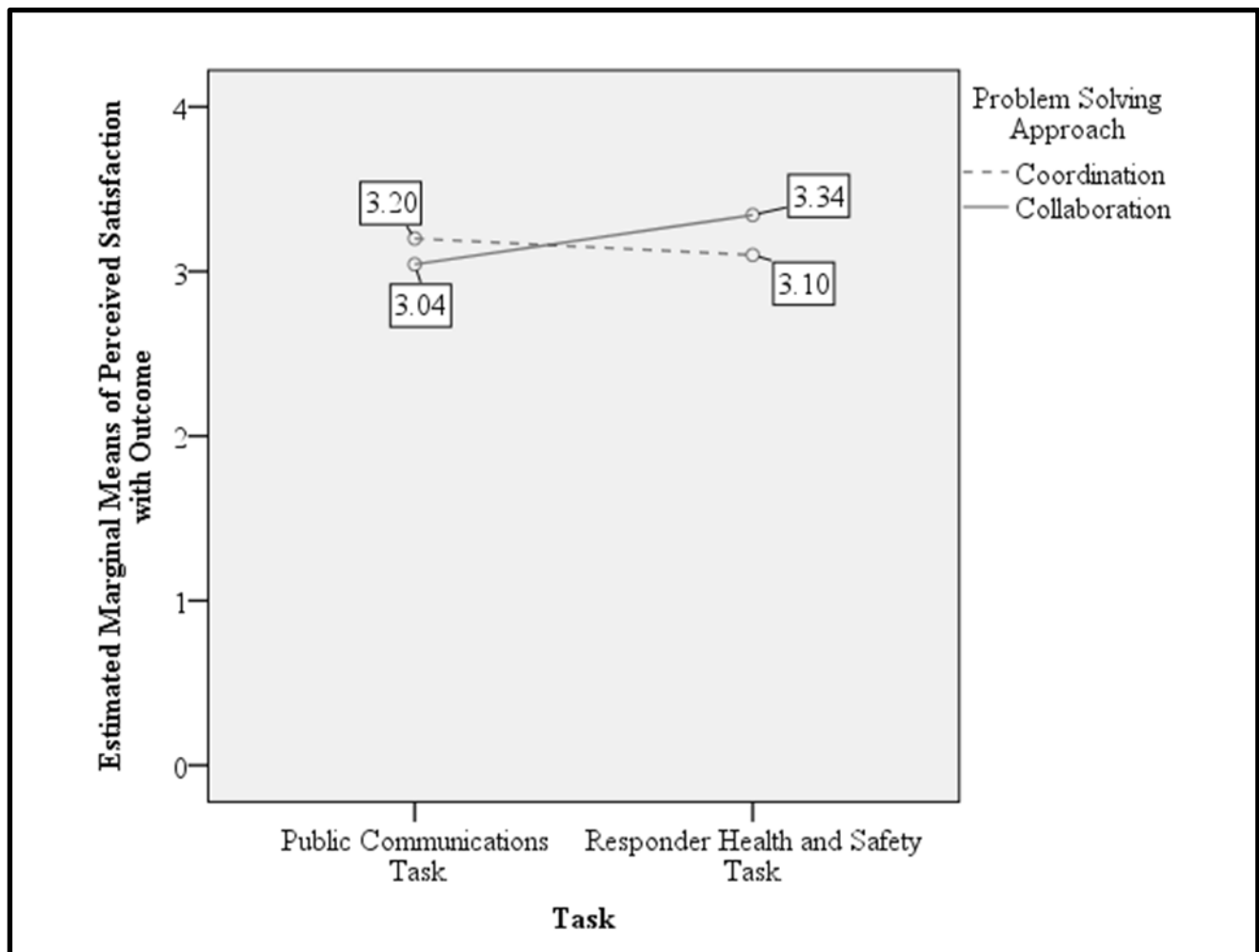


Figure 9. Perceived satisfaction with outcome scores plotted by the two problem solving approach categories and two types of tasks independently of Pod composition. The figure displays a significant interaction ($p < .05$). Planned comparisons did not reveal any significant results. Patterns suggest that collaborative teams feel best about their performance during the responder health and safety task.

This pattern suggests that collaborative teams feel best about their performance during the responder health and safety task. This is in direct contrast with the result found among decision quality expert rating scores.

Any further interactions and direct effects were all found to be non-significant. Overall, results have demonstrated that contextual factors act together to impact satisfaction with outcome among disaster managers, fulfilling the first step of the study. In addition the result concerning context and performance contribute to the goal, as they all suggest that context is important to team work as indicated in the common ground literature. Results demonstrated that important factors in common ground theory were also proving to be important for inter-organizational disaster management. Lastly, results support that context may account for the past successful teamwork and performance among inter-organizational disaster managers.

Comparing performance measures. The first step of the study has been completed; however, it seems that another issue must be addressed within the performance results. Notable differences between the analyses conducted on expert rating of quality of decision and perceived satisfaction with outcome exist. First, the analyses on both dependent variables revealed different interactions. An interaction between pod composition and problem solving approach revealed itself only in the decision quality analyses. In addition, a significant three way interaction was unique to the perceived satisfaction with problem solving analyses. The most notable difference was that decision quality analyses suggested that collaborative pods performed better during the public communication task than the responder health and safety task. While, perceived satisfaction with outcome analyses results were in direct opposition with this finding.

Due to these stark differences Pearson's correlational analyses with Holm's sequential Bonferroni correction were conducted to determine how perceived satisfaction with outcome and decision quality were related to one another, to identify whether these performance measures correlated with other team process measures. Thus, Pearson's correlational analyses with Holm's sequential Bonferroni correction of decision quality and each of the perceived team process measures were conducted. In addition, Pearson's correlational analyses with Holm's sequential Bonferroni correction of perceived satisfaction with outcome and each of the perceived team process measures were conducted.

Results revealed a non-significant relationship between the two performance measures for the public communications and the responder health and safety task (See Table 9). The non-significant results indicated that the two performance measures were not related to one another. Correlational analyses of decision quality with perceived team process measures revealed that decision quality only correlated with differences of opinion and with generation of various alternative ideas. Correlational analyses of perceived satisfaction with team process measures revealed that perceived satisfaction with outcome correlated with perceived consensus decision making and perceived personal active participation (See Table 9).

Overall, it seems that perceived satisfaction with outcome is related to measures of group consensus and personal active participation, while decision quality is related to generation of alternative ideas and debate. These results suggest that individuals' perceptions are not always aligned with what team processes truly matter when it comes to producing good quality outcomes.

Table 9. Pearson Correlations for Measures of Performance and Measures of Perceived Team Process

	Task			
	Task 1: Public Communications		Task 2: Responder Health and Safety	
	Decision Quality	Perceived Satisfaction with Outcome	Decision Quality	Perceived Satisfaction with Outcome
Decision Quality	--	.30	--	.14
Perceived Satisfaction with Outcome	.30	--	.14	--
I participated actively in the decision making process.	-.02	-.06	.27	.53**
People in the other pods had frequent differences of opinion.	-.41*	-.35	-.04	-.03
People from the other pods generated various alternative ideas.	.06	.09	.48*	.27
Decisions made between my pod and the other pods were consensus-based.	.30	.56**	.22	.10

*p<.05 **p<.01

The measure of decision quality will be carried forward into additional analyses as the current research is mostly interested in decision quality as opposed to disaster managers' perceived performance. Both are important aspects of disaster management but for the sake of parsimony and controlled alpha error rate, we will address only one aspect.

The next section presents the second step of the study and identifies whether social and organizational contextual factors act together or independently in their effect on common ground.

Common Ground Indicators

The second step of the study addresses whether contextual factors (pod composition, problem solving approach) acted together or independently in their effect on a common ground indicator (implicit coordination) during the two tasks. To fulfill this objective a single mixed between-within subjects 2X2 ANOVA for implicit coordination was conducted.

Data cleaning of implicit coordination met assumptions of homogeneity of inter-correlations. A single outlier was identified among implicit coordination, but was not discarded as it did not substantially alter the results of the analyses. Missing value analyses revealed that the dependent variable implicit coordination was missing 7.4% (2 participants) data for the second task. This was due to the fact that an anticipation ratio could not be calculated for two individuals. Specifically, the two individuals' ratios involved division by 0, which does not produce a result. Due to the inability to calculate this ratio, these two individuals were not included in the analyses involving implicit coordination. A MCAR test revealed that the implicit coordination data was missing at random. Skew and kurtosis issues were found among all dependent variables when splitting by pod composition and problem solving approach. Transformation of variables was considered. Similarly to the previous

section, the dependent variables were not transformed in order to prevent altering the interpretation of the data (Tabachnick & Fidell, 2007). Violations to homogeneity of variance were also found among implicit coordination. In response to these findings a cut off alpha level of .10, which is appropriate for exploratory research was reduced by .04 (Tabachnick & Fidell, 2007) to a more stringent level of .06.

Planned paired comparisons with Holm's sequential Bonferroni correction based on the hypotheses were made for significant interactions for implicit coordination. A total of four comparisons were made within the theme of implicit coordination.

Implicit coordination. Following data cleaning, a mixed between-within subjects ANOVA ($n=25$) was conducted to assess the impacts of two different contextual factors (Problem Solving Approach, Pod Composition) on participants' implicit coordination across two tasks (Public Communications Task, Responder Health and Safety Task) (See Table 10). Mixed between-within repeated measures ANOVA analyses revealed a significant main effect of pod composition, $F(1, 21) = 5.42, p < .05$, partial eta squared = .21. Results demonstrated that homogenous pods have significantly higher levels of implicit coordination when compared to mixed pods.

Findings also revealed a significant interaction between task type and problem solving approach, Wilks Lambda = .78, $F(1,21)=5.95, p < .05$, partial eta squared=.22 (See Figure 10). Planned paired comparisons with Holm's sequential Bonferroni correction were made using t-tests and one way ANOVA analyses to identify what means significantly differ within this interaction. Results demonstrate that collaborative pods have higher levels of implicit coordination during the responder health and safety task when compared to coordinative pods, $F(1, 23) = 12.14, p < .01$.

Table 10. Implicit Coordination Scores for Two Tasks across Problem Solving Approach and Pod Composition Categories

Implicit Coordination		Task					
Problem Solving Approach	Pod Composition	Task 1: Public Communications			Task 2: Responder Health and Safety		
		Mean	SD	N	Mean	SD	N
Coordination	Homogenous	9.09	5.23	10	4.22	0.73	10
	Mixed	5.50	3.91	5	5.08	2.29	5
	Total	7.90	5.00	15	4.51	1.42	15
Collaboration	Homogenous	6.50	2.92	6	9.74	3.72	6
	Mixed	4.09	1.02	4	6.13	3.41	4
	Total	5.54	2.57	10	8.30	3.88	10
Total	Homogenous	8.12	4.57	16	6.29	3.54	16
	Mixed	4.88	2.93	9	5.55	2.70	9
	Total	6.95	4.30	25	6.02	3.23	25

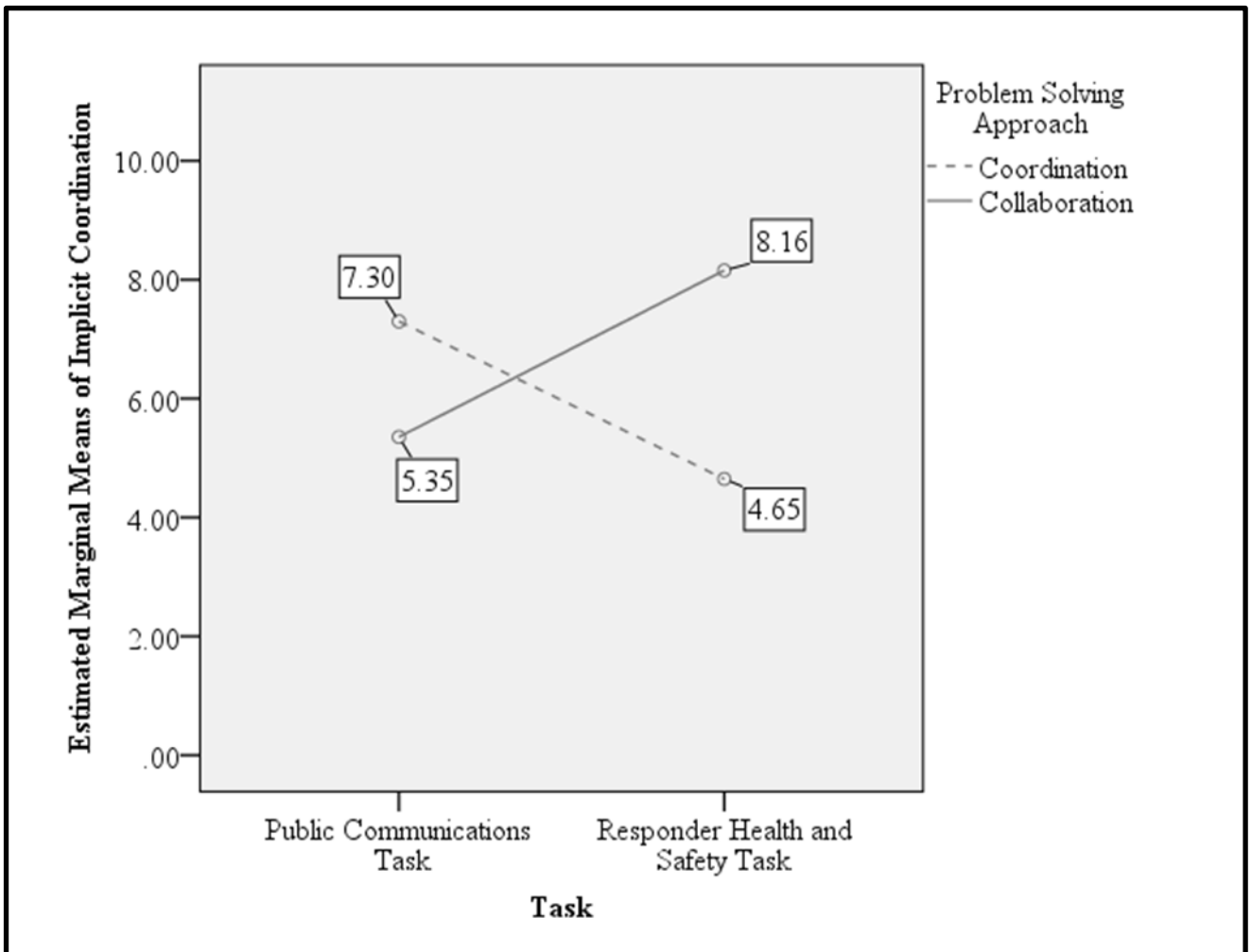


Figure 10. Implicit coordination ratios plotted by the two problem solving approach categories and two types of tasks independently of Pod composition. The figure displays a significant interaction ($p < .05$). Planned comparisons revealed that collaborative teams implicitly coordinate more than coordinative teams during the responder health and safety task. In addition, non-significant patterns also suggest that coordinative teams implicitly coordinate more during the public communications task than in the responder health and safety task.

Also, results revealed that coordinative pods had marginally significant higher levels of implicit coordination in the public communications task ($M=7.90$, $SD=4.99$) in comparison to the responder health and safety task ($M=4.50$, $SD=1.42$), $t(14) = 2.49$, $p < .05$ (two tailed). These results suggest that collaborative pods are superior in their level of implicit coordination to coordinative pods during the responder health and safety task. In addition, results suggest that coordinative pods have higher levels of implicit coordination in communication tasks when compared to responder health and safety tasks. All other results were found to be non-significant.

Overall, results have demonstrated that contextual factors act together and independently to impact implicit coordination among disaster managers. These findings contribute to the study's objective as it describes how contextual elements impact common ground.

Mediation Analyses

In order to fulfill the third and last step of this analyses this section examines the hypothetical causal sequence between contextual factors, common ground, and performance through a mediation analyses as proposed by Baron and Kenny (1986). Although mediation analyses are usually conducted using regression analyses, here, the use of ANOVA analyses was deemed more appropriate given the experimental nature of the study.

Baron and Kenny (1986) lay out the following four requirements: 1) there needs to be a significant relationship between the IV and the DV, 2) there needs to be a significant relationship between the IV and the mediator, 3) the mediator still predicts the DV after controlling for the IV, 4) the relationship between the IV and the DV is reduced when the mediator is in the equation.

Baron and Kenny's third and fourth step could be tested with an ANCOVA; however, given the significant interactions Tabachnick & Fidell (2007) suggest to treat the covariate as another independent variable and conduct a two 2X2X2 mixed between-within subjects ANOVA's to complete the four step sequence in Baron and Kenny's method. Considering the nature of the current exploratory study and its small sample size it is acknowledged that this may impact the robustness of the results.

The first 2X2X2 mixed between-within subjects ANOVA tested whether implicit coordination still predicted decision quality after controlling for problem solving approach and pod composition. The custom model included the within subjects variable of Task type, and included the between subjects variables of Pod composition, Problem solving approach, the interaction between implicit coordination and pod composition, the interaction between implicit coordination and problem solving approach, and the covariate of implicit coordination.

The second mixed between-within subjects 2X2X2 ANOVA tested whether the relationship between the contextual factors (problem solving approach, pod composition) and decision quality is reduced when controlling for implicit coordination. The custom model includes the within subjects variable of task type and includes the between subjects variables of pod composition, problem solving approach, the interaction between pod composition and problem solving approach, and the covariate implicit coordination.

Data cleaning of decision quality met assumptions of homogeneity of inter-correlations and revealed no outliers, and some skew and kurtosis issues among decision quality when splitting by pod composition, problem solving approach, and implicit coordination. Transformation of variables was considered, however the researcher did not

transform the data in order to avoid altering the meaning of the results (Tabachnick & Fidell, 2007). Assumptions of homogeneity of variance were also violated. In response to these findings a more stringent alpha level will be used as suggested by Tabachnick and Fidell (2007). A cut off alpha level of .10, which is appropriate for exploratory research was reduced by .04 (Tabachnick & Fidell, 2007) to a more stringent level of .06. Lastly, 7.4% (2 participants) of data on the implicit coordination variable was missing, as mentioned earlier. This missing data was deemed as missing at random by the little MCAR test.

The first two steps of Baron & Kenny's (1986) method have already been completed through the fulfillment of the first two steps of this study. These results will be summarized prior to reporting the results of step 3 and 4 of the Baron and Kenny (1986) method.

Step 1. The first step to Baron & Kenny's (1986) method is to identify whether there is a significant relationship between the IV and the DV. In this study the IV's are pod composition and problem solving process and the DV is decision quality. Earlier analyses have already revealed that there is a significant relationship between the IVs and the DV. Specifically, a significant interaction between task type and problem solving approach was found, Wilks Lambda = .84, $F(1,23)=4.29$, $p<.06$, partial eta squared=.16. Additionally, a significant interaction between problem solving approach and pod composition was also found $F(1, 23) = 17.46$, $p<.001$, partial eta squared=.43.

Overall, the first step of the mediation analyses was successful as the results reveal that a significant relationship between the IV and the DV. This step is followed by the second step of the mediation analyses.

Step 2. The second step to Baron & Kenny's (1986) method is to identify whether there is a significant relationship between the IV and the mediator. In this study the IVs are

pod composition and problem solving process and the mediator is implicit coordination, an indicator of common ground. Earlier analyses have already revealed that there is a significant relationship between the IVs and the mediator. Specifically, a significant interaction between task type and problem solving approach was found, Wilks Lambda = .78, $F(1,21)=5.95$, $p<.05$, partial eta squared=.22. Additionally, a significant main effect of pod composition was found, $F(1, 21) = 5.42$, $p<.05$, partial eta squared = .21.

Overall, the second step of the mediation analyses was successful as the results reveal a significant relationship between the IV and the mediator. This step is followed by the third step of the mediation analyses.

Step 3. The third step to Baron & Kenny's (1986) method is to identify whether the mediator still predicts the DV after controlling for the IV. A 2X2X2 between-within subjects ANOVA with a custom model was conducted. Results revealed a main effect of implicit coordination, $F(1, 19) = 4.13$, $p<.06$, partial eta squared=.18. Results demonstrated that participants who had low implicit coordination had significantly lower decision quality scores in comparison to participants who engaged in a higher level of implicit coordination (See Table 11). Findings also revealed a significant interaction between problem solving approach and implicit coordination, $F(1, 19) = 4.67$, $p<.05$, partial eta squared = .20 (See Figure 11).

Overall, the results demonstrated that the mediator still predicted the DV after controlling for the IV. This step is followed by the fourth and last step of the mediation analyses.

Table 11. Decision Quality Score Frequencies for Two Tasks across Problem Solving Approach, Pod Composition, and Implicit Coordination Categories

Decision Quality Scores				Task			
				Task 1: Public Communications		Task 2: Responder Health and Safety	
Problem Solving Approach	Pod Composition	Implicit Coordination	N	Mean	SD	Mean	SD
Coordination	Homogenous	Low	6	1.47	1.02	1.55	0.52
		High	4	1.70	0.36	2.30	0.53
		Total	10	1.54	0.85	1.80	0.62
	Mixed	Low	4	2.30	0.93	2.28	0.73
		High	1	2.1	.	3.00	.
		Total	5	2.26	0.81	2.42	0.71
Collaboration	Homogenous	Low	0	.	.	.	.
		High	6	3.15	0.24	2.77	0.35
		Total	6	3.15	0.24	2.77	0.35
	Mixed	Low	2	1.95	0.07	1.45	0.35
		High	2	2.15	0.49	2.15	1.48
		Total	4	2.05	0.31	1.80	0.97
Total	Homogenous	Low	6	1.47	1.04	1.55	0.52
		High	10	2.67	0.77	2.61	0.45
		Total	16	2.19	1.05	2.19	0.71
	Mixed	Low	6	2.18	0.74	2.00	0.72
		High	3	2.13	0.35	2.43	1.16
		Total	9	2.17	0.61	2.14	0.84

Note: 2x2x2 ANOVAs with three significant interactions (from $p < .06$ to $p < .01$)

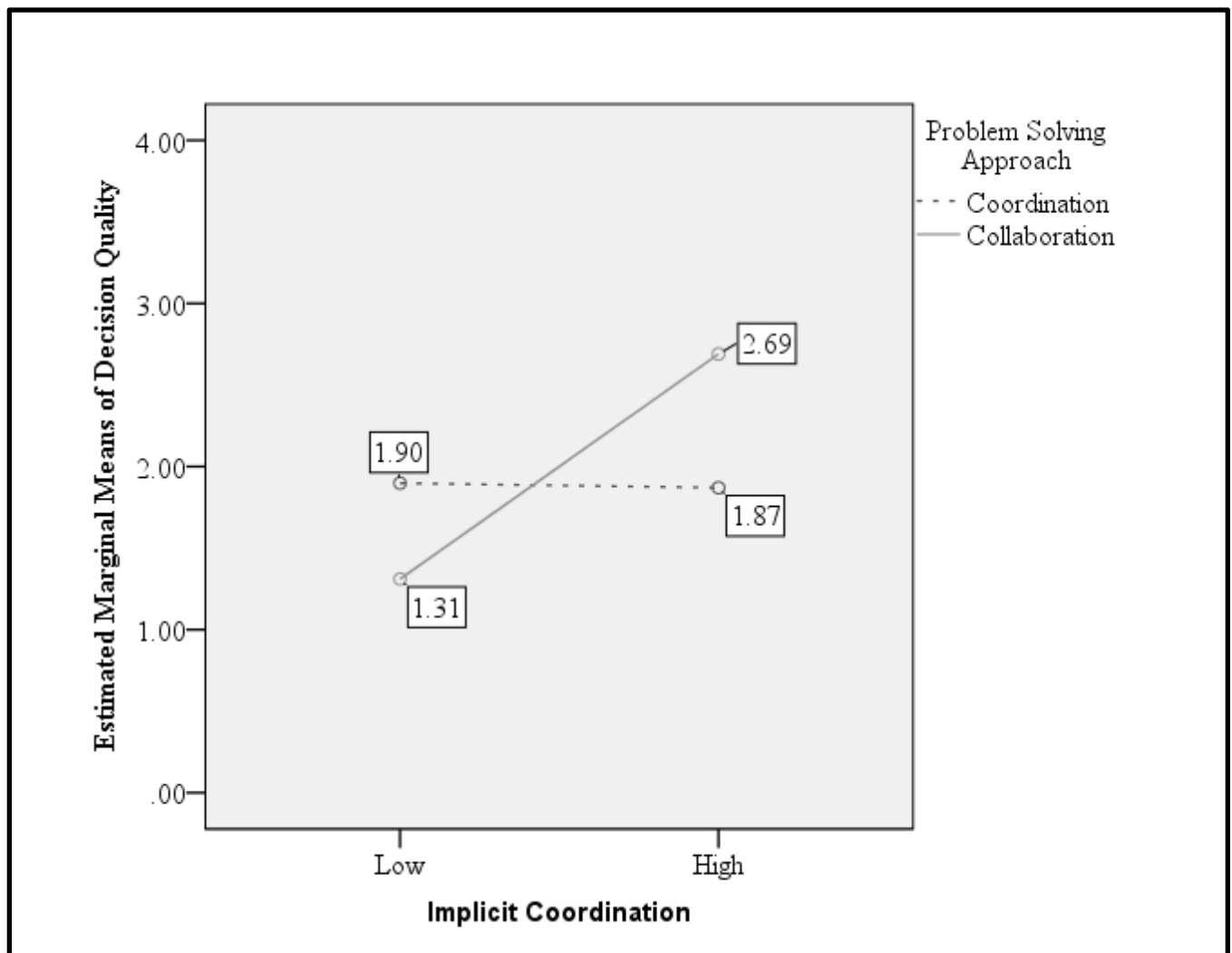


Figure 11. Decision quality scores plotted by the two problem solving approach categories and two levels of implicit coordination independently of pod composition. The figure displays a significant interaction ($p < .05$).

Step 4. The fourth step to Baron & Kenny's (1986) method is to identify whether the relationship between the IV and the DV is reduced when the mediator is in the equation. A 2X2X2 between-within subjects ANOVA with a custom model was conducted (See Table 11). The results revealed a significant interaction between task and problem solving approach, Wilks Lambda = .80, $F(1, 20)=4.97$, $p<.05$, partial eta squared= .20. Results also revealed a significant interaction between pod composition and problem solving approach, $F(1, 20) = 11.84$, $p< .01$, partial eta squared = .37.

When these results are compared to the first step of the Baron and Kenny (1986) method the partial eta squared (effect size) for the interaction between pod composition and problem solving approach decreased from .43 to .37. Thus, the relationship between the IV and the DV is reduced when the mediator is in the equation suggesting that the measure of implicit coordination is a mediator between the contextual IV's and the decision quality DV.

Additionally, it was also found that the partial eta squared (effect size) for the interaction between task type and problem solving approach increased from .16 to .20. This increase suggests that the measure of implicit coordination is also acting as a suppressor variable for the interaction between task type and problem solving approach, as its inclusion increases the effect of this interaction (Tabachnick & Fidell, 2007).

Overall, these findings contribute to the study's objectives as it demonstrates how contextual factors, common ground, and performance are related to one another. In addition, the results from the mediation analyses contribute to the goal, as they demonstrate that implicit coordination (a common ground indicator) influences the relationship between context and performance. Lastly, the partial mediation indicates that both context on its own

and implicit coordination account for the past varied performance among inter-organizational disaster managers.

The interpretations and implications of the findings, limitations of the current study, and directions for future research will be discussed in the following section.

Discussion

Until recently, the common ground literature has produced little research in the area of disaster management. Within this inadequate literature only a very limited number of contextual factors have been explored. In addition, the literature had yet to directly explore the hypothetical causal relationship between context, common ground, and performance. In addition, studies that do exist are restricted by their level of generalizability to inter-organizational disaster management.

Overall, the literature is quite limited in terms of content and in terms of its generalizability to disaster management. Further research was required to confidently conclude that contextual elements in the disaster environment impact common ground, and that this could explain the past varied successful teamwork and performance among inter-organizational disaster managers. In response to this gap in the literature the current studies goal was to reveal whether common ground and the grounding process were important to inter-organizational disaster management problem solving teams. The study's objective was to demonstrate in an experimental scenario simulation design how contextual elements such as team composition, problem solving approach and type of task impact common ground, performance, and their relationship to one another in inter-organizational disaster management.

Review and Interpretation of Results

Three steps were completed to meet the needs of objective and goal with experienced disaster managers of ICS, Non-ICS, and Military.

The first hypothesis stated that levels of performance and common ground differ according to pod composition and the problem solving approach the team uses. This hypothesis was only partially confirmed, as results found that homogenous pods possessed significantly higher levels of implicit coordination when compared to mixed pods. Results did not find that performance measures varied across pod composition and neither performance measures nor implicit coordination varied according to the problem solving approach the team used.

The second hypothesis stated that level of performance and common ground would differ according to combinations of the type of task, the problem solving approach, and the team's composition. This was found to be true as multiple interactions between these variables were found for decision quality, perceived satisfaction with outcome, and implicit coordination. Within the second hypothesis specific comparisons were hypothesized.

The first hypothesized comparison was that differences would exist between coordination and collaboration. Results found that during the public communications task collaborative teams scored significantly higher on decision quality in comparison to coordinative teams. This comparison was not found to be significant elsewhere among perceived satisfaction with outcome scores or level of implicit coordination.

The second hypothesized comparison was that differences exist between tasks. This hypothesized difference was not confirmed as paired comparisons were no longer significant following the bonferroni correction. However, the comparisons did reveal patterns that

indicated collaborative teams decision quality tended to be better in the public communications task when compared to the responder health and safety task. In addition, patterns also revealed that collaborative teams' perceived satisfaction with outcome was higher in the responder health and safety task in comparison to the public communications task. These non-significant patterns proved to be very useful as they revealed an interesting difference between performance measures.

The third comparisons hypothesized that differences would exist between homogenous coordinative and homogenous collaborative teams. Results revealed that homogenous collaborative pods scored significantly higher on decision quality in comparison to homogenous coordinative pods. Such differences were not found for participants' perceived satisfaction with outcome scores or levels of implicit coordination.

The fourth comparison made a similar hypothesis but for mixed teams. Specifically, it hypothesized that differences would exist between mixed coordinative and mixed collaborative teams. Unfortunately, this hypothesis was not confirmed. Such differences were not found among decision quality scores, perceived satisfaction with outcome scores, nor level of implicit coordination.

The fifth comparison hypothesized that differences exist between homogenous collaborative and mixed collaborative teams. Results revealed that homogenous collaborative teams' decision quality was significantly higher in comparison to mixed collaborative pods. The hypothesized comparison was not significant among perceived satisfaction with outcome scores and level of implicit coordination.

The sixth and last hypothesized comparison was that three way interaction differences would exist between task type, team composition, and problem solving approach.

Results indicated that mixed collaborative teams had significantly higher perceived satisfaction with outcome scores during the responder health and safety task in comparison to the public communications task. The hypothesized comparison was not found among decision quality scores and level of implicit coordination. Overall, the second hypothesis was only partially confirmed as the hypothesized comparisons did not reveal themselves consistently among both performance measures and the common ground indicator.

The results from the first two hypotheses have revealed three major findings which describe how contextual factors impact performance and common ground. Context impacts decision quality and perceived satisfaction with outcome in a differentiated manner. Decision quality and perceived satisfaction with outcome are not resulting from the same factors. Collaboration and coordination are clearly task specific.

Further correlational analyses confirmed that these two variables were not significantly related to one another. Perceived satisfaction with outcome seems to be related to how the disaster managers feel about their own level of active participation and the consensus among the team, while decision quality was related to the generation of various ideas and the differences of opinion among team members. What the results do suggest is that disaster managers' perception of a satisfactory outcome is at times in opposition with the true quality of the decision. These results suggest that disaster managers' perceptions may guide them in the wrong direction when they are relying on their level of satisfaction.

The second major finding garnered from the findings from the first two hypotheses was that contextual factors differently impacted measures of performance and implicit coordination (a common ground indicator). This finding is in opposition to findings in past literature. Past literature has often found that contextual factors effect on measures of

performance is very similar to its effect on measures of common ground (Convertino et al., 2011). The fact that our study did not mimic past literature could suggest that not all contextual factors impact performance and common ground similarly.

It could also suggest that the current research captures the complexity that comes with using senior disaster manager participants, as opposed to undergraduate participants. There may be additional variables that could have been controlled that influence performance and/or common ground indicators. Unfortunately, this was beyond the capabilities of this study as the number of variables was restricted by the limited sample size/power.

Lastly, a major finding discovered from the results from the first two hypotheses was that there were no consistent differences across task found among the results. This is in opposition from past literature, as it has found that indicators of common ground demonstrate that common ground increases across repetitive tasks, suggesting that common ground increases with the number of shared experiences (Carroll et al., 2007; Convertino et al., 2008, 2007). An increase from the first task to the last task was not seen within the current research likely due to the fact that the tasks were not repetitive in nature. The researcher feels that disaster managers would likely gain common ground across different types of tasks but this gain is most likely small and not significant from one task to the other. The change in common ground gained from shared experiences is most likely a slow process for disaster managers, as they are almost never engaged in repetitive tasks but rather new tasks due to the novel nature of emergencies.

Finally, common ground partially mediated the relationship between the interaction of cultural and social context and performance. This hypothesis was confirmed by the

decrease in effect size in the interaction between pod composition and problem solving approach within the decision quality data. Specifically, implicit coordination demonstrated to partially mediate the interaction between pod composition and problem solving approach found among the decision quality data.

Aside from the mediation, results revealed an unexpected suppression effect. Specifically, the addition of the implicit coordination variable increased the effect size and p value for the interaction between task type and problem solving approach among the decision quality data. These results triggered further investigation into the measurement of implicit coordination used in the current study. However, it could also be a spurious effect linked to the small sample.

The measure of implicit coordination used was referred to as an anticipation ratio by Entin and Serfaty (1999). The problematic aspect of this measure is that there is no way to divide information that was correctly anticipated from information that was incorrectly anticipated. It would seem rational that information anticipation would cause an increase in decision quality as correctly anticipated information increases efficiency and as a result allows more time for other aspects of decision making. In addition, information anticipation would also cause a decrease in decision quality as incorrectly anticipated information would decrease efficiency and time for other aspects of decision making. Thus, controlling for anticipated information decreased the magnitude in one relationship while increasing the magnitude in the other relationship as it contains both correctly anticipated information and incorrectly anticipated information.

Although this bi-dimensional aspect of the implicit coordination measure was described as problematic it is not necessarily wrong. It is likely that the measure captures the

true nature of implicit coordination in inter-organizational disaster management team work.

When disaster managers implicitly coordinate they are drawing on their knowledge of others, knowledge that may be correct or incorrect. Whether implicit coordination is based on accurate or inaccurate common ground it is likely to have positive and negative effects similar to those found in this study.

Taken as a whole, the results highlight the major finding that one needs to consider the type of team and the type of task when choosing the problem solving approach which will foster the best decision quality. Results suggest that a collaborative approach is most appropriate in homogenous teams. Homogenous teams are likely to foster the best decision quality when using collaboration as they were also shown to possess higher levels of implicit coordination. It is likely that the higher level of implicit coordination allows homogenous pods to take advantage of a collaborative approach. Homogenous pods are likely to accurately anticipate one another's needs as they have gained common ground from their similar decision making structures and most likely have previously interacted, unlike mixed pods. In addition, a grouping of homogenous teams which are able to organize their actions in advance and then interact with heterogeneous teams will most likely be more of an efficient process.

In addition, results also indicated that a collaborative approach fosters the best decision quality during the public communications task. This is likely as public communications is a malleable task, one in which individuals can easily alter it to meet the needs of the group. While, responder health and safety standards are often set up beforehand and are unalterable. Thus, a public communications task can benefit from collaborative work

while a collaborative approach during a responder health and safety task is no better than using a coordinative approach.

Overall, the results revealed that common ground is important to inter-organizational disaster management problem solving teams. The importance of common ground in disaster management has been demonstrated by the fact that implicit coordination mediated 6% of the relationship between context and decision quality. In addition, implicit coordination demonstrated to be a suppressor variable which accounted for 4% of the variance between context and decision quality. In total, implicit coordination accounted for 10% of the relationship between context and decision quality. These relationships demonstrated the importance of common ground, as common ground enabled accurate implicit coordination and a lack of common ground led individuals to inaccurately implicitly coordinate.

In addition, common ground's importance in disaster management has also been revealed as results mimic common ground theory. Specifically, results and common ground theory suggest that contextual factors impact implicit coordination and that implicit coordination is tied to common ground. In the current study, in the implicit coordination analyses an interaction between task and problem solving process explained 22% of the variance and a main effect of pod composition explained 21% of the variance. It demonstrated that common ground theory is applicable to team work in inter-organizational disaster management.

Implications

The results of the current study have implications for research. First, the results suggest that the interactions among contextual factors are of great importance to disaster management outcomes. Contextual factors should be more widely integrated into common

ground research and their interactions should be explored in order for research to gather a better understanding of what is involved in inter-organizational disaster management decision making and performance.

In addition, this research has also suggested that one needs to carefully consider measurement when interpreting results. Research using participants' perceptions of their own performance should not lead the reader to interpret results as sufficient measures of performance. It seems that participants' perception of performance is associated to the participants' level of active participation and the team's ability to come to consensus, items that are not related to externally rated decision quality. Both disaster managers' perceptions of performance and rating of performance are useful, but interpretations and implications that are garnered from the results using the measures should be explained with respect with what they really mean.

The results of the current study also have implications for policy. On the practical side results suggest that collaboration is not always the best approach and should not be idealized as such. Rather, teams of disaster managers need to learn to identify whether their team has sufficient levels of mutual understanding and identify the type of task in order to choose the right problem solving approach in order to optimize the quality of their decisions.

In addition, implicit coordination's' mediating and suppressing effects on the relationship between context and performance demonstrated that common ground among team members is essential for team members to perform at their very best. This suggests that policy needs to focus on fostering common ground among inter-organizational disaster managers by implementing compulsory joint training on a regular basis. Such training would allow inter-organizational disaster managers to begin to gain the common ground that is

required for accurate implicit coordination and for their optimal performance. It will allow them to make use of the advantages that a collaborative approach offers. In addition, such constant interaction would allow individuals to correct their mistaken knowledge, beliefs, and assumptions about other organizations which will reduce inaccurate implicit coordination.

Limitations and Future Directions

One of the main limitations of the current study is the fact that it is exploratory and uses a standard alpha level of .10, or an alpha level of .06 when controlling for heterogeneity of variance, as the number of participants limited the power of the current analyses. Considering these limitations the study found a number of interesting results at very significant levels. However, future research should attempt to replicate these results in future studies in order to assess reliability of these results and perhaps even discover additional patterns.

Another limitation of the current study was the measurement of implicit coordination. Implicit coordination is naturally linked to common ground as one cannot anticipate others information needs without having a sense for what they need. The measure used in the current study did not distinguish between correctly and incorrectly anticipated information needs. Thus, the effect of common ground could not be isolated in this study. However our measure proved to have other benefits as it has revealed an aspect of implicit coordination that has not been acknowledged elsewhere. In addition, it most likely captured a realistic phenomenon as it is human nature to be susceptible to inaccurate circulating information when one is unfamiliar with a group of individuals. Future studies should explore the bi-

dimensionality of implicit coordination as well as explore each in isolation with a more specific measure.

In addition, future research should attempt to obtain a higher level of inter-rater reliability on numerous tasks for decision quality ratings. Another aspect that was not ideal in the current research was that the numbers of tasks were limited to two. Future research would benefit from having disaster managers participate in three to five different and counter balanced tasks in order to identify how quickly common ground increases across shared experience for disaster managers. It would give a sense of how common ground may increase for disaster managers in the real world where they are faced with participating in numerous varying tasks.

Lastly, in the current study common ground was unevenly distributed. This is not quite a limitation of the current study but did limit the ability of the current study to identify performance differences between homogenous and mixed teams both with high levels of common ground. Currently it seems that homogenous pods have an advantage over mixed pods, however it is still unclear what benefits in performance may be gained by a high level of common ground in mixed pods as opposed to homogenous pods.

Conclusion

Using an innovative experimental setting with experienced disaster managers the study provided unique insights. Overall, the current study revealed five main findings. First the study revealed that disaster managers perceived satisfaction with the outcome are not related to decision quality. Secondly, the study demonstrated that contextual factors such as Team composition and collaborative or coordinative approaches differently impacted

measures of performance and implicit coordination. In opposition to past research, this suggests that contextual factors effect is more complex than demonstrated in past research.

Thirdly, results did not reveal consistent differences across tasks, negating the possibility that common ground and performance significantly increased over repeated interactions. Fourth, implicit coordination mediated and suppressed the relationship between context and performance. Revealing both the benefits and set back of implicit coordination, and how the accuracy of one's knowledge, beliefs, and expectations of other organizations is essential to performance. Results indicated that a collaborative approach is a better approach in the hands of homogenous teams that interact heterogeneously once major details have been organized. Results also indicate that collaboration is best in malleable tasks such as in public communications tasks.

The objective of the current study has been fulfilled as the study has demonstrated how contextual elements impact common ground, performance, and their relationship to one another in inter-organizational disaster management.

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CHAPTER 4: GENERAL DISCUSSION

As disasters require many responders of different backgrounds and purpose to work together at mitigating problems, common ground has been put forth as a concept of required minimal common understanding. To ascertain whether common ground accounts for the past varied successful teamwork and performance among inter-organizational disaster managers; the goal of the present thesis was to identify whether common ground and the grounding process was indeed important to inter-organizational disaster management problem solving teams. This was accomplished in two parts.

First, a qualitative study involving interviews with a group of senior disaster managers was conducted. These interviews yielded a description of common ground theory from inter-organizational disaster managers' perspective. Results revealed that disaster managers themselves perceived that there was an inadequate understanding between organizations, and also perceived the importance of holding mutual understanding. In addition, the study found that disaster managers perceived common ground similarly as the past literature, with the exception that they did not identify the contribution of implicit coordination or of the physical context. Lastly, disaster managers recognized a number of contextual facilitators and barriers to inter-organizational understanding. Results varied by disaster manager type, which seemed to be attributable to their unique work environment. This study demonstrated that common ground and the grounding process is essential to inter-organizational disaster management.

In order to substantiate the perceptions found in the qualitative study a quantitative study followed. So the second part of the thesis involved a quantitative experimental study with a simulated disaster scenario to demonstrate how contextual elements impact common

ground, performance, and their relationship to one another in inter-organizational disaster management.

Results revealed that disaster managers' perceived satisfaction with the outcome was not related to their decision quality; however, contextual factors (problem solving approach, pod composition, task type) differently impacted both of these measures as well as implicit coordination. Specific to decision quality, results indicated that a collaborative approach was the better approach in homogenous teams that interacted heterogeneously once major details had been organized within teams. Results also indicated that collaboration was best in malleable tasks such as in public communications tasks. Lastly, it was found that implicit coordination mediated and suppressed the relationship between context and performance. This revealed both the benefits of and detriments of implicit coordination. The results from this study supported that both context as well as implicit coordination, viewed as common ground can account for some of the past varied successful performance among inter-organizational disaster managers.

The results of these studies highlight the importance of context, the nature of implicit coordination, and the relationship between perceived satisfaction with the outcome and decision quality in inter-organizational disaster management.

Context

One of the main findings within both of the studies was the importance of contextual factors for inter-organizational disaster management. It was demonstrated that contextual factors impact the level of common ground, impact performance, and impact implicit coordination and whether information is shared.

Results also suggest that contextual factors in emergency managers daily work impacts their levels of common ground. Cross-training could serve as a useful tool to increase emergency managers' common ground with one another. For example, simply implementing regulations where responders are briefed about other organizations roles and activities on a regular basis may help the level of common ground between disaster managers. Whether basic cross-training is satisfactory or whether individuals really need firsthand experience to begin substantial common ground still needs exploration within inter-organizational disaster management.

The studies touched on several different contextual elements including: familiarity, frequency of interaction, cultural composition, and problem solving approach. Many other contextual factors that may be important for common ground in disaster management could be examined such as leadership. Past research on distributed teams has shown that the leader facilitates common ground among the team (Jones & Hinds, 2002). It would be interesting to explore how this functions in disaster management teams and whether different types of leadership impacts levels of common ground.

Another contextual factor that has shown to be quite relevant for work teams is turnover. Specifically, turnover has been identified as a reason why internal collaboration is not better within disaster management organizations (Wood, Kovacs, Bostrom, Bridges, & Linkov, 2012). Turnover could also affect inter-organizational disaster manager teams. This problem may not be as frequent at the senior disaster management level, but may have a greater impact when someone with a tremendous level of common ground with other team members decides to move on elsewhere. Turnover is inevitable but there may be ways to decrease the rate and smooth the process.

Specifically, levels of common ground may impact turnover intentions. Common ground may impact turnover intentions as common ground may play a role in how individuals perceive relatedness toward work colleagues. Research has demonstrated that relatedness to work colleagues has been identified as one factor that is related to motivation. Motivation that is associated with work satisfaction and emotional exhaustion, which have been shown to direct turnover intentions (Richer, Blanchard, & Vallerand, 2002). It seems likely that common ground in a team would increase relatedness toward work colleagues as mutual understanding would allow members to identify similarities within the team, and as a result would help decrease turnover intentions. Additionally, fostering common ground among newcomers using cross-training may also help smooth the turnover transition.

Implicit Coordination

Another main finding within the two studies focuses in on the nature of implicit coordination. Specifically, implicit coordination was not perceived by disaster managers as playing a role in inter-organizational disaster management. However, it did demonstrate to play a mediating and suppressing role in the relationship between context and performance in the experimental study. These results really highlight the fact that implicit coordination exists in disaster management but is likely an unconscious process as disaster managers do not report its existence.

Another major finding was the bi-dimensionality of implicit coordination. Implicit coordination mediated and suppressed the relationship between context and decision quality. It can be inferred that the mediation effect likely stems from the benefits of implicitly coordinating, by passing on information that is truly useful for the other team member(s). This is attributable to common ground, as accurate mutual understanding would allow

accurate implicit coordination. It can also be suggested that the suppression effect likely comes from the detriments of implicitly coordinating, by passing on information that is not necessarily useful for other team mates. This can be ascribed to individuals' incorrect knowledge, beliefs, and assumptions about other team members. However, we should be cautious as this could be a spurious effect linked to the small sample. This bi-dimensional nature of implicit coordination needs to be validated in future research.

Performance

Other main findings in the thesis reside in inter-organizational disaster managers' performance. Specifically, it was found that disaster managers' satisfaction with the outcome was not related to the level of expert rating of decision quality. In fact, responders' perceived satisfaction with the outcome was highest in the task where decision quality was the lowest. These findings demonstrate that disaster managers' perceived satisfaction is in some disconnect with their actual performance. This is potentially due to the fact that disaster managers' perception of the outcome is focused on team processes issues as opposed to solid outcomes. Looking back on the results from the interviews, this seems like an accurate assumption as managers only reported performance in terms of group processes (e.g. conflict, ease, working well together) and did not mention work outcomes.

The fact that satisfaction is not associated to decision quality is an interesting finding. One potential explanation is found in the correlations conducted with team process variables. Specifically, satisfaction with outcome correlated with one's active participation and consensus within the group. Consensus within a group and team member's active participation is not necessarily a recipe for good decisions. These qualities may reduce stress and difficulty but a certain level of frustration and conflict naturally occurs in competitive

environments when individuals are proposing different ideas and debating which idea or which combinations of ideas are the best. A complete lack of frustration may suggest that there are not enough ideas and perspectives available to produce a multi-dimensional solution appropriate for a disaster. Failing to account for all dimensions in decisions could aggravate the situation as opposed to improving it.

Another explanation as to why satisfaction was not related to performance could be explained by stress. Work satisfaction is often linked to an individual's stress, and stress impacts performance. Even though the results of this thesis suggest that this issue is non-existent as the relationship between satisfaction and decision quality is not correlated, one also needs to consider the context in which the results were obtained. In real disasters responders are likely to care considerably more about the teams' decisions, and experience high levels of stress. Here, satisfaction may not have been related to decision quality in the current study as the level of stress was likely non-existent due to the lack of importance of their decisions. External validity in field studies should be verified.

Findings from the two studies also indicate that common ground mediates both the relationship between context and satisfaction, as well as the relationship between context and decision quality. Even though common grounds mediation of the relationship between context and satisfaction is not empirically established, qualitative results are very convincing. Common ground not only improves performance but also reduces unnecessary conflict caused by confusion, which would likely impact an individual's satisfaction with team work.

Implications

The findings from these studies have implications for policy. Results suggest that a mutual understanding among disaster managers is important for a smooth inter-

organizational process as well as for decision making quality. These results suggest that it is very important that inter-organizational disaster managers develop mutual understanding prior to disaster events. The research therefore suggests frequent and ongoing training sessions where disaster managers from different areas and different organizational structures (ICS, Non-ICS, and Military) are required to work with one another and begin to develop the necessary mutual understanding. If ongoing training is not a possibility more basic levels of cross-training may be helpful. Such measures should be integrated with other disaster preparedness strategies.

The usefulness of common ground in disaster preparedness is not solely restricted to disaster managers. Past research has also suggested that it is useful for community preparedness. A study involving a community intervention in Truro revealed to be very important for common ground and enabled implicit coordination during the Truro flooding. Specifically, the intervention allowed the community members to become familiar with the Red Cross organization and understand their needs. This enabled the community members to feed the Red Cross useful information during the flooding crisis and prevented the Red Cross from having to waste time to seek out this information (T. O'Sullivan, personal communications, April 18, 2013).

Limitations and Future Directions

These studies are limited as they are conducted with disaster managers from Ontario recruited using a purposive sampling strategy. Although quantitative studies are more widely generalizable, it would be wise for future research to explore the patterns found in this research within other populations. The quantitative study is also limited by the exploratory alpha level used (.10) and possessed limited power due to the small sample size. Future

studies should explore the patterns found in the current research with larger sample populations and stricter alpha levels.

Because it is quite difficult to recruit disaster managers, it is recommended that larger projects run at the government level attempt to explore these patterns. One good example of such a project is the ORCHIDS project in the UK; this project conducts applied research on disaster management procedures including the evaluation of training procedures (Health Protection Agency UK, 2009, <http://www.orchidsproject.eu/project.html>). Integrating measurements of common ground into such training programs would be simple and could be used to assess how different level of common ground contribute to performance during such training exercises.

In addition to these limitations the researcher has also identified a few setbacks in terms of the methodology used in the current thesis. First, future qualitative research would be wise to use focus groups with disaster managers from a single event. This would allow for research to grasp a larger understanding and description of common ground, and to identify whether common ground exists between disaster managers or whether it is only a perception. This would allow for research to describe how false perceptions of common ground may impact process and performance.

Furthermore, future studies should attempt to isolate the two dimensions of implicit coordination. As the measure used in the quantitative study did not distinguish between correctly and incorrectly anticipated information needs. This would be useful to isolate the effects of each of these dimensions on team process and team performance, and also identify how contextual factors may play a role in fostering each of these separately. Another potential improvement for future research would involve increasing the number of tasks that

disaster managers are required to complete in an experimental study. This would give a sense as to how long it takes to foster common ground in a real world disaster where disaster managers need to deal with varying tasks.

Additionally, studies should attempt to gain a higher level of inter-rater reliability on various tasks for decision quality ratings. Lastly, future research should explore the differences between mixed teams and homogenous teams that both possess high levels of common ground. This is still somewhat unclear as the current studies unevenly distributed implicit coordination may have given homogenous pods an advantage.

Conclusion

The current research highlighted the challenge of inter-organizational disaster managers' working across sectors, and sought to explain this phenomenon using common ground theory. The goal of the thesis was to demonstrate that common ground and the grounding process was important in inter-organizational disaster management problem solving teams. Two studies were conducted with experienced disaster managers, a qualitative analysis of interviews and an experimental study involving a simulated disaster scenario.

Results revealed that disaster managers reported gaps in understanding among responders, the importance of mutual understanding, and described common ground comparably to descriptions in theory with a few omissions. The experimental scenario found that contextual factors such as Pod composition, Problem solving approach, and Type of tasks influenced disaster managers' performance and implicit coordination, and that implicit coordination partially mediated and suppressed the relationship between contextual factors and decision quality.

These results fulfilled the goal of the thesis as common ground and the grounding process were demonstrated to be important to inter-organizational disaster management problem solving teams. Results suggest that common ground, implicit coordination, and context account for the past varied successful teamwork and performance among inter-organizational disaster managers, and should be fostered through cross-training.

Contributions

The candidate's thesis was based on an overarching project funded by Defence Research and Development Canada (DRDC) which was designed by the supervisor, the participants were recruited and the design executed by the GAP-Santé research team (including the candidate and supervisor). The candidate participated in the data collection and measurement, designed the qualitative coding grid, coded the interviews and categories, identified the hypotheses, chose appropriate measures, designed and ran the analyses, and wrote the literature review and study reports.

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APPENDIX A

Qualitative Interview Guide

Risk Perception and Risk Management: Multi Organizational Problem Solving**Interview Reference Sheet**

Points to go over with respondent before the interview starts.

Context:

- These interviews are one component of a larger study examining multi-organizational problem solving during emergencies and extreme events. Other main component is an experiment where organizations go through an in vivo exercise and are required to problem solve with other types of organizations.
- The information collected in the interviews will help in interpreting the findings from the experiment.

Content:

- Interviews are being conducted with senior level decision-makers who participated directly in planning and/or responding during key events.
- Interview should take about one hour.
- We are interested in your perceptions of the challenges and opportunities that exist when making decisions with multiple organizations involved.
- During the interview, we will:
 - initially go through some background about how you were involved in [event]
 - then get you to focus in on one specific challenging situation where you were actively involved in problem solving and decision-making in a multi-organization context that was particularly challenging, especially one that involved multiple sectors such as the Canadian Forces, or NGOs like Red Cross or citizen associations, and multiple jurisdictions such as Federal, Provincial, and Municipal
 - ask you questions about how the group moved through the problem solving process
 - get your thoughts on how some key concepts we are using in the experiment component of the study

Questions before getting started?

Participant overview

1. To get started, can you just briefly confirm for me the organization you were with during the event and aspects like your title, main role and responsibilities, etc.? [we want to also understand their training background both professional and experience-based – ask here if natural segue, or at the end of the interview once rapport has been established]

Event overview and selection of situation

2. What are one or two situations planning for the event or during the event that stick out for you as being particularly challenging – I need you to think of situations that focused on problem solving or decision making, and that had a number of different types of organizations actively involved. Briefly, what would these be? [*who, what, where, when, why*]

- a. Which of these should we focus on for the remainder of the interview? [*get any additional details required*]

Problem identification and definition

3. Thinking about the situation, what problem was the most challenging that had multiple organizations involved? Who knew about the problem first? How did the other organizations become involved? How was the problem defined once other organizations became involved? What were the main areas of agreement/conflict among the players involved at this early stage? Which organizations' perspectives were dominant at this stage? Was there a lead organization or person at this stage? How were they selected?

Solution generation

4. Once the problem had been defined, how did the group generate various potential solutions? What were the solutions considered? What were the main areas of agreement/conflict among the players when it came to solution generation? Which organizations' perspectives were dominant at this stage? Was there a lead organization or person at this stage? How were they selected?

Decision making and implementation

5. Once various potential solutions had been generated, how did the group decide which solutions to implement? What were the main areas of agreement/conflict among the players when it came to deciding on which solutions to implement? Which organizations' perspectives were dominant at this stage? Was there a lead organization or person at this stage? How were they selected?

Sharing resources and flexibility

6. Thinking back to this specific situation, what types of things were shared across organizations in order to make the decision? To implement the solutions? – for example, information, resources, leadership? [*what, when, who*]

Expectations and alternatives

7. Thinking back to just before this specific situation occurred, what would have been your expectations with respect to how the situation would have played out with the organizations involved? Considering how it rolled out, what aspects surprised you?
8. Reflecting back on the situation, what should have been done differently? What should other organizations have done differently? What would/could your organization have done differently?

Concepts

9. The experimental component focuses on the concepts of coordination, cooperation and collaboration. When these terms are used, what examples or meanings would you assign to each of them? Do you see them differently? How would you differentiate them? How do you see them related to decision-making and problem solving?

APPENDIX B

Recruitment E-mail

Dear <insert name>,

I am inviting you to participate in a study at the University of Ottawa. Our research team has received your name from <insert reference>. Please see below for a brief description of our study. We believe that participants will find it an interesting experience.

Problem-solving and Organizational Decision-making Simulation (PODS) Project

Needed: Participants for an innovative simulation exercise on problem solving and decision making within the context of an extreme event. The research is being conducted by the University of Ottawa and funded by Defence Research and Development Canada (DRDC).

Purpose of the study: To examine how officials work together during emergencies which require joint responses from both traditional first responders (police, fire and EMS, public health) and non-traditional ones (social and community services, non-governmental organizations or volunteer groups) as well as from the Military or other government agencies. The overall objective of the research is to identify ways to improve interoperability between organizations during a large scale emergency event or threat.

Who: Senior level emergency management practitioners with at least one year of experience with high-level decision-making in managing and responding to emergencies.

When: Session dates include:

- February 23rd - Wednesday
- February 24th – Thursday
- February 25th – Friday
- February 28th – Monday
- March 1st – Tuesday
- March 2nd – Wednesday
- March 3rd – Thursday
- March 23rd – Wednesday

Sessions will be held in the mornings between 8:30-12:30. A light lunch will be provided.

Where: Desmarais Hall, Room 3120, University of Ottawa (55 Laurier East, K1N 6N5)

What: During sessions, participants will be assigned to groups of three participants, called a "pod". These pods will be immersed in a table-top exercise, which is driven by a CBRNe scenario and situated in the fictional mid-sized city of "GAPVille". The participants will work in small groups on a series of tasks to address particular aspects of the emergency. In some cases, participants will be communicating with the other pods with the aid of video-conferencing software. All aspects of participation are voluntary. You will be asked to read through and sign a consent form indicating informed consent prior to participation in the session.

Please contact Hilary Kitchener at <insert e-mail address> or <insert phone number> to indicate your interest in participating. We will contact you to confirm arrangements.

Sincerely,
<insert name & signature>

APPENDIX C**Study Reminder Email**

Dear <insert participant name>,

This is a reminder of your upcoming appointment to participate in the **Problem-solving and Organizational Decision-making Simulation (PODS) Project** experiment on <insert date>. Please come to **room 3120** on the 3rd floor of the Desmarais Building located at the University of Ottawa; there will be signs to help direct you. The session begins at 8:30 am and runs until 12:30 pm. A light lunch will be served following the session.

The Desmarais Building is located at 55 Laurier Avenue East ([click here for a link to our location on Google Maps](#)). If you arriving by bus, please exit at Laurier Station. Directions to the Desmarais Building by car can be found following this e-mail.

Underground parking is available in the Desmarais Building (at a cost of \$4.00 an hour, prepaid). In order to access the parking, you must take the 417E exit at Nicholas Street. Next, take your first right after you go across the Laurier intersection. Alternate options for parking are available in the Byward Market or at the Rideau Centre.

If you have any questions about the study, please do not hesitate to contact Hilary Kitchener by e-mail at <insert e-mail address> or by phone at <insert phone number>. If, for any reason, you need to cancel your appointment please let us know as soon as possible.

Sincerely,

<insert name of sender>

.....

Directions to Desmarais Building, University of OttawaDesmarais Building from the East

The main access to Ottawa from the East is via Highways 417 and 174.

- Off Highway 417 West, take the Nicholas/Mann exit
- Follow the Nicholas Street exit to Laurier Avenue. (Continue straight ahead, do not turn on Laurier)
- Turn right (east) immediately after Laurier Avenue intersection to access the Desmarais Building parking lot.

Desmarais Building from the West

The main access to Ottawa from the West is via Highways 417 and 7.

- Off Highway 417 East, take the Nicholas/Lees exit.
- Follow Nicholas Street to the first set of lights (Laurier Avenue) (Continue straight ahead, do not turn on Laurier)
- Turn right (east) immediately after Laurier Avenue intersection to access the Desmarais Building parking lot.

Desmarais Building from the South

The main access to Ottawa from the South is via Highways 16, 31 or 416.

From Highway 16:

- Follow Prince of Wales Drive to Carling Avenue
- Turn right (east) on Carling Avenue
- Follow Carling Avenue to Bronson Avenue
- Turn left (north) on Bronson Avenue
- Follow Bronson Avenue to Laurier Avenue
- Turn right (east) on Laurier Avenue
- Follow Laurier Avenue to Waller Street
- Turn right (south) on Waller Street, and follow loop around the condominiums to Nicholas Street
- Turn right (north) on Nicholas Street
- Turn right (east) immediately after Laurier Avenue intersection to access the Desmarais Building parking lot.

From Highway 31:

- Follow Bank Street to Isabella Street
- Turn right (east) on Isabella Street
- Off Isabella Street, take the Highway 417 East on-ramp
- Off Highway 417 East, take the Nicholas/Lees exit.
- Follow Nicholas Street to the first set of lights (Laurier Avenue) (Continue straight ahead, do not turn on Laurier)
- Turn right (east) immediately after Laurier Avenue intersection to access the Desmarais Building parking lot.

From Highway 416:

- Take the Highway 417 East on-ramp
- Off Highway 417 East, take the Nicholas/Lees exit.
- Follow Nicholas Street to the first set of lights (Laurier Avenue) (Continue straight ahead, do not turn on Laurier)
- Turn right (east) immediately after Laurier Avenue intersection to access the Desmarais Building parking lot.

Desmarais Building from the North (Quebec)

The main access to Ottawa from the North is via Highways 5, 50 and 148 in Quebec.

- Follow the indications for Ottawa via Macdonald Cartier Bridge
- Off the Macdonald Cartier Bridge, follow the indications for King Edward Avenue
- Follow King Edward Avenue to Laurier Avenue
- Turn right (west) on Laurier Avenue
- Follow Laurier Avenue to the third set of lights (Nicholas Street)
- Turn right (north) on Nicholas Street
- Turn right (east) to access the Desmarais Building parking lot

APPENDIX D**Informed Consent Form**

You have been invited to participate in a study entitled **Risk Management and Governance: Understanding Problem Solving and Decision Making: “Problem-solving and Organizational Decision-making (PODS) Project”** (the “Project”) This document provides information on the study including the overall purpose of the study, what is involved in participating, possible risks and benefits, how confidentiality and anonymity will be protected by the researchers, how data will be conserved, and the voluntary nature of the study. As you read through this information sheet, please note any questions that you have or anything that you would like to have clarified by the researcher before you sign your acceptance to participate in the study.

Title of the study: **Risk Management and Governance: Understanding Problem Solving and Decision Making: “Problem-solving and Organizational Decision-making (PODS) Project”**

Principal Investigator: Louise Lemyre
Professor, School of Psychology
Faculty of Social Sciences
University of Ottawa
Tel: <insert phone number>
<insert e-mail address>

Funders: This study is funded by the Social Sciences and Humanities Research Council, with additional funding from Defense Research Development Canada.

Purpose of the Study: I understand that the purpose of the study is to better understand how people in decision making roles perceive risks, assess problems and manage threats during emergencies. This study involves having people from different organizations participate in a session that is similar to a table-top exercise that focuses on a specific emergency scenario.

Participation: My participation in the study will consist of one session of approximately four hours, located at the downtown campus of the University of Ottawa. During the session I will be asked to participate in an exercise that resembles a table-top exercise often used for emergency planning. I and the other participants assigned to my group for the session will be presented with a scenario and asked to complete problem-solving tasks related to the scenario. I will be asked to interact with other session participants as I work through the tasks. As well, I will be asked to complete questionnaires that ask about my perceptions and opinions of the tasks, performance and interactions. The session will be video and audio recorded for data collection purposes, and later transcribed in an electronic file.

Risks: I understand that this research is devoid of physical and psychological risks other than the possible mild negative feelings that could be associated with working with a scenario that focuses on an emergency situation. The research team has selected the materials and developed the scenario in a manner that attempts to minimize this risk by not including graphic descriptions or negative images.

Benefits: My participation in this study will help improve understanding and provide useful information for the emergency planning and response community on how to potentially improve decision-making and management of emergency events.

Confidentiality and Anonymity: I have received assurance from the researcher that the information I will share will remain strictly confidential. I understand that the contents will be used only for research purposes and that my confidentiality will be protected: only grouped data will be reported. My participation in the study will not be completely anonymous, as the fellow session participants will know that I am participating. Beyond this, the research team will protect my anonymity by ensuring that my name is not provided to any group outside of the research team directly involved with this study.

Conservation of Data: The questionnaires, audio and video tapes and the transcriptions will be kept in a secure manner in a laboratory at the University of Ottawa to which only the researchers have access for a period of ten years.

Voluntary Participation: I am under no obligation to participate and if I choose to participate, I may withdraw from the study at any time. I may also refuse to answer any questions, without suffering any negative consequences. If I choose to withdraw, all data gathered until the time of withdrawal will be destroyed and will not be used.

Acceptance: Participation is completely voluntary. You are free to withdraw at any time, refuse to participate, or refuse to answer certain questions. There is no direct individual benefit from answering the questions. There is no expected harm or risk except the possible negative feelings sometime associated with self-reflecting on public emergencies. However, in the unlikely event of distress or discomfort you may wish to contact the Confidential Help Line within your locality. You may also contact Dr Louise Lemyre at the University of Ottawa at <insert phone number> or the University of Ottawa Research Ethics Board Officer at 613-562-5387, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 159, Ottawa, ON ethics@uottawa.ca). I agree to participate in this study **Risk Management and Governance: Understanding Problem Solving and Decision Making: “Problem-solving and Organizational Decision-making (PODS) Project”** conducted by Dr Louise Lemyre.

PARTICIPANT: _____

DATE: _____

Louise Lemyre, Ph.D. University of Ottawa Professor

APPENDIX E

Task Instructions

Collaboration Session**Instructions for Task 1 completion**

Task Goal:	To develop <u>two</u> priority communication messages for the general public on behalf of <u>all organizations</u> in the pods, and to decide how they will be delivered.
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Step One: Develop two priority messages that the overall group believes are the most important to relay to the general public at this point. Attempt to get consensus from all organizations represented in the three pods.

Step Two: Identify potential options for approaches that could be used by the overall group to effectively deliver the two priority messages to the public (who, when, venue/method).

Step Three: As a group, decide which options are most appropriate for message delivery.

Instructions for Task 2 completion

Task Goal:	To determine the <u>two</u> most significant occupational health and safety issues on behalf of <u>all organizations</u> in the pods, and to decide on possible <u>actions</u> .
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Step One: Identify the two most significant occupational health and safety issues facing the overall group at this point that need to be addressed.

Step Two: Identify potential options for actions to be taken and how they will be implemented to address these issues.

Step Three: As a group, decide which actions are most appropriate at this point and how they will be implemented.

Coordination Session

Instructions for Task 1 completion

Task Goal: To develop two priority communication messages from your organization for the general public, and to decide how they will be delivered.

- Step One:** Develop two priority messages from your organization that you think are the most important to relay to the general public at this point.
- Step Two:** Compare your messages with those from the other organizations in the pods to determine where there is overlap, contradictions, and gaps
- Step Three:** Consider options for grouping and organizing your messages with those from other organizations.
- Step Four:** Decide how your organization's messages will be delivered to the general public (who, when, venue/method) taking into account other organizations' options and decisions.

TASK WORKSHEET #2

Instructions for Task 2 completion

Task Goal: To determine the two most significant occupational health and safety issues for your organization, and to decide on possible actions.

- Step One:** Identify the two most significant occupational health and safety issues for your organization at this point that need to be addressed, and the possible actions required to address them.
- Step Two:** Compare your occupational health and safety issues and actions with those from the other organizations in the pods to determine where there is overlap, contradictions, and gaps
- Step Three:** Consider options for grouping and organizing your interventions with those from other organizations.
- Step Four:** Decide how your organization's actions will be implemented taking into account other organizations' options and decisions.

APPENDIX F**Coding Matrix**

POD #__ Session #__

Speaking direction	Task# 1		Task# 2	
	Add Info	Reply	Add Info	Reply
to 11				
to 12				
to 13				
to 14				
to 21				
to 22				
to 23				
to 24				
to 31				
to 32				
to 33				
to 34				

APPENDIX G

Decision Quality Rating Grid

Rating Sheet #:

Rater:

Date:

Instructions

Before proceeding to rate participant responses, please ensure that you have familiarized yourself with the background material.

Please rate your level of agreement with the following statements on a scale of 0 to 4 (0 – strongly disagree; 1 – disagree; 2 – neutral; 3 – agree; 4 – strongly agree). Your rating should take into account both statements made by the participant.

		Strongly disagree 0	Disagree 1	Neutral 2	Agree 3	Strongly agree 4
Q1	The decision/recommended action addresses the most significant priorities/issues.	☐	☐	☐	☐	☐
Q2	The decision/recommended action presents a novel approach to addressing the issue.	☐	☐	☐	☐	☐
Q3	The decision/recommended action is implementable given the context (e.g., time and available resources).	☐	☐	☐	☐	☐
Q4	The decision/recommended action would be effective in mitigating real and/or perceived risk.	☐	☐	☐	☐	☐
Q5	The decision/recommended action anticipates indirect consequences (e.g., decision might include re-visiting the decision if certain conditions not met).	☐	☐	☐	☐	☐

APPENDIX H**Participation and Perspectives Task Questionnaire****Individual Participation and Perspectives - Task Questionnaire**

Please reflect on **your own participation** and thoughts during the task that you just completed. Read each of the following statements and then rate your level of agreement on a scale of 0 to 4 (0 – strongly disagree; 1 – disagree; 2 – neutral; 3 – agree; 4 – strongly agree).

		Strongly disagree 0	Disagree 1	Neutral 2	Agree 3	Strongly agree 4
Q1	I am satisfied with the problem solving processes I used during the task.	☐	☐	☐	☐	☐
Q2	I am satisfied with the opportunities I had to provide input.	☐	☐	☐	☐	☐
Q3	I am satisfied with the overall quality of the outcome from the task.	☐	☐	☐	☐	☐
Q4	I am frustrated working with the people in <u>my pod group</u> .	☐	☐	☐	☐	☐
Q5	I am frustrated working with the people in the <u>other pods</u> .	☐	☐	☐	☐	☐
Q6	I participated actively in the decision making process.	☐	☐	☐	☐	☐
Q7	I participated in a leadership role within my <u>own pod</u> .	☐	☐	☐	☐	☐
Q8	I participated in a leadership role <u>across the other pods</u> .	☐	☐	☐	☐	☐

		Strongly disagree 0	Disagree 1	Neutral 2	Agree 3	Strongly agree 4
Q9	I facilitated discussion within my <u>own pod</u> .	☐	☐	☐	☐	☐
Q10	I facilitated discussion <u>between pods</u> .	☐	☐	☐	☐	☐
Q11	I recorded information on behalf of my <u>own pod</u> .	☐	☐	☐	☐	☐
Q12	I recorded information on behalf of <u>all pods</u>	☐	☐	☐	☐	☐
Q13	I was frustrated by differences of opinion within <u>my pod</u> during the task.	☐	☐	☐	☐	☐
Q14	I was frustrated by differences of opinion between the <u>other pods</u> during the task.	☐	☐	☐	☐	☐
Q15	I trust the people in <u>my pod</u> .	☐	☐	☐	☐	☐
Q16	I trust the people in the <u>other pods</u> .	☐	☐	☐	☐	☐
Q17	I felt a sense of belonging within my <u>pod</u> .	☐	☐	☐	☐	☐
Q18	I felt a sense of belonging with the <u>other pods</u> .	☐	☐	☐	☐	☐
Q19	I agree with the decisions and outcomes from the task.	☐	☐	☐	☐	☐

		Strongly disagree 0	Disagree 1	Neutral 2	Agree 3	Strongly agree 4
Q20	Prior to today's session I would describe my relationship with at least one of the people in <u>my pod</u> as a friendship.	☐	☐	☐	☐	☐
Q22	Prior to today's session, I have worked with at least one of the people in <u>my pod</u> .	☐	☐	☐	☐	☐
Q24	There was enough time allotted to solve the problems during the task.	☐	☐	☐	☐	☐
Q25	The information and instructions given by the session facilitator were clear.	☐	☐	☐	☐	☐
Q26	The task was difficult to complete.	☐	☐	☐	☐	☐

Within POD Participation and Perspectives - Task Questionnaire

Please reflect on **the participation of the various people in your pod** during the task that you just completed. Read each of the following statements and then rate your level of agreement on a scale of 0 to 4 (0 – strongly disagree; 1 – disagree; 2 – neutral; 3 – agree; 4 – strongly agree).

		Strongly disagree 0	Disagree 1	Neutral 2	Agree 3	Strongly agree 4
Q27	The outcome of the task reflects the input from all the people in my pod.	☐	☐	☐	☐	☐
Q28	The differences of opinion within my pod helped us reach better decisions during the task.	☐	☐	☐	☐	☐
Q29	The people in my pod actively participated in the problem solving process.	☐	☐	☐	☐	☐
Q30	The people in my pod communicated effectively with one another.	☐	☐	☐	☐	☐
Q31	The people in my pod were engaged in the decision making process.	☐	☐	☐	☐	☐
Q32	The people in my pod generated various alternative ideas.	☐	☐	☐	☐	☐
Q33	A clear leader emerged within my pod.	☐	☐	☐	☐	☐
Q34	There was more than one leader within my pod.	☐	☐	☐	☐	☐

		Strongly disagree 0	Disagree 1	Neutral 2	Agree 3	Strongly agree 4
Q35	Personality styles within my pod got in the way of completing the task.	☐	☐	☐	☐	☐
Q36	The people within my pod had frequent differences of opinion.	☐	☐	☐	☐	☐
Q37	The people in my pod were motivated to complete the task.	☐	☐	☐	☐	☐
Q38	The people in my pod were able to stay focused on the task.	☐	☐	☐	☐	☐

Between PODS Participation and Perspectives - Task Questionnaire

Please reflect on **the participation of people from all the pods** during the task that you just completed. Read each of the following statements and then rate your level of agreement on a scale of 0 to 4 (0 – strongly disagree; 1 – disagree; 2 – neutral; 3 – agree; 4 – strongly agree).

		Strongly disagree 0	Disagree 1	Neutral 2	Agree 3	Strongly agree 4
Q39	The differences of opinion across the pods helped us to reach a better decision during the task.	☐	☐	☐	☐	☐
Q40	People from the other pods actively participated with people from my pod in the problem solving process.	☐	☐	☐	☐	☐
Q41	The pods communicated effectively with one another.	☐	☐	☐	☐	☐
Q42	People from the other pods were engaged in the decision making process.	☐	☐	☐	☐	☐
Q43	People from the other pods generated various alternative ideas.	☐	☐	☐	☐	☐
Q44	A clear leader emerged between the pods.	☐	☐	☐	☐	☐
Q45	Personality styles between people in the different pods got in the way of completing the task.	☐	☐	☐	☐	☐
Q46	People in the other pods had frequent differences of opinion.	☐	☐	☐	☐	☐

		Strongly disagree 0	Disagree 1	Neutral 2	Agree 3	Strongly agree 4
Q47	The people from the other pods were motivated to complete the task.	☐	☐	☐	☐	☐
Q48	The pods were able to stay focused on the task.	☐	☐	☐	☐	☐
Q49	Decisions made between my pod and the other pods were consensus-based.	☐	☐	☐	☐	☐
Q21	Prior to today's session I would describe my relationship with at least one of the people in the <u>other pods</u> as a friendship.	☐	☐	☐	☐	☐
Q23	Prior to today's session, I have worked with at least one of the people from the <u>other pods</u> .	☐	☐	☐	☐	☐