Extreme Teams: Towards a Greater Understanding of Multi-Agency Teamwork During Major Emergencies and Disasters

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Abstract

Major emergencies are extreme team decision making environments. They are complex, dynamic, high-stakes and fast paced events, wherein successful resolution is contingent upon effective teamwork. Not only do emergency teams coordinate at the intra-team level (e.g., Police team), but they are increasingly required to operate at the inter-team level (e.g., Police, Fire and Ambulance teams). This is in response to the desire for networked and cost-effective practice and due to the evolving nature of modern threats, such as extreme weather events and terrorist attacks, which require a multi- rather than single-agency response. Yet the capacity for interoperability between emergency teams is under researched and poorly understood. Much of the teamwork research is based on student-samples or in artificial lab settings, reducing the salient contextual demands of emergencies (e.g., high-stakes, meaningful risk). Furthermore, the minimal research that has been conducted has tended to provide broad descriptive accounts of challenges faced during emergencies, but failed to develop and test solutions. This paper identifies what is known about emergency teams and highlights why it is an important and timely area for research. It will focus on the challenges and solutions to three areas of team processing: cooperation; coordination and communication. Future research must have a solutions-focussed approach. This can be oriented around areas: training, socio-technical networks, and policies/procedural guidelines. Greater collaboration between academics and practitioners can grow knowledge in this domain, ensuring that interventions to improve emergency teamwork are both contextually grounded and empirically validated.

Keywords: Teamwork; Emergency Services; Coordination; Cooperation; Communication

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Major emergencies, either manmade or as the result of natural disasters, are extreme team decision events. They are characterized by the potential for mass casualties, crowds, public enquiries, media and involve the coordinated response of emergency services and supporting organizations (Cabinet Office, 2013). They are complex, dynamic, high-stakes and fast paced contexts, wherein successful resolution is contingent upon effective teamwork and collaboration (James, 2011). Examples of real-world major emergencies include natural disasters, such as Hurricane Katrina (2005) and the Indian Ocean Tsunami (2004), and man-made disasters, such as the terrorist attacks in Paris (2015), Brussels (2016) and across the UK (2017), and the safety failures that contributed to the Fukushima nuclear disaster (2011). Major emergencies are intense contexts wherein individuals and teams make critical choices whilst managing ambiguity and complexity (Millitello, Sushreba, Branlat, Bean & Finomore, 2015). This creates significant demands on the physical, psychological and interpersonal skills of individuals and teams (James, 2011; Orasanu & Lierberman, 2011).

Psychological research can help us to better understand how emergency teams operate under extremes. However, there has been little research that has explored emergency teamwork, taking into account the high-risk and extreme uncertainty involved in such contexts, and the tendency for teams to be inter-organizational, meaning that team members are often unfamiliar to each other. Furthermore, the research that has been conducted in emergency settings has largely focused on narrative accounts of the broad challenges to emergency management and paid comparatively little attention to how research can be used to design and test interventions to facilitate emergency teamwork. This paper aims to engender and shape the trajectory of future research in this field by: (i) highlighting the

uniquely challenging context under which emergency teams operate; (ii) embed the limited research that has been conducted within a team processing framework; and (iii) advocate the need for more solutions-focused research oriented around the empirical validation and testing of interventions to improve emergency teamwork.

Importantly, this paper will focus on factors that influence team *processing* (i.e., the coordinating mechanisms and behaviors that are used by team members to achieve collective goals during a task); namely, coordination, cooperation and communication (Wilson, Salas, Priest & Andrews, 2007). Unlike traditional organizational teams who have stable structures and work together regularly, emergency teams form rapidly in response to unanticipated crises; making them dynamic and reactionary, wherein 'team processing' is of paramount importance to facilitate fast and life-saving action. Thus, rather than adopt a temporal perspective of teamwork by considering the mediating impact of emergent states that develop over the lifetime of a stable team (e.g., team cohesion; *see* Marks, Mathieu & Zaccaro, 2001), this paper will focus on team *processes* that take place during an episode of teamwork. In support of this, it will identify how solutions to improve team processing might be achieved by investing research in three areas where interventions might be most effective: training to support the preparedness of emergency teams; socio-technical networks to support common understanding during emergencies; and changes to policies and procedures that can help support the overall resilience of emergency teams.

Teamwork during emergencies: what we know so far

What is an emergency team? A team is defined as two or more individuals working together in pursuit of a common goal. Teamwork is described as the *"set of interrelated thoughts, actions, and feelings of each team member… that combine to facilitate coordinated adaptive performance and task objectives resulting in value-added outcomes"* (p.562; Salas et al., 2005). Emergency teams engage in teamwork whilst operating in uniquely stressful,

high-stakes, pressurized and complex environments. When a major incident occurs, it triggers the establishment of a number of different sub-teams operating at different levels, who must operate interdependently in order to achieve both individual and collective goals. In the UK for example, the Integrated Emergency Management (IEM) structure is used to create a hierarchy of command, from operational (actions at scene) to tactical (take charge at the scene) to strategic (overall executive command) (DOH, 2005; Salmon, Stanton, Jenkins & Walker 2011). At the ground level, there are emergency response teams (Police, Fire, Ambulance) who coordinate their behavior at both single and multi-team levels to deal with the emergency itself. At the operational level, there are incident commanders who must direct their team and coordinate operations with commanders from the other core emergency services at the scene. At the tactical level, representatives from the emergency services and other civil services (e.g., highways agency, utilities) coordinate tactical objectives and act as the conduit between the operational actions being carried out on-scene and the strategic directives that are outlined by their superiors. Finally, the strategic team, which involves the most senior representatives from the emergency services along with civil authorities (e.g., local council, government) are responsible for setting strategic directives, dealing with the media and making plans for recovery after the incident. A successful emergency response is dependent upon effective teamwork across and between multiple sub-team levels.

An opportunity for researchers interested in emergency teams is to explore, challenge and test structures that are used to support interoperability and maximize performance. A unique feature of emergency teams is their rapid and dynamic make up, wherein responders are required to coordinate behavior (at single- and multi-team levels) without necessarily having worked together before. The role of the researcher is to question whether existing organizational structures, such as IEM, support teamwork in emergency contexts or whether adaptations, based on what we have learnt from more general teamwork literature, can be

incorporated; for example, might the multiple command layers within IEM create ambiguity about who is ultimately in charge, especially if team members are unfamiliar with each other? Academic research that is independent of these organizations can be useful for exploring these types of questions.

Due to the tendency for emergency teams to form rapidly and involve multiple layers of teams and individuals who are unfamiliar to each other, it is argued that research should primarily focus on identifying solutions to facilitate the 'team processes' that happen during task-related teamwork (i.e., an emergency incident). Team processes enable team members to achieve collective goals by structuring task-relevant behavior, and are themed into three types: (i) coordination (i.e., using behavioral and cognitive mechanisms to transform team action into goal-related outcomes); (ii) communication (i.e., the reciprocal process of sending and receiving information between team members to inform attitudes, behaviors and cognitions); and (iii) cooperation (i.e., the motivational drivers related to attitudes, beliefs and feelings that inspire team members to work together) (Mathieu, Heffner, Goodwin, Salas & Cannon-Bowers, 2000; Salas, Shuffler, Thayer, Bedwell & Lazzara, 2015). In their examination of fratricide (friendly fire) in war contexts, Wilson, et al. (2007) identified how inappropriate phraseology (communication), poor shared mental models (coordination) and a lack of mutual trust and collective efficacy (cooperation) contributed to teamwork breakdowns; whereas adaptive team processes such as the use of closed-loop communications, mutual performance monitoring (coordination) and cohesion (cooperation) have been found to facilitate team performance (Espevik, Johnsen & Eid, 2011; Salas, Sims & Burke, 2005). Team processes reflect the team's capacity to perform effectively during a given task, which makes them of central importance to research. The purpose of this paper will be to use this team processing framework in order to structure what we know and what remains to be researched with emergency teams.

Research on the management of major disasters and emergencies. Despite its rich history, psychological research on teamwork has been inconsistent and fragmented, meaning that its application and understanding in the real world is limited (Salas et al., 2005). In his review of 32 major disasters in the UK, Pollock (2013) identified how serious teamwork failures were repeated time and again due to the inability to embed lessons from past events. Every one of the 32 reports outlined recommendations to improve: doctrine and organization; operational communications; shared situational awareness; and training and exercising. For example, recommendations following the Dunblane shootings at a primary school in Scotland in 1996 included improvements in cordoning procedures and data recording (doctrine and organization), prioritizing incoming/outgoing calls (operational communication), sharing information with other emergency services and relatives (shared situational awareness) and ensuring school staff were better prepared to deal with emergencies (training and exercising). Yet lessons such as these have persistently failed to be embedded across the 24 years of major incidents that he reviewed. Furthermore, there are concerns that disaster research over recent years has been overly dominated by the desire to develop technological solutions, ignoring human-centric approaches that, at times, might be more appropriate (Janssen, Lee, Bharosa & Cresswell, 2010). Thus, although there is a clear need for interventions to facilitate teamwork during extreme emergencies, there is a general lack of consensus on how to best develop and implement changes in practice.

A persistent failure of emergency management research is the inability to translate findings into practice (Piotrowski, 2010). The majority of research exploring disaster management has tended to focus on identifying general challenges to emergencies via observations and interviews. These general challenges have included unpredictability, high risk, time pressure, resource shortages, large-scale disruption to infrastructure, multiple authorities and conflicts of interest (Chen, Sharman, Rao & Upadhyaya, 2008; James, 2011;

Janssen et al., 2010). Emergencies have also been described as reflecting 'un-ness' as they are unexpected, undesirable, unimaginable and generally unmanageable (Hewitt, 1983). Although useful for building descriptive knowledge about the difficulties presented during emergencies, these categories are too broad and not useful for guiding the development of interventions to improve practice. Many challenges interact with one another (e.g., an unpredictable environment is likely to also be ambiguous) making it difficult to target and measure the impact of interventions on team processing. Furthermore, although solutions via training or technology are often recommended (Janssen et al., 2010), there is a lack of research that tests these solutions or empirically validates technologies in the field. Indeed, solutions for one type of challenge might exacerbate another; digital communications could alleviate time pressure by increasing the speed of information sharing, but an unintended byproduct might be information overload if technology is designed without consideration of psychological or human factors relating to cognitive load (Charman, 2014; Janssen, et al., 2010). This is especially problematic at the multi-team level, wherein different emergency services use different internal protocols and communications platforms, making it difficult to identify how to reach consensus across organizations in terms of which structures should be commonly adopted or implemented in support of interoperability. This paper argues that a more targeted approach to identify teamwork failures, develop interventions and validate them in the field should be a gold standard for research in emergency contexts.

To facilitate a more systematic understanding of challenges in high-risk environments, Alison, Power, van den Heuvel and Waring (2015) distinguished between *endogenous* uncertainty, relating to the inherent challenges of a high-risk incident, and *exogenous* uncertainty, relating to challenges with the operating system and teamwork. They found, during a live counter-terrorism training exercise, that 75% of uncertainties were related to exogenous team issues. The authors recommended that interventions to reduce

uncertainty in high-risk environments should specifically target exogenous challenges, which might in turn reduce inherent endogenous challenges. In a second study, the authors used cognitive interviews to explore exogenous challenges in emergency teams and found that uncertainty was related to four sources: trust issues, competition, poor role understanding and communication (Power & Alison, 2017a). Although more research is needed to comprehensively identify the challenges to emergency teamwork, these challenges provide a starting point that will be used in this paper to integrate research on emergency teamwork within the existing team processing framework (e.g., Wilson et al., 2015).

Cooperation during emergencies

Cooperative teams are those whose team members are motivated to work together in pursuit of collective goals due to shared attitudes, beliefs and feelings that drive behavioral action (Salas, et al., 2015). Examples of cooperation in emergency teams might include paramedics responding to orders from police officers when operating in time pressured environments, or firefighters providing backup behavior to paramedics who are overloaded and in need of support. However, cooperation breakdowns can occur when team members lack desire and motivation to work together (Wilson et al., 2007); for example, refusing to complete tasks requested by another team member, or watching team members make mistakes and failing to intervene. In emergency contexts, cooperation is vital for team effectiveness as having the motivation and the desire to work together can support a team member's willingness to take extreme risks. However, cooperation is uniquely challenged as emergency teams are often temporary and dynamic, meaning that team members rotate and are unfamiliar at an interpersonal level. Related to cooperation, Power and Alison (2017a) identified two challenges to emergency teamwork: (i) trust issues; and (ii) competition between team members. They suggest that these challenges impeded cooperation as they reduced team members' motivation to work together.

Trust issues. Trust, defined as the willingness to be vulnerable to the advice or behavior of others (Mayer, Davis & Shoorman, 1995), is important for cooperation as it can lead to greater information sharing and faster decision-making, whilst reducing the potential for misunderstanding between team members (Wilson et al., 2007). During an ambiguous and complex emergency requiring rapid action, team members who trust each other would be more willing to place faith in the advice provided by other team members without question. Trust enables team members to expedite decision making in high-risk contexts due to the belief that team members are working towards collective goals and will support one another (Das & Teng, 2004).

McAllister (1995) distinguished between two types of trust: affective trust (i.e., faith in another's benevolence) and cognitive trust (i.e., faith in the abilities/skills of others). Affective trust is subjective and relies on the experiences and/or observations of others during interactions, whereas cognitive trust is objective and relies on the use of measures such as qualifications and skills (seen or assumed based on the trusted other's role) (Leana & Van Buren III, 1999). In organizational contexts, such as the Emergency Services, a specific type of cognitive trust that is especially relevant to performance is role-based trust: the knowledge that a person in a given role will perform given duties (Kramer, 1999). During emergencies, where teams are temporary and dynamic, role-based trust might facilitate cooperation as members are motivated to work with and support others based on an understanding of their responsibilities in the team network rather than interpersonal experience. Indeed, Curnin, Owen, Paton, Trist and Parsons (2015) found that role understanding was the main contributing factor to rapid action in emergency teams. Similarly, Pollock (2013) described how a poor understanding of roles during the London 7/7 bombings impeded responding; for example, when emergency personnel failed to recognize that some of the first ambulance

staff to arrive at the scene were there as incident officers rather than paramedics and so were not responsible for treating casualties.

It is possible that emergency contexts are enhanced by specific types of trust. Power and Alison (2017a) found that high levels of affective trust *impeded* emergency responding, specifically at the command level when trusted advice conflicted with personal judgements on strategic planning. Commanders were conflicted between their own judgement and the conflicting advice of trusted others. Under conditions of low time pressure and risk disagreements with trusted others might be overcome via deliberation to reach consensus or, when time pressure is high, deferring to the advice of trusted others in order to reduce cognitive load by not having to process information (De Wever, Martens & Vandenbempt, 2005; Thorgren & Wincent, 2011). Yet the fast paced and high-stakes context of emergencies creates an environment wherein deliberation to reach consensus is impractical, whilst blind adherence to advice is unacceptable. Indeed, the use of hierarchical command structures in emergency teams helps to reduce these effects by giving primacy to one decision maker who commands and controls the exercise (DOH, 2005; Salmon et al., 2011); allowing them to consider the advice of others, but to take the final decision on how to coordinate their team. However, Comfort and Kapucu (2006), in their review of the response to the 9/11 World Trade Centre attacks, warned that rigid hierarchy when operating under the dynamic and urgent conditions of a disaster can impede teamwork by reducing adaptability (e.g., who makes a decision when key personnel are missing?). An important question for future research is how to manage trust in the age of 'interoperability', when commanders of equal status across the Police, Fire and Ambulance Services must come together to make decisions with no clear accountability. As will be discussed later in this paper, a solution might be via interventions to specifically develop role-based trust in emergency teams.

Intra-agency competition and inter-team conflict. A second challenge to cooperation in emergency teams is related to competition and conflict between team members who seek to prioritize their own (personal or intra-agency) goals over collective goals. Power and Alison (2017a) identified how cooperation can break down in emergency teams at the intra-team level, when team members pursued personal goals (e.g., to be a 'hero') at the expense of collective goals, and at the inter-team level, when teams competed to take primacy or to prioritize their own agency's goals at the scene. In line with the psychological literature on teamwork, it is suggested that Power and Alison's (2017a) findings reflect intra-team *competition*, whereby individuals seek to achieve their own goals at the expense of collective goals (Deutsch, 1949), and inter-team *conflict*, wherein sub-organizational team goals collide with one another. This distinction is important as interventions to reduce intra-team competition and inter-team conflict differ. For example, competition might be reduced by reorienting team members to focus on group goals in place of individual goals; whereas conflict could be reduced by providing a forum that enables deliberation and consensus over which goal to prioritize at a given point of time.

A culture of competition reflects the active desire between team members to outperform one another; the antithesis to cooperation. Competition is not always negative as within-team competition can be useful when it encourages team members to work harder (Crawford & LePine, 2012). Yet, the time criticality of emergencies requires rapid action and so there is little time for disagreement and discussion, especially for incident commanders who must rapidly set strategic or tactical parameters for responders on the ground to operate within. He, Baruch and Lin (2014) distinguished between *development* competition, which empowers team members to compete in pursuit of the collective team goals, and team *hypercompetition*; the desire of team members to outperform each other in pursuit of self-serving rather than collective goals. Team hypercompetition would be problematic if, for

example, team members deviate from the hierarchical command structure and seek to take on responsibilities outside their remit, such as inappropriately trying to lead and direct a team in line with the way they think they should be operating.

At the multi-team level, disagreement between team members is characterized by conflict, specifically related to goals. Indeed, paramedics seeking to treat casualties might be prevented from achieving their goal (i.e., 'save life') if the fire and police services declare the zone as too high-risk for operations (i.e., 'protect responders') creating inter-team goal conflict. This is related to uncertainty about who should take 'primacy' (main control) at an incident (Power & Alison, 2017a). At the ground level, this could be associated to conflict between ambulance and fire responders to a road traffic collision who might disagree over whether to extricate a casualty via a spine board (slower but safer) or via rapid removal (riskier but quicker). This type of decision lacks clear authority as paramedics have expertise about the medical status of the casualty, whilst the fire service has expertise over the risk of conducting different extrications, meaning the potential for conflict between team members about the 'right' strategy is high. Conflict might also arise if team members misinterpret one another's goals. It was found during a multi-agency counter-terrorism training exercise that, although all agencies agreed that they were working towards a 'save life' goal, how they interpreted this goal through their own organizationally informed lens differed (Power & Alison, 2017b). When operating under pressure, this conflict between sub-group and collective multi-team goals might derail cooperation as team members favor actions in support of salient and familiar sub-group goals over collective ones.

The solutions section of this paper will consider how competition and conflict in multi-team settings could be reduced via the development of multi-team decision models and procedural guidelines that facilitate clear goal identification. A greater understanding of concrete objectives within the team network will facilitate cooperation as individuals

understand the motivations driving other team members, allowing them to prioritize goals more effectively. Training to increase a shared 'cultural interoperability' between emergency workers will help to embed shared values, reduce competition and increase cooperation.

Coordination during emergencies: Poor role understanding

Coordination is the enactment of behavioral and cognitive mechanisms that enable teams to sequence, synchronize and integrate their efforts to complete goal-relevant tasks (Salas et al., 2015; Wilson et al., 2007). Coordination is essential for teamwork in complex environments as it allows multiple individuals and groups to work together effectively. Team coordination is associated with behaviors such as mutual performance monitoring (i.e., monitoring other team members' behavior to 'catch errors'), backup behavior (i.e., ability to provide feedback or assistance to team members), and adaptability (i.e., ability for teams to adapt to cues and changes in the environment; Wilson et al., 2007). A coordinated emergency team responding to a road traffic collision might involve a paramedic spotting a fuel leak from a car that a fire team is working on (mutual performance monitoring), the paramedic informing the fire team and offering their assistance to adapt procedures (backup behavior) and the team adapting to this information by rapidly extricating the casualty (fire adaptation), with the paramedic team ready to treat and transfer the patient to hospital (paramedic adaptability).

Coordination is one of the most commonly studied topics in disaster and emergency management (e.g. Chen et al., 2008), yet the capacity for coordination in emergency teams remains poor (Salmon et al., 2011). Coordination is facilitated by accurate shared mental models between team members that allow them to monitor, predict and adapt to the crisis environment. Shared mental models *"allow team members to draw on their own well-structured knowledge as a basis for selecting actions that are consistent and coordinated with those of their teammates"* (p.274; Mathieu et al., 2000). In teams, mental models can be

separated into two types: task mental models (i.e., shared situational awareness and knowledge about tasks) and team mental models (i.e., shared knowledge about team members, their roles, their strengths/weaknesses, skills; Banks & Millward, 2007). Shared mental models develop over time as cognitive emergent states (Millward, Banks & Riga, 2010) and can be task-specific and related to real-time situational awareness on the ground. For example, 'common operational pictures' have been identified as important for emergency teams as they contribute to a shared understanding of the unfolding situation between team members, enhanced by the use of 'cognitive artefacts' (i.e., information representations in the world, e.g. interactive white board; Salmon et al., 2011).

Power and Alison (2017a) identified how a poor understanding of roles degraded coordination. As discussed earlier, poor role-based *trust* can impede *cooperation* as team members lack faith in other team members to perform their role; a poor *understanding* of roles can impede *coordination* as team members are unsure how to synchronize behaviors; for example, impeding sense-making and the development of common operational pictures (i.e., knowing who is responsible for a given task/holding specific information). Poor role understanding was found to occur at the individual level when team members appeared to be unaware of their own responsibilities (e.g., not fulfilling one's own responsibility to make a decision), and at the team level when team members lacked an understanding of each other's roles and responsibilities (Power & Alison, 2017a). Teams that lack a clear articulation of roles have been found to reduce information sharing and general coordination, operating in silos rather than as a collective team (Perry & Wears, 2011; Pollock, 2013).

An understanding of roles in a team can be classified as 'team knowledge', a cognitive emergent state relating to the team's awareness and anticipation of the skills and behaviors of others. This differs to task-related knowledge, associated with awareness of the materials needed or being used to complete a task (Salas et al., 2005). Team knowledge is

related to the team's 'transactive memory system', a shared understanding about who is responsible for different types of knowledge during a task (Wegner, 1987). In a study looking at police tactical teamwork, it was found that implicit (i.e., non-verbal) coordination improved team adaptability and performance and that this effect was *greater* for teams with transactive memory systems (i.e., knowledge of each other's roles and responsibilities; Marques-Quinteiro, Curral, Passos & Lewis, 2013). In other words, role understanding enhances adaptability and performance in teams relying on implicit modes of coordination (i.e., non-verbal), making it important for teamwork in high-stakes and time-pressured critical incidents. This paper suggests that coordination can be improved by research to support the development of effective socio-technical team networks (e.g., linked communication platforms, shared technologies), incorporating both prior knowledge about roles and responsibilities and using adaptive technology to share relevant knowledge and inform sense-making during crises.

Communications during emergencies: Inefficient and ineffective communication

Communication facilitates problem solving in teams by enabling effective information exchange, directing actions and sharing perspectives about the emergency (McIntyre & Salas, 1995; Orasanu, 1994). It is a reciprocal process that involves the sending and receiving of information between team members in order to form and revise attitudes, behaviors and cognitions (Salas, et al., 2015). In their analyses of Incident Management Teams deployed to emergencies in Australia, Hayes and Omodei (2011) identified communication as a moderator to team effectiveness - teams who communicated better were more effective in achieving their goals. When operating in high-stakes and complex contexts, it is important that communication is appropriate in order to update shared mental models (Salas, Cannon-Bowers & Johnston, 1997). It would be unhelpful if a paramedic updated the commanding police officer on the status of every casualty as this specific information is

irrelevant to the police, would delay decision-making and risk cognitive overload; instead they would follow a structure of communications whereby the paramedic updates their team leader who can liaise relevant information to their multi-agency partners. Likewise, when crucial information is discovered, it must be rapidly shared with those who need it. Communication must be relevant in terms of *what* is said, to *whom* it is said and *how* the message is communicated. Effective communications facilitate common relevant operating pictures (McMaster & Baber, 2012). Unnecessary communications, such as information about one's role-specific procedural knowledge, has been found to *worsen* performance (Banks & Millward, 2007).

Despite the importance of communication, it is repeatedly identified as being problematic in emergency contexts. Power and Alison (2017a) identified that miscommunication and insufficient updating were core challenges to emergency decision-making, which in fast paced and dynamic emergencies meant that commanders struggled to keep pace with the situation and establish which pieces of information remained relevant. An evaluation of a live multi-agency disaster training exercise found that multi-team communication was impeded by incompatible communication channels (i.e., using different technologies to log information), a poor understanding of information relevance, and lack of trust in the information they received (Bharosa, Lee & Janssen, 2010). Communication failures also arose when different teams or individuals perceive different messages in different ways, depending upon their own perspectives and biases (Bandow, 2001). For example, the 'save life' strategic goal commonly used by emergency teams could be interpreted in different ways by different emergency response teams with regards to whose life this referred to – the citizens in the risk area; the emergency responders operating inside the risk area; or the wider public around the risk area (Power & Alison, 2017b). Thus, there remains issues around how to facilitate timely, relevant and clear communications.

Solutions to Emergency Teamwork

The remainder of this paper will explore how emergency teamwork might be improved via solutions-focused research. Emergencies are inherently complex, but a resilient emergency team can control and reduce complexity. Interventions to develop 'soft resilience' (i.e., to enhance flexibility and agility in the team network) are arguably more useful than those that build 'hard resilience' (i.e., development of robustness and redundancy in a network) as they increase adaptation to uncertainty (Miao, Banister & Tang 2013). This paper will provide recommendations for how processing might be improved in emergency teams; specifically framing this around *how* it can be practically achieved through: (i) teamwork training; (ii) developing a socio-technical team network; and (iii) changes to policies and procedural guidelines. Importantly, all of these recommendations are grounded in the assumption that they will be empirically tested and validated in the real-world to bridge the gap between theory and practice.

Interventions through teamwork training. It has been argued that multi-agency training is the key to improving multi-team coordination during emergencies (Salmon et al., 2011). Training enables individuals to develop their skills whilst operating in safe environments. It can be delivered using a range of formats, such as classroom teaching, table top exercises, immersive simulations or live exercises. Live exercises, for example, can last a number of hours or days to simulate a real-world emergency using role-players who act as casualties and civilians to test responding. 'Hydra' is an example of an immersive simulated learning environment that has been used to train decision making in emergency teams - running delegates through an unfolding multi-stage decision scenario wherein they log decisions and dynamically interact with the information they receive (Alison, et al., 2013).

Emergency teams participate in regular training as part of their ongoing professional development. However, there is a heavy emphasis on the development of *technical* skills

(e.g., testing capabilities to respond to a chemical attack, testing procedures for mass evacuation of civilians) and less emphasis on the development of competencies related to *teamwork* and decision making (e.g., how to reach consensus on decisions, how to coordinate behaviors). In their evaluation of a multi-agency training course, Wilson and Gosiewska (2014) found that trainees perceived team interaction as the most important benefit of training, over and above traditional training outcomes such as having the opportunity to practice skills and receive feedback. Thus, rather than assume that training facilitates teamwork by proxy of social interaction during practical skills development, it is argued that training should *explicitly* focus on the development of teamwork competencies.

One area of focus for emergency teamwork training is to develop a shared and accurate understanding of roles and responsibilities across the team network. As discussed, a poor understanding of roles can reduce *cooperation* as team members lack cognitive trust in others' abilities, and impede *coordination* as team members fail to communicate relevant information to each other. A positive example of how team training has progressed in recent years is via the UK's Joint Emergency Services Interoperability Programme (JESIP), whose goal was to enhance interoperability between emergency services (JESIP, 2016). They ran a series of multi-agency classroom-based training days, which brought commanders from the emergency services together to run through incidents in slow time and discuss the roles and capabilities of different agencies. This can be beneficial for building knowledge about the capabilities of less familiar team members, whilst debunking any myths or misunderstandings about other team members. Further research to explore the effects of such training on inter-team attitudes and behavior is needed.

Teamwork training can also be beneficial for developing role-based trust: trust based on the knowledge that a person in a given role will perform given duties (Kramer, 1999). Indeed, 'dynamic' or 'flash' teams, where membership is fluid, are typical of emergency

teams, and increasingly common in wider organizations (Tannenbaum, Mathieu, Salas & Cohen, 2012). Klein, Ziegert, Knight and Xiao (2006) defined dynamic teams as 'extreme action teams', whose members must cooperate to perform urgent and high-consequence tasks whilst coping with frequent changes in team composition. As such, the notion of building affective trust over time through repeated teamwork episodes is problematic as team members have not worked together before (Marks, et al., 2001). Curnin et al., (2015) argued that temporary emergency teams are reliant on rapid or 'swift' trust, which is facilitated by clear role understanding. Role-based trust could further contribute to a sense of 'collective efficacy': the team's shared belief in its conjoint abilities to organize teamwork and execute action (Millward et al., 2010), in spite of limited interpersonal experience. Thus, training should be designed to specifically develop de-individualized knowledge about roles so that responders understand the expected competencies of a given role; a recommendation that can also apply to sporadic organizational teams outside of the emergency context.

In addition to role understanding, teamwork training might also be usefully designed to generate a shared sense of culture and values. Research on 'cultural interoperability' in emergency teams has identified how, despite police and ambulance staff describing a common identity based on their need to deal with the 'nastier side of life', this was not something they felt they shared with the fire service, whose role they were less familiar with (Charman, 2014). However, when thinking about a common 'emergency service' identity, police and ambulance participants identified more closely with the fire service. This suggests that cultural identification with others can influence a team members' willingness to cooperate with others. Furthermore, ingroup identification has been found to predict collective efficacy and trust in teams (Fransen, et al., 2014) and increase the perceived clarity of task-relevant communications (Greenaway, Wright, Willingham, Reynolds & Haslam, 2015). It is important that multi-agency teamwork training is therefore designed in a way that

considers the role of organizational identities to foster 'cultural interoperability' and support joint working. Research to better understand how multi-team training interacts with organizational identity, attitudes and behaviors is needed.

Developing a Socio-Technical Team Network. Emergency teamwork can also be facilitated by research on how to strengthen and develop the socio-technical team network. A socio-technical network is the structure of individuals, sub-teams and technologies that are used to exchange information and coordinate behavior. An evaluation of the emergency response to the hurricanes that hit the State of Florida in 2004 found that technology significantly aided response efforts by providing a rapid platform for the communication of safety messages to the public (Kapucu, 2008). Furthermore, geographic information systems and interactive maps were essential for updating situation awareness (e.g., noting the location of downed trees and power lines). Alternatively, it was found in an in-depth study of a train derailment in Cumbria (UK) that inter-agency coordination was impeded due to a poor understanding of the disaster management system that was being used; communications between team members were lost in the socio-technical network as individuals passed messages to a central communication center, but it was not clear who sent which message when they were disseminated to other agencies (Smith & Dowell, 2000). The socio-technical network is essential for creating a shared situational awareness between team members and facilitating interoperability. Research to identify what an effective socio-technical network should look like is imperative to enhance team processing, information sharing and the maintenance of relevant and common situational awareness.

One way to improve the team network could be via the adoption of common communication styles, both virtually and in the real world. The psychological literature on communication suggests that the utility of different communication styles is dependent upon context. For example, 'closed-loop communications' (CLC), whereby messages are sent,

acknowledged and verified, can be useful for enabling rapid teamwork (Salas et al., 2005; Wilson et al., 2007). A study on emergency medical teams found that CLC improved team performance, but only during predictable algorithm-based tasks and not for knowledge-driven tasks that required interpretation (Schmutz, Hoffman, Heimberg & Manser, 2015). CLC are thus useful in predictable environments, but are less adaptable to complex or novel contexts as teams must communicate to understand the situation. This is important when considering the design of novel systems and technologies that might be used to share information during emergency teamwork as the style of communications must fit or be adaptable to the requirements of different tasks (Mendonca, Jefferson & Harald, 2007).

In their analysis of the emergency response to the World Trade Centre Attacks in 2001, Comfort and Kapucu (2006) recommended that future inter-organizational systems must be auto-adaptive in order to cope with the unbounded uncertainty that is typical of large scale emergencies. A socio-technical structure should support five distinct phases of extreme teamwork: (i) information search; (ii) information exchange with other organizations; (iii) sensemaking and strategy selection; (iv) adaptation of, or action to implement strategic; and (v) evaluation of actions taken and modifications if required. The process is underpinned by organizational learning and adjustment to unforeseen events during emergencies. Comfort and Kapucu (2006) described how the events of 9/11 were so extreme and incomprehensible that they exceeded the sensemaking abilities of on-site security guards in the South Tower who failed to recognize the potential collapse of the tower and instructed employees to remain inside the building. They contrasted this to the quick actions of more experienced federal officials to mobilize communications equipment to New York; arguing that their expertise facilitated sensemaking under extreme conditions. They argue that an auto-adaptive socio-technical system must be designed to rapidly share expertise and organizational

learning across the network under conditions of extreme uncertainty via rapid and clear communications.

In addition to considering the *process* of communication, it is important to be aware of the *content* of shared information. This is especially important for emergency teams due to the range of acronyms and specialist language used in this context (e.g., 'HART' for 'Hazardous Area Response Team'; 'SRT' for Search and Rescue Team). Although acronyms can expedite team processing in fast paced environments, their use risks miscommunication when working in unfamiliar teams (Laakso, 2013). Terminology can be specific to agencies, specialist teams within agencies, and further regionally influenced across the country and abroad. The UK's Emergency Services have encouraged 'acronym free' communications between agencies as best practice (JESIP, 2016). Although useful to aid understanding, there is a risk that this might delay communications due to the increased cognitive load required to translate back from common acronyms to plain English, or that practitioners might simply not adopt this technique when under pressure. A technological solution might be to develop a communications platform that translates typed messages into agency-relevant language. For example, a paramedic might log "there are 20 P3s", which is then automatically translated by the algorithm to "there are 20 walking wounded casualties" and shared with colleagues from other agencies. It has also been suggested that technology might be developed in the future that could detect and help filter out duplicated and unessential information (Mendonca et al., 2007).

A more human-focused solution to ensuring a smooth team network is via the use of 'liaison officers'; individuals who are responsible for coordinating information and action during an emergency and who are trained to understand the different roles in different emergency teams. Curnin, Owen, Paton and Brooks (2015) identified liaison officers to act as the 'boundary spanners' who link different teams together during an emergency by, for

example, providing the right information to the right person, clarifying roles and responsibilities, and generally enabling coordination. The use of liaison officers removes the need for other team members to fully understand the team structure as they are able to rely on liaison officers to provide and share relevant information to the right person. Liaison officers are useful for establishing common *relevant* operational pictures as they know which pieces of information should be passed on to which team member (McMaster, Baber & Houghton, 2007), offering a non-technological solution to team processing.

Importantly, although socio-technical solutions might help to facilitate team processing in theory, it is important that all members of the network use common structures. In their analyses of a multi-agency disaster exercise, Bharosa, et al. (2010) identified how the introduction of unfamiliar technologies caused team leaders to revert back to non-technical resources (e.g., paper maps). The return to non-technical practices can cause considerable issues in multi-team contexts if different agencies utilize different and/or incompatible procedures (Salmon, et al., 2011). If sub-teams within multi-team systems use dissimilar platforms for information sharing it risks a large proportion of information loss. Mendonca et al. (2007) argued that technology should avoid rigidity and instead be designed to support flexible and improvised behavior that are typical of emergencies. In order for technology to support emergency responding, there must be a concerted effort to empirically validate technologies and networked enabled capabilities with an awareness of the 'human' in the loop, especially in multi-agency settings. Although technology might offer a modern solution to communication during emergencies, liaison officers might be just as, if not more, effective when time pressure is extreme. To ensure adaptive networked enabled capabilities during emergency responding, there must be careful consideration of the human in the sociotechnical loop (McMaster & Baber, 2012; McMaster et al., 2007).

Changes to Policies and Procedural Guidelines. Organizational policies and procedures can enhance and embed team processing. In acknowledgement of the increased requirement for emergency services to work together during disasters, a number of emergency management groups across the world have developed procedural guidance to facilitate 'interoperability', defined as *"the extent to which organizations can work together coherently as a matter of course*" (p. 8, Pollock, 2013). The Australian Inter-Agency Incident Management System (AIIMS) is a management framework to coordinate emergency response and control the incident (Australian Fire Authority Council, 2004). It is based upon three principles: (i) functional management of the incident, whereby the incident controller delegates functional roles to sub-teams; (ii) the establishment of 'spans of control', to ensure that no more than five reporting groups or individuals are reporting to an individual at any one time; and (iii) ensuring management by objectives, where the incident controller ensures only one set of objectives is being used at a time (Hayes & Omodei, 2011). In the USA, the Incident Command System (ICS), part of the National Incident Management System (NIMS), was designed to help federal, state and local government coordination (Jensen & Waugh Jr, 2014). Likewise, JESIP in UK was developed to facilitate joint working between agencies responding to major disasters by use of a common 'Joint Decision Model' (JDM) (JESIP, 2016).

Although the development of collaborative management frameworks is well intentioned, there is limited empirical evidence to support their usefulness in practice. Jensen and Waugh Jr (2014) explored the efficacy of the American ICS, and warned of little evidence that the system was consistently used or whether it was effective in practice. They found that whilst the ICS has been used appropriately by some organizations, it was largely ignored, underused or even misused by others. They also queried the use of the ICS as an 'all hazards' solution, arguing that it may be inappropriate when applied to some disaster

contexts (Jensen & Waugh Jr, 2014). In the UK, Power and Alison (2017b) suggested that, despite the potential usefulness of the JDM, the absence of a 'goal-setting' phase in the model was inconsistent with the plethora of research that identifies the importance of goals, especially in inter-organizational settings (Locke & Latham, 1990). They described how the use of 'abstract' (i.e., ambiguous) goals (such as 'save life') to guide multi-agency teamwork was inappropriate because different response agencies interpreted this goal based on their organizational biases, and suggested that the use of concrete objectives that are iteratively updated would be more appropriate. Likewise, NIMS in the US has been criticized for being ineffective if goals are not consistent or clearly identified (Chen et al., 2008). Criticisms such as these do not suggest that policies and procedures are inherently redundant. Instead, they offer a gateway through which psychological research can be used to inform operational practice. This is especially apparent in emergency contexts as policies and procedures are crucial for trying to standardize and reduce variation in human behavior when operating in chaotic environments. It is thus crucial that efforts are made to provide an evidence-based rationale for future emergency guidelines.

Empirical validation: translating theory into practice. A final point to make when discussing the potential solutions to emergency teamwork is the importance of empirical validation of solutions. A core limitation to research on emergency teamwork is the gap between theory and practice. This gap can occur due to ignorance on both sides; whereby researchers fail to clearly outline how theoretical conclusions can be applied in the real-world or acknowledge the practical constraints that limit their application, and practitioners selectively choose solutions from the literature that seem to fit strategic objectives, but fail to empirically validate their effectiveness on the incident ground. It is paramount that future research overcomes these problems by addressing these issues through the empirical validation of research in naturalistic and applied settings.

An example of incorporating theory into practice can be taken from a series of recent papers on UK emergency decision making. This research began with the development of the theoretical 'SAFE-T' model of emergency decision making (van den Heuvel, Alison & Crego, 2012), which described how effective decision making should follow phases of 'Situation Assessment (SA)', 'Plan Formulation (F)', 'Plan Execution (E)' and 'Team learning (T)', whilst identifying the specific cognitive biases and decision errors derailed this process. This theoretical model was then tested by researchers working with the Fire Service, where it was found that incident commanders repeatedly skipped from situation assessment straight to plan execution phases (Cohen-Hatton, Butler & Honey, 2015). The authors warned that skipping the plan formulation phase might impede decision making as it would limit the reflexive process when considering the goals or reasons 'why' for action. To mitigate these effects, Cohen-Hatton and Honey (2015) developed a training intervention using 'decision controls' to encourage commanders to think 'why am I doing this?' prior to taking action. The results of this study were impressive; commanders increased their use of 'plan formulation' during responding, yet this did not increase the time it took for them to make decisions. As a result, guidance on using these 'decision controls' has now been implemented into operational guidance for the UK Fire Service (CFOA, 2015). The successful bridging between theory (van den Heuvel et al., 2012) and practice (CFOA, 2015) was fundamentally driven by empirical validation (Cohen-Hatton, et al., 2015). We argue that this model of best practice should be used to guide future research to improve emergency teamwork.

Conclusion

Whether the result of man-made or natural causes, major emergencies and disasters are an increasing reality in modern day society. Psychological research has made great advances in understanding how teams operate in general organizational settings, but there is a paucity of research that specifically examines how emergency teams operate in high-risk and

complex environments. This is important due to the unique stressors associated with emergency teams who must coordinate their behavior under extreme pressures, often in sporadically forming and multi-layered teams, which limits the application of traditional teamwork research from more artificial and low-stakes settings. By fitting the limited research on emergency teamwork within a team processing framework, this paper has provided a first step in bridging understanding between experts in disaster management and researchers studying the psychology of teams. To move this collaboration forward there must be a common and agreed understanding between researchers and emergency service practitioners; namely that research, to be useful, must have buy-in from practitioners operating in the real-world who can implement findings, and commitment from researchers that their research findings have contextualized and relevant application to support practice. This can be achieved by designing research projects that explore team processing, but provide solutions-focused recommendations oriented around new training, novel socio-technical systems, or changes to policies and procedural guidelines. This paper has thus served to highlight the growing need for research on how extreme emergency teams operate in these uniquely challenging environments, and offered a solutions-focused framework from which future research might grow.

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