Defining Team Cognition in Emergency Response: A Scoping Literature Review

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With so many natural and man-made disasters bringing catastrophic losses worldwide, the initial response is the one during which real-time decision-making is particularly important for the overall performance. During the response phase, first responders with diverse backgrounds (e.g., fire, medical, law enforcement, or public work) need to work together as an ad hoc team to save lives and infrastructures at risk. For successful response operations, cognition (i.e., the ability to support timely and effective decision-making) needs to be understood not only at the individual level but also at the team level. Yet, team cognition still remains to be an inadequately addressed topic in emergency response literature (Bigley & Roberts, 2001; Comfort, 2007; Majchrzak, Jarvenpaa, & Hollingshead, 2007).

While the need to study real-world teams in the context of "broader sociotechnical systems" has been documented in team cognition and behavior literature (Kozlowski & Ilgen, 2006; Salas, Cooke & Rosen, 2008; DeChurch and Zaccaro, 2010), emergency response literature lacks attention to emergency responders' collective efforts. Unlike many other cognitive psychology research topics, the theoretical growth of team cognition has been primarily driven by application needs – i.e., "there was no time to wait for a psychology of team cognition" because applications were "needed yesterday" (Cooke et al. 2007). That is, the scarcity of literature can be traced back to lack of efforts in conceptualizing and operationalizing team cognition in the unique context of emergency response.

Most of all, the emergency response field must first come to consensus on what it means by team cognition. As it stands, there are at least five research domains of team cognition (Wildman, Salas, & Scott, 2014), i.e., team mental models, transactive memory systems, team situation awareness, strategic consensus, and interactive team cognition (ITC). While each of these domains highlights some aspects of the multifaceted construct of team cognition, the direction of future research hinges on having a clear conceptualization of team cognition – particularly in the context of emergency response.

A scoping review of literature was conducted as an initial effort to outline and synthesize how team cognition has been defined in the field of emergency response. Using targeted keyword searches in MEDLINE, COMPENDEX and CINAHL, the total of 1,799 articles published in English after 1994, which either empirically or otherwise investigated team cognition in emergency response were retrieved. After the initial search, paper titles, abstracts, and full texts were subsequently reviewed to exclude irrelevant ones and to define the subset for detailed review. Our qualitative analysis identified inconsistencies in definitions that may generate redundant research efforts and hinder the generalization of findings.

Three main research gaps with respect to defining team cognition in emergency response are identified. (1) Team cognition needs to be defined at the team level, viewing a team either as an aggregated group of individuals or a cognitive system. (2) Product-based and process-based definitions of team cognition need to be clearly differentiated and aligned with two distinct views on a team. While team cognition has a nuanced literature that describes subtle distinctions between two perspectives (i.e., an emergent state vs. a cognitive process) (Durso, Rawson, & Girotto, 2007; Cooke et al. 2007; Saner et al. 2009), emergency response literature has yet to produce research that shows satisfactory exploration on those distinctions. (3) Team cognition needs to be redefined in the unique context of emergency response. As posited by the ITC theory ("team cognition is inextricably tied to context", Cooke et al. 2013), team cognition in emergency response could differ depending on the nature of the surrounding dynamic context including team, task, and environment. However, different constructs are taken directly from other disciplines and only very few of them are redefined in the context of emergency response (Sætrevik, 2015).

This research documents the first component of the multistage on-going project that investigates how interactions among human, team, and technology affect team cognition and performance in emergency response. Based on the synthesis, a working definition for future work is presented as: "a collective cognitive process of team members 1) perceiving changes in the status of critical elements, 2) adapting in response to the perceived changes, and 3) learning from past performance, which supports timely and effective coordinated decision-making and manifests itself as behavioral patterns of dynamic interactions among individuals and technologies". Future work in progress includes developing an appropriate measurement technique for team cognition based on working definition, designing and evaluating potential technologies to support team cognition in the simulated emergency response environment (i.e., Emergency Operations Training Center, TEEX, College Station, TX).

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REFERENCES

Bigley, G. A., & Roberts, K. H. (2001). The incident command system: High-reliability organizing for complex and volatile task environments. Academy of Management Journal, 44(6), 1281-1299.

Comfort, L. K. (2007). Crisis management in hindsight: Cognition, communication, coordination, and control. Public Administration Review, 67(s1), 189-197.

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

Cooke, N. J., Gorman, J. C., Winner, J. L., & Durso, F. T. (2007). Team cognition. Handbook of applied cognition, 2, 239-268.

DeChurch, L. A., & Zaccaro, S. J. (2010). Perspectives: Teams won't solve this problem. Human Factors: The Journal of the Human Factors and Ergonomics Society, 52(2), 329-334.

Durso, F. T., Rawson, K. A., & Girotto, S. (2007). Comprehension and situation awareness. Handbook of applied cognition, 2, 163-193.

Guha-Sapir, D., Vos, F., Below, R., & Ponserre, S. (2016). Annual disaster statistical review 2015. Centre for Research on the Epidemiology of Disasters.

Kozlowski, S. W., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. Psychological science in the public interest, 7(3), 77-124.

Majchrzak, A., Jarvenpaa, S. L., & Hollingshead, A. B. (2007). Coordinating expertise among emergent groups responding to disasters. Organization science, 18(1), 147-161.

Salas, E., Cooke, N. J., & Rosen, M. A. (2008). On teams, teamwork, and team performance: Discoveries and developments. Human factors, 50(3), 540-547.

Saner, L. D., Bolstad, C. A., Gonzalez, C., & Cuevas, H. M. (2009). Measuring and predicting shared situation awareness in teams. Journal of Cognitive Engineering and Decision Making, 3(3), 280-308.

Sætrevik, B. (2015). Psychophysiology, task complexity, and team factors determine emergency response teams' shared beliefs. Safety science, 78, 117-123.

Weick, K. E. (2010). Reflections on enacted sensemaking in the Bhopal disaster. Journal of Management Studies, 47(3), 537-550.

Wildman, J. L., Salas, E., & Scott, C. P. (2014). Measuring cognition in teams a cross-domain review. Human Factors: The Journal of the Human Factors and Ergonomics Society, 56(5), 911-941.