

Didn't roger that: Social media message complexity and situational awareness of emergency responders

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ABSTRACT

This study investigates the role of social media in situational awareness in the emergency response domain. It builds a theoretical model to that effect, the first such effort to the best of our knowledge, and empirically investigates one of the components of the model, text complexity. The empirical analysis was performed on a dataset of 999,243 messages from 997 Facebook pages of US police departments in 2009–2016. Messages were classified into four categories based on their utilitarian or hedonic nature: emergency preparedness, emergency response, post-emergency and user engagement. Three measures of complexity were used, each capturing different aspects of text. Contrary to the hypothesis formulated in the study, messages in the post-emergency and the emergency response categories were found to be the most complex. With text complexity on social media being an underexplored area, these results suggest a need for an explicit study of the link between social media messages and situational awareness, and indicate a need for practitioners to revisit social media practices.

1. Introduction

The use of social media in emergency response has been gaining increased attention in recent years (Meier, 2015). Social media have been acknowledged to play a role at different stages of emergency response, from disaster response (Avvenuti, Cresci, Marchetti, Meletti, & Tesconi, 2016) to emergency preparedness (Merchant, Elmer, & Lurie, 2011), and in emergencies of different scale, from large-scale disasters such as earthquakes (Yates & Paquette, 2011) to smaller-scale emergency events, e.g. wildfires (Slavkovikj, Verstockt, Van Hoecke, & Van de Walle, 2014). In turn, the public increasingly expects emergency responders to communicate through social media (Lindsay, 2011).

In all but the simplest cases, emergency response involves several groups of actors (e.g. firefighters and police working side by side at the location where the emergency took place). Therefore, emergency-related information disseminated on social media by one actor (e.g., a police unit) is consumed by a diverse variety of other actors (e.g. other police units, firefighter and medical units and the public). In addition, emergency's responders understanding of the specific emergency influence how they produce and consume social media information. When looking for a theoretical construct that allows to frame social media messages within the context of emergency responders' awareness of a situation, the notion of situational awareness (SA) seems to be an appropriate choice. Situational awareness is a concept that the human

factors community has been researching since the early 1990s (Endsley, 1995) and is the notion of “knowing what is going on so you can figure out what to do” (Yang, Chen, & Su, 2016).

All emergency responders need to attain situational awareness (SA) when dealing with a specific event, a phenomenon that has been labeled shared or intergroup SA (Seppänen, Mäkelä, Luukkala, & Virrantaus, 2013; Sonnenwald & Pierce, 2000). SA, according to Endsley (1995), includes three stages: perception, comprehension, and projection. The first step, perception, deals with capturing the data. The comprehension stage has to do with the interpretation of that data, and the last step aims to predict situation's possible outcomes. During the perception stage, the subject captures data by means of the senses (seeing, listening, smelling, etc.). Some of the captured data can be written, and for that kind of data the comprehension degree will depend on text features such as length, content, structure, and readability (Jagtman, 2014).

One type of textual data contributing to SA is social media, which allow information about an ongoing emergency to diffuse quickly and provide a better view of post-disaster recovery efforts (Verma et al., 2011; Yin, Lampert, Cameron, Robinson, & Power, 2012). To show how social media messages and actors' SA interact, and which of these interactions have been studied previously, we propose a simple model shown in Fig. 1. It follows the categorization of social media messages that are sent and received during disasters developed by Reuter, Marx

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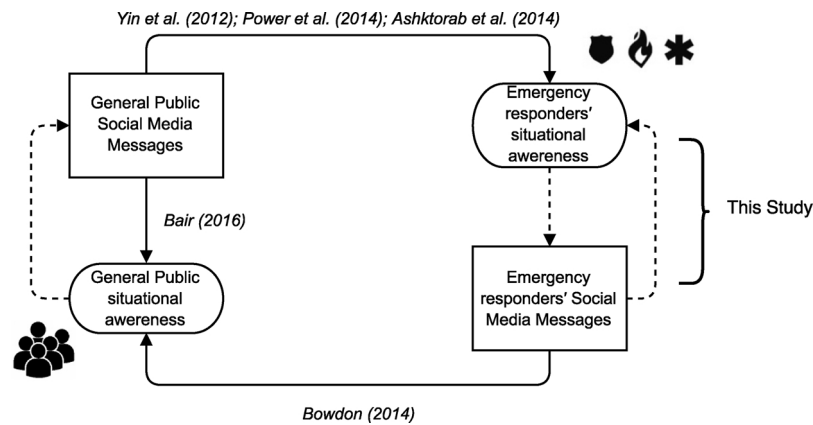


Fig. 1. Social media messages and actors' situational awareness relationships.

and Pipek(2012). The categorization considers two types of actors: organizations involved in emergency response and general public, and the four possible combinations of messages between them (emergency responders to emergency responders, emergency responders to the public etc.). Social media influences SA of both groups, and their SA in turn impacts the crafting of new messages.

The model includes previous work that can be categorized using information's flow. Dotted lines represent paths that have not been studied. There are three unexplored paths: how SA of the general public SA affects social media messages posted by it; the impact of messages posted by emergency responders on their SA; and the effect of SA of emergency responders on their messages.

This study focuses on the second path, how emergency responders' social media messages influences emergency responders' SA. Our approach revolves around the notion of complexity. Since emergency responders need to provide accessible information to other actors, communication should be done at a level that is readily understood by them, as these actors may not “speak the same language”: e.g. some terms may be specific to a profession or location, and some acronyms may not be widely known. For this reason emergency-related communication should be simple, and calls to that effect have been issued by academics (Temnikova, Vieweg, & Castillo, 2015) and practitioners alike (International Association of Fire Chiefs, 2009).

However, whether emergency information on social media is indeed communicated in simple language in practice is not well understood. So far only very limited research has examined language simplicity in emergency-related social media communication, see Temnikova et al. (2015). Our paper aims to contribute to this nascent field by comparing the degree of complexity of different types of information communicated by emergency responders on social media. And, rather than viewing text complexity as an end in itself, we use Endsley's (1995) theory of SA to develop a model where complexity affects SA among involved actors, which in turn may lead to actions to respond or adapt to the emergency.

Specifically, our goal is to empirically rank types of messages created by emergency responders by simplicity of language used in these messages. To achieve this goal, we collected and classified 999,243 Facebook messages of 997 US local police departments from January 2009 to October 2016. These messages were classified into four categories: emergency preparedness, emergency response, post-emergency and engagement with users. We used three measures of text complexity, which use different operationalizations of complexity. Results indicate that post-emergency and emergency response messages were the most complex using all three complexity measures, and that trend has been consistent throughout most of the period under consideration.

This research contributes to the underexplored area of social media message complexity in the emergency response realm, and the effect of emergency-related messages' complexity on SA. We develop a model of

social media-assisted SA in emergency response and explore the relationship between social media message complexity and message type. With that information, emergency manager organizations can develop guidelines to facilitate the generation of effective social media communications that lead to better SA. Additionally, our model can be used by other researchers studying how different type of data (pictures, diagrams, etc.) influence emergency responders' SA.

2. Literature review

2.1. Situational awareness during emergencies

Situational awareness is defined as “all knowledge that is accessible and can be integrated into a coherent picture, when required, to assess and cope with a situation” (Sarter & Woods, 1991). SA has been extensively studied at the individual level, and in dynamic environments such as air traffic control (Jensen, 1997), aviation (Sarter & Woods, 1991), military (Sonnenwald & Pierce, 2000) and emergency response (Seppänen et al., 2013). Research has highlighted factors that facilitate SA (e.g., information processing capabilities of an individual and their workload), as well as the effect of increased awareness on decision-making and taking action in response to the situation (Endsley, 1995).

Endsley (1995) developed a theory of SA where awareness is a mediating factor between, on the one hand, technical system factors such as system capabilities and complexity as well as individual factors, and on the other hand decision-making and taking action. Endsley (1995) points out how firefighting, police and military personnel depend on their SA to make decisions. Since social media messages are crafted depending upon specific circumstances, they are byproducts of a decision making process.

More recently, the concept has been found applicable to the group level as well. In fast-changing situations SA needs to be formed not only by individuals, but also within and between groups to facilitate efficient response to the situation (Nofi, 2000; Sonnenwald & Pierce, 2000). Specifically in the context of emergency response, different groups are likely to perform different roles in the response process: e.g., during a forest fire police, firefighters and medical services are performing different tasks. Each group thus needs to develop SA both within their own group to successfully perform those tasks, as well as a shared SA to not obstruct the performance of other groups.

Achieving SA, however, is not an easy task. It can be hampered, among others, by a lack of fluency in communication or by divergent understanding of some concepts by different actors (Seppänen et al., 2013). Sonnenwald & Pierce (2000) report that in the military settings, actors observed that “we argue constantly over definition of terms”. Therefore clarity in communication can be expected to facilitate SA.

Information technology has long been seen as one tool that could aid in increasing SA (Sonnenwald & Pierce, 2000). More recently, social

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