Chapter 8
Social Media Technologies and Disaster Management

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Abstract The social–technological developments of the past decade have changed how we communicate during disasters. Given the wide reach of social media, when a disaster occurs in the digital era, people check social media platforms such as Twitter and Facebook immediately to explore and to share disaster-related information. These help us to understand the extent of the serious damage it would cause, where and whether to evacuate, and what kind of support victims might need. Although social media has just recently emerged as a social–technological tool, past research has shown that it is human nature to share information during disasters. This chapter provides an overview of how the characteristics of social media platforms influence our information-sharing behavior during disasters. In addition, it focuses on not only the advantages but also the potential threat of using social technology based on recent empirical research. While social media makes it possible to share information more rapidly, widely, and easily than ever before, their technological characteristics could benefit us only if we share reliable information; however, social problems could be caused if false information is spread. By reviewing the psychological aspects behind false information spreading through social media, anticipated challenges in using social technology during disasters will be discussed.

Keywords Social media · Disaster · Psychological perspective · False rumor · Information management

8.1 Introduction

The latest social media technologies allow individuals to share information more rapidly and extensively anywhere and anytime, even in the middle of a disaster situation. In January 2020, there were 3.8 billion active users of social media platforms such as Facebook and Twitter (Hootsuite and We Are Social 2020). The number has

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increased by one billion in only 3 years and amounts to almost half of the world population. People use mobile devices daily for an average of 3.7 h, and approximately 50% of this time is spent on social platforms and communication applications. This chapter provides an overview of how the characteristics of social media platforms influence information-sharing behaviors during disasters. The primary focus of this chapter is natural disasters (e.g., earthquake and hurricane), although a disaster is a usually complex phenomenon and some natural disasters are followed by human-made crises (e.g., nuclear accidents) that can result in secondary damage. Social media has evolved into an important communication tool to help people prepare for, respond to, and recover from natural disasters. According to the White Paper on Disaster Management (Cabinet Office, Government of Japan 2018), people in their 20 s and 30 s particularly tend to emphasize the importance of social media as a source of disaster-related information. However, with the rapidly growing number of social media users worldwide, both the benefits and repercussions of using social media during disasters have been magnified.

8.2   Roles of Social Media During a Disaster

When an earthquake occurs, the shaking makes a person realize that something unusual is suddenly happening. Many questions come to mind in a few seconds. Is this shaking caused by an earthquake or just road construction? How long will it last? Was this just a foreshock? Is the mainshock coming? Should I evacuate immediately? Where is the epicenter? Is my family safe? Attempts are made to find information that could explain the situational change. These are only examples of information needs that arise in the early phases of a disaster. Then, information needs to change continually. As Mikami (2004) described, different information needs emerge as the phases progress: In the early phase, which starts immediately after a disaster, people need information such as early warnings, cause of the disaster, and location and severity of the damages. In the next phase, people need security and safety information as they would be concerned about the risks of crimes such as looting, and of losing contact with their family and friends, or finding the missing. In the post-event phase, people need living information to recover and rebuild from the disaster.

Gathering and sharing information quickly and appropriately is the foundation of efficient disaster management. However, during a catastrophic disaster, some information channels might not be available. For instance, before the era of the Internet and social media, evacuees needed to depend on mass media (e.g., printed newspapers, TV, radio) to acquire disaster-related information. The traditional media essentially provides one-way communication and does not fulfill individual information needs. The emergence of social media has changed the process of dissemination of information during disasters by allowing two-way communication that connects victims directly with family, friends, governments, on-site and off-site volunteers, mass media, and international aid. In addition, social media has the advantage of being

accessible during a disaster. For instance, while the 2011 Japan earthquake disabled a large number of fixed communication networks and mobile communications using cellular phones owing to the damage to their base stations (Ichiguchi 2011), people could still communicate through social media by accessing the Internet.

There has been widespread use of social media during disasters since the mid-2000s. People started communicating through social media during the 2005 suicide bombing attack in UK and 2007 wildfires in the USA (Peary et al. 2012). During the 2010 Haiti earthquake, the Ushahidi crisis map, which collects disaster information from Twitter and Facebook, was widely used (Norheim-Hagtun and Meier 2010). In the case of the severe flood that began from the northern region of Thailand in July 2011, the number of messages via Twitter increased by 52% by the time the flood reached the Bangkok Metropolitan area in October (Kongthon et al. 2012). People shared the following information: situational announcements and alerts, support announcements, requests for assistance, and requests for information. The 2012 Yilian earthquake in China is another instance where social media was used for information sharing. Disaster-related information transmitted via Sina Weibo, a Chinese microblogging platform, included personal posts, caution and advice, actualities and damage, donation of money, goods or services, and appeals for help (Li et al. 2018).

Social media plays an important role in both emergency management (sharing emergency information and coordinating community response) and community development (increasing and improving social networks through social media). With respect to emergency management, one of the primary concerns people have during a catastrophic disaster is safety information. People are anxious to know whether their family, friends, and relatives are safe. Social media has been used as a platform to exchange information about missing, injured, and isolated people (Imran et al. 2015; Subba and Bui 2017). The following is an outstanding example of how social media helps information sharing and rescue. On the night of the 2011 Japan earthquake, the then Tokyo Governor found an SOS message on Twitter. The tweet was posted by a Japanese man living in London, UK, and asking for help. His mother, who was the head of a kindergarten, and a dozen kindergarten children were isolated on the third floor of a shelter which nobody could approach from the ground because the lower floors were flooded due to a tsunami. The Governor immediately contacted a fire-rescue helicopter dispatched by Tokyo Metropolitan Government and succeeded in rescuing them. A person in charge of the Tokyo Fire Department later said "we sometimes receive 119 calls by people based on Twitter information. Although not always checking (Twitter), but we would like to respond to the information as much as possible." (Mainichi Shimbun 2011). This case clearly shows how emergency information was transmitted via social media and resulted in saving lives. Moreover, there are numerous studies examining the utilization of social media for emergency information sharing such as early disaster detection and warning (Chatfield et al. 2013; Bui 2019), visualizing affected and secure locations, and mapping the locations and the types of help needed (Gao et al. 2011; Reuter et al. 2015; Slamet et al. 2018).

In accordance with community development, Taylor et al. (2012) discussed the role of social media from a psychological perspective. During Cyclone Yasi, which

was a destructive tropical cyclone that hit Australia in January 2011, a Facebook page named "Cyclone Yasi Update" was created 5 days after the disaster hit the area. Organized and coordinated by several administrators and content managers living in scattered locations, the page functioned as a disaster management hub. Taylor et al. (2012) illustrated the two roles of maintaining a Facebook page during a disaster. One is for timely information gathering and dissemination from both official and informal sources (e.g., sharing images, the details of the affected area, links by official sources, and warnings). The other is to create connections among, and provide psychological support to, people who are anxious about the disaster (e.g., users made comments such as "glad everyone is ok," "don't worry, they're safe and well," and "Great job by all involved, kept me sane throughout the time, knowing what was going on for my loved ones"). The number of messages posted on the Facebook page and direct page views surged to 3,576 and 509,743, respectively, in the first 3 days. An advantage of social media for community development is that it engenders mutual support. During a disaster, the significance of mutual help is emphasized as public assistance (e.g., supports by the local government) but has its limitations (Cabinet Office, Government of Japan 2015). In addition, there are gaps between citizens and public organizations in cases where citizens in the areas that are affected to a lesser extent are more concerned about their daily necessities, such as food supplies in local stores, while the local government needs to prioritize life-saving efforts in the severely damaged areas (Hong et al. 2018). In this regard, social media would be appropriate to fill this gap by promoting mutual assistance among people within the local community.

8.3   Risks of Using Social Media During a Disaster

In contrast with the cases that shed light on the benefits or promising aspects of the use of social media platforms for disaster management, a number of recent studies have also explored the repercussions of the same (Castillo et al. 2011; Oh et al. 2013; Starbird et al. 2016; Vosoughi et al. 2018; Zubiaga et al. 2018). The biggest threat is "information pollution." Social media platforms allow users to share information rapidly and widely without any regard to its reliability. As reliable information is imperative for disaster management, the repercussions of false rumor propagation could have negative impacts on our society and result in recovery delay.

The earthquakes that hit Haiti in January 2010 and Chile in February 2010 are the first disaster situations where rumors were spread through social media (Mendoza et al. 2010; Oh et al. 2010; Gao et al. 2011; Castillo et al. 2013). In the case of the 2010 Chile earthquake of magnitude 8.8, which was one of the largest recorded earthquakes in the world, more than 500 people died, and there was extensive damage to infrastructure. Mendoza et al. (2010) analyzed the disaster-related information shared through social media 4 days after the earthquake had occurred. There were nearly 5 million tweets by more than 700 thousand different users. The result revealed that several types of false rumors were posted and retweeted. The following are

some examples: "Tsunami warning in Valparaiso," "Death of artist Ricardo Arjona," "Looting in some districts in Santiago." After a year, another devastating earthquake hits the northern part of Japan in March 2011, triggering tsunami waves and the Fukushima Daiichi nuclear accident. The catastrophic disaster that resulted in the deaths of more than 15,000 people, with 2,000 people missing, and hundreds of thousands of victims forced to evacuate across several prefectures, was also a case where many false rumors were spread.

One serious repercussion of rumors during a disaster is the wastage of limited human resources for disaster management. For instance, the following false rumor spread through Twitter after the 2011 Japan earthquake: in summary, "I was in a server room at the office when the earthquake occurred. A rack collapsed. My abdomen is crushed and I am bleeding. I can't breathe. I can't call for help by myself." This message was retweeted by many users who were worried about the person, asking help by providing the address information of his company and trying to reassure the person (Tachiiri 2011). However, an acquaintance soon tweeted that the original tweet was false. Another such case emerged after a large earthquake hit Kumamoto, the western part of Japan, in 2016. The following text message was posted: "The earthquake caused a lion to escape from a neighboring zoo," along with a picture of a lion walking across a street in a town. This tweet was posted on Twitter just after the earthquake hit Kumamoto prefecture and retweeted more than 20,000 times, resulting in the officials at a zoo in the disaster area being compelled to answer repeated telephone calls more than 100 times. The person who posted the tweet was a 20-year-old man living in Kanagawa prefecture, which is located roughly 1,000 km away from the epicenter, and was ultimately arrested on the suspicion of forcibly obstructing business (Shimbun 2016). This was the first case in Japan of an arrest being made for posting a false rumor on social media. The culprit accepted the charges and confessed that he was playing a practical joke. Both tweets were posted less than 30 min after the earthquakes and were originated outside the perimeter of the disaster. Although the intention of posting the tweets was to play a joke, many users took the tweets seriously and genuinely attempted to take appropriate actions. As seen in these examples, it is challenging during disasters to distinguish serious warnings and rescue requests from false ones, resulting in wastage of resources. The characteristics of social media platforms, that allow anyone from anywhere to post messages, enable malicious users to take pleasure in other people's reactions to their pretense of being the victims of a disaster.

It is to be noted that while there are malicious rumor spreaders, some users post and spread false rumors without confirming their reliability. They believe that the information is true and thus try to share it with others. In addition, in certain instances, information that used to be true could become false in a different context. For instance, imagine that an evacuee posted the following message: "There was a shortage of relief supplies at our shelter. We need your help. Please send supplies!!" This was true at that moment and was shared by many people through social media. Shortly after, sufficient relief supplies arrived at the shelter, and the evacuee posted another message: "Thank you for your great help! The shortage has been solved." However, the first message was still circulating among users who were unaware of the second message.

Because of their redundant requests, excessive relief supplies were dispatched to the specific shelter and, as a result, were not appropriately distributed to the other shelters. Although everyone who was involved in this information-sharing process did so with good intentions, it ended up hindering disaster recovery. Such proliferation of unreliable information during disasters not only causes wastage of limited human resources but also unnecessary anxiety, confusion, and distrust among people in the society.

8.4 Frameworks for Understanding Rumor Propagation

Although circulation of rumors through social media is a recent social problem in the digital era, rumors during disasters have been recognized as problematic social phenomena as early as the beginning of the nineteenth century. As a framework to better understanding rumor propagation through social media, this section will briefly review the findings of social science research on rumors.

8.4.1 Defining a Rumor

The history of research into rumors in social sciences goes back to a study into rumors spread during a specific disaster. A catastrophic earthquake hits the northern part of India on January 15, 1934, causing widespread damage to bridges, railway lines, and roads. Prasad (1935) observed and classified numerous rumors in the aftermath of the disaster such as "the earthquake was a punishment for our sin," "a large house has disappeared in the cracks of the earth," and "January 23 will be a fatal day. Unforeseeable calamities will arise." These were false or fabricated information. In later research, Prasad (1950) illustrated that rumors spread during earthquakes that occurred in different locations in the past 1000 years had similar characteristics. Since then, research has shown that similar types of disaster-related rumors were repeatedly propagated, such as reporting unlikely natural phenomena (e.g., rain of blood, disappearance of rivers) (Prasad 1950), warnings of human-induced threats (e.g., looting, rape) (Ogiue 2011), and fabricating the death of famous people (Castillo et al. 2013). Shibutani (1966, p. 17) defined rumor as "a recurrent form of communication through which men caught together in an ambiguous situation attempt to construct a meaningful interpretation of it by pooling their intellectual resources." Rumor spreads as a means of filling a discrepancy between information needs and supply. Note that the definition of a rumor does not determine the authenticity of information and includes unverified information to support its authenticity. This frequently happens especially in disaster situations as identifying true or false information is time-consuming during the chaos after a disaster.

Recently, "fake news," a term that is similar to "rumor," has been used frequently. As indicated, the term is used in myriad ways, and accordingly, Wardle and
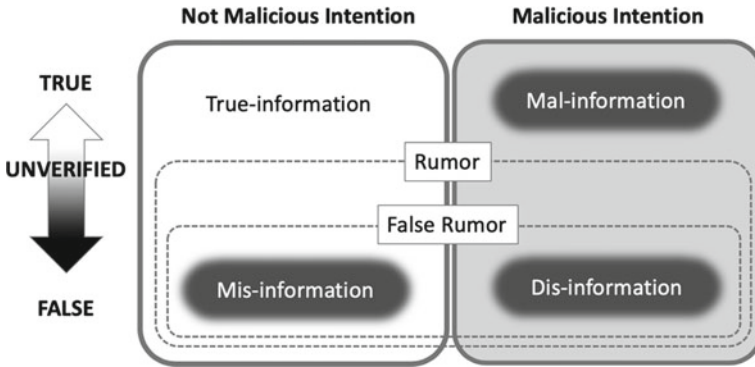
Fig. 8.1 Categorization of false information based on falsehood and maliciousness (modified Wardle and Derakhshan (2017)'s three components by incorporating with the definition of rumor)

Derakhshan (2017) proposed a conceptual framework to adequately describe information pollution. The framework consists of three components (i.e., mis-information, dis-information, and mal-information) based on two criteria: falsehood and existence of harmful intention. False information is categorized into either mis-information or dis-information. The latter is generated intentionally to cause harm to others, but the former is not. Mal-information is also generated with a harmful intention, but it is not false. For example, accusing a politician based on a leaked e-mail corresponds to mal-information. To clarify the terminology of rumor, false rumor, mis-information, dis-information, and mal-information, a conceptual framework (Wardle and Derakhshan 2017) was modified by incorporating the definition of rumors (Fig. 8.1). Considering that the intention of posting rumors during a disaster is not necessarily to harm someone, but rather it is to enjoy watching the confusion of people or to take undue advantage of the chaos after a disaster, the wording "harmful" of intention was replaced by the contextually appropriate word "malicious." The figure also added a spectrum of falsehood shown as a vertical arrow on the left. The middle of the spectrum refers to information that is not verified as true or false. Once a rumor has been identified as being untrue, the rumor is called a false rumor. As was illustrated in the aforementioned example of rumors during disasters, social media users shared outdated information and it resulted in the dispatch of excessive relief supplies to a shelter. As they were involved in information sharing with the good intention of helping evacuees, this is categorized into mis-information in false rumors. On the other hand, the previously mentioned rumor that included the picture of a lion walking in a town corresponds to dis-information in false rumor. The picture itself was originally taken in Africa for a film shooting and thus not fabricated, but it became a rumor when it was used in a false context (i.e., false location of "Kumamoto," and inappropriate timing such as after an earthquake). However, other users would immediately misunderstand the picture as a lion escaping from a zoo after the damage from an earthquake. This false rumor corresponds to an example of dis-information.

8.4.2 Psychological Factors

The observations of recurrent rumor spreading in disaster situations inevitably raised a question: Why do rumors emerge in most disaster situations? Why do people transmit rumors that might be false? What types of psychological factors are behind human behavior?

Social science research has established that rumors emerge when information needs are not satisfied (Prasad 1935; Knapp 1944; Shibutani 1966). DiFonzo and Bordia (2007, p. 14) analyzed rumor communication as a means of understanding an ambiguous situation and managing a threat. In a disaster situation, information supply cannot keep pace with the sharply rising information needs. The unsatisfied needs for information trigger peoples' attempts to compensate for this discrepancy by sharing unreliable information (Hong et al. 2018).

Allport and Postman (1946) proposed a basic formula to comprehend the intensity of a rumor as follows: $R \sim i \times a$. Analyzing rumors spread during WWII, they found that two conditions were essential to explain the phenomena: the importance (i) of the message and the ambiguity (a) of the situation. The formula envisions that the number of rumors increases by multiplying i and a. They emphasized that the relationship between these two conditions is not additive but multiplicative, that is, if either condition is not met, no rumor emerges. In addition, as carefully noted by Allport and Postman (1947), not every individual spreads the rumor when these two conditions are met. Therefore, extending the basic formula of rumormongering, Chorus (1953) inserted individual critical sense (c) into the formula as follows: $R \sim i \times a \times I/c$. Here, c refers to the individual characteristic to reflect, consider, and morally criticize a rumor. I stands for the general average of c. He states rumor dissemination reduces or stopped if c increases and that the influence of individual characteristic can be negligible if c equals to I. Further studies have empirically demonstrated that along with importance and ambiguity, anxiety and accuracy are also associated with rumor propagation (Anthony 1973; Rosnow 1980; Walker and Beckerle 1987).

8.4.3 Roles and Networks

In the collective process of rumor circulation by a crowd, there are different levels of involvement by individuals. For example, Shibutani (1966) distinguished them into a *messenger* who brings related information to a group, an *interpreter* who evaluates the information, a *skeptic* who doubts it, a *protagonist/agitato*r who supports one side over the others when several interpretations are possible, an *auditor* who is a bystander, and a *decision-maker* who assesses the information and decides further actions. The emerging social–technological environments highlight another role: a *transmitter*. A *transmitter* is a person who is involved in the transmission of rumors but not in the direct generation, evaluation, or modification of the content of the

rumor. This person just receives information from someone and reposts or forwards it to others.

Normally, the social media environment is different in three perspectives from the traditional environment in which rumors spread from person to person: speed, impact, and anonymity. First, rumors spread digitally through social–technological environment and can be instantaneously circulated worldwide. Second, rumors can be transmitted from one person to thousands of others by just a single click. This impact is further magnified when the person is a social media influencer, who has access to, and is persuasive to a large number of followers. The third characteristic is anonymity. Some users interact on social media networks with their real names, but others do so anonymously by using nicknames or false names. Even if a person uses his/her real name, other attributes such as age and location are often implicit. Third, social media allows a person to have several social media accounts or usernames for different purposes. These characteristics create further complexity in understanding the social influence of a rumor.

In addition, social media technologies have made it easier than before to analyze to a greater extent the manner of propagation of a rumor, that is, metadata allow us to identify where the rumor originated, how many times the rumor was transmitted, and by how many users to how many other users. These phenomena are called a *cascade*, which is the successive transmission of information (Sunstein 2009). A recent study, which analyzed approximately 126,000 rumor cascades tweeted or retweeted more than 4.5 million times, demonstrated that false rumors spread significantly further (i.e., more hops from the original message), faster, and are more widespread (i.e., rapidly reach more people) than true information (Vosoughi et al. 2018). False rumor propagation can cause *group polarization*, which induces social group members to take a wrong course of action. Another network analysis of false rumors supports this possibility. Choi et al. (2020) demonstrated that false rumors tended to propagate in an *echo chamber network*. In echo chambers that were operationally defined in the study as a cluster in which members share at least two common false rumors, the transmission of false rumors was faster when compared to transmission by non-members of an echo chamber. However, we note that these analyses were performed using Twitter meta-information, and it is questionable how generalizable the results are with respect to other social media environments and to specific rumors spreading during disaster situations. Recent advances in network analysis are beneficial for a general understanding of rumor propagation and eventually could facilitate better rumor control.

8.5 Rumor Control as Disaster Management

Anyone who uses social media is at risk of being affected by false rumors and being involved in their propagation. Rumors spread through social media have become a matter of public concern due to their influence on the community, especially during a disaster, and consequently have become an interdisciplinary research topic. This

section will consider three approaches to mitigate the negative impacts of rumors: educational, technological, and psychological approaches. These three approaches have different backgrounds with varying methodologies. However, given the wide-ranging implications of rumors on society, it is important to consider these approaches as mutually complementary and to identify methods to integrate them so as to assist in rumor management, especially during a disaster.

8.5.1 Educational Approach

Chorus (1953) focused on the critical thinking abilities of individuals and assumed that as critical thinking grows, rumor propagation would weaken. A widely accepted definition of critical thinking is "*reasonable reflective thinking focused on deciding what to believe or do*" (Ennis 1996). Critical thinking consists of two components: ability (e.g., to analyze arguments, ask and answer clarification questions, judge the credibility of a source, understand and use graphs and mathematics, and deal with fallacy labels) and disposition (e.g., to seek and offer clear reasons, be alert for alternatives, withhold judgment when the evidence and reasons are insufficient) (Ennis 2015). These components are indispensable for differentiating reliable information from false information. In the current information society, anyone can take the role of information gatekeeper. Given the fact that even children can be involved in rumor transmission through social media, teaching critical thinking to students should be an essential component of the curriculum at all educational levels. Numerous education-related studies have proposed enhancements to teaching methods (Marin and Halpern 2011; Hitchcock 2015), assessments of ability and disposition (Watson and Glaser 1980; Facione et al. 2001), and explanations for developmental and cognitive mechanisms of critical thinking (Brabeck 1983; Marin and Halpern 2011). In the case of disaster, it is also helpful to have metacognitive knowledge in advance, such as "rumors tend to emerge during a disaster" or "people tend to share false rumors without confirming their reliability." Understanding the human tendency of trying to understand an "ambiguous situation" will help children to prepare for a disaster situation, and encourage them to use their best thinking skills and disposition especially during such crises.

8.5.2 Technological Approach

Perhaps, the ultimate goal should be that every user is able to critically assess any information on social media at all times. However, in reality, human cognitive resources (e.g., memory, time, mental effort) are limited to consciously examine each piece of information. Particularly, as critical thinking is an effortful cognitive process (Halpern 2014), people who are victims of a disaster cannot afford to check the veracity of every scrap of information. Instead, certain forms of support that

counterbalance the limited individual cognitive resources are required. Further in-depth studies regarding rumor detection are one way to contribute to this issue (Han and Ciravegna 2019). If it is possible to computationally detect rumors on social media, especially in disastrous situations, that are highly likely to be false, it would help reduce wastage, and more efficiently allocate human resources.

There are two main approaches to research with regard to rumor detection. One approach focuses on the contents of messages. Based on an assumption that a rumor tends to be followed by countering-posts, it utilizes countering messages as an indicator to detect rumors. For instance, a potentially false rumor is traced back using countering-posts that are identified with specific expressions (e.g., "is (that | this | it) true," "real? | really? | unconfirmed," "(that | this | it) is not true," "see the list of the earthquake related false rumors http://…") as signals (Miyabe et al. 2014; Zhao et al. 2015). However, social media messages include fluctuations in text (e.g., abbreviations, emoticons, slang expressions) and multimodal contents (e.g., text, video, photo, image, URL). Moreover, not all false rumors evoke countering messages. A rumor may be followed by only supportive comments at a certain point in time, that is, the rumor will spread as if it was true until countering messages appear. This period is crucial for rumor control during disasters because disaster management requires rapid decision making. Thus, taking into consideration these possibilities, the other approach focuses on the context of messages, instead of the contents. Recent studies have developed computational models to detect rumors and revealed specific network patterns of false information diffusion on social media (Mondal et al. 2018; Rosenfeld et al. 2020). When the above-mentioned systems are implemented, they will mitigate the negative impacts of false rumors during disasters on society during any future disasters.

8.5.3 Psychological Approach

Numerous psychological studies have endeavored to understand the psychological mechanisms behind rumor spreading behavior and to develop strategies of minimizing its negative impacts on society. The experimental results have demonstrated consistently the effectiveness of exposure to countering-messaging that denies, refutes, corrects, inquires, or criticizes the rumor: Exposure to countering-message reduced both beliefs in the rumor (Jaeger et al. 1980; Iyer and Debevec 1991; Einwiller and Kamins 2008; Garrett 2011), as well as the anxiety created by the rumor (Bordia et al. 2005; Tanaka et al. 2014). In a real-life disaster situation, numerous attempts to combat false rumors by showing countering-messages have been demonstrated. As an illustration, here are some false rumors and the corresponding countering-messages that were posted on social media during the 2011 Japan earthquake: "Tokyo Electric Power Co.'s workers ran and left. They were drinking in another city." (false rumor) and "Tokyo Electric Power Co. announced that the workers were found dead" (countering-message); "Chubu, Kansai, and Kyusyu Electric Power companies are beginning to transfer electricity to Kanto. Please

cooperate!" (false rumor) and "Transfer is impossible because of the differences in frequencies" (countering-message). The attempt to mitigate a false rumor by correction is usually done by authorized organizations officially (e.g., government offices, public institutions, mass media). For instance, the Federal Emergency Management Agency (FEMA) implemented rumor control by creating a web page that shows a list of rumors and the corresponding corrections during Hurricane Michael (FEMA 2018). Additionally, attempts are also made by social media users collectively and voluntarily (Arif et al. 2017). Empirically, an experimental study was conducted after the 2011 Japan earthquake, utilizing the rumors and countering-messages spread during the disaster as stimuli. The results demonstrated that exposure to countering-messages about the rumors increased the proportion of users who intended to stop transmitting it to others from 32.1 to 49.3%, with subjective decrease in the anxiety, accuracy, and importance of the rumor (Tanaka et al. 2014). Furthermore, a meta-analysis revealed that detailed countering-messages had stronger effects on weakening belief in rumors (Chan et al. 2017). For this purpose, effective strategies were proposed to influence individuals at the cognitive and emotional process level to curb the propagation of mis-information (Lewandowsky et al. 2012).

8.5.4 Outstanding Issues

Ultimately, from the perspective of efficient disaster information management, we envisage a society that promotes long-term critical thinking education and builds the foundation of citizens who examine information deliberately and take decisive action in preparation for future disasters. When a disaster occurs, the computational technologies would screen rapidly and comprehensively for potential false information on social media and prioritize the falsehood. Then, experts would examine the high priority potential false information and its negative implications on society in detail. If the information is confirmed to be false and having negative implications, official organizations (e.g., governments, ministries) make an announcement with corrections, to citizens through widely spreading information channels (e.g., websites, social media, mass media), mitigating unnecessary anxiety and false belief.

However, even if the society became cognizant, some outstanding issues that need to be addressed remain. First, although the countering strategy is effective at weakening psychological reactions to false rumors, in general, a question remains about the extent to which the strategy is effective in combating false rumors. For example, as the above-mentioned result showed (Tanaka et al. 2014), 50.7% of people still intended to transmit false rumors even after exposure to countering-messages. This was on account of their unchanged high anxiety about, and belief in, the false rumors. Another past study consistently demonstrated that countering strategy decreased pre-belief in a false rumor by 30% on average, although the post-belief was positive, if anything, against the rumor (Bordia et al. 2005). Chan et al. (2017) named this tendency as "misinformation-persistence effect" and argued that countering-message exposure tends to be less effective unless it provides new and detailed information.

In reality, human behavior that supports the results of these laboratory experiments can be observed. For example, a false rumor "toilet paper will run out due to coronavirus" spread at the end of February 2020, causing people to stockpile it across Japan. A paper manufacturing company immediately denied it by explaining that abundant stock was available. Mass media and experts repeatedly stated that it was a false rumor and called for deliberative behavior by consumers. However, people kept lining up before a store opened. In an interview, a housewife who was waiting in the line stated that though she knew that the rumor was false, the possibility of short supply made her anxious (Shimbun 2020).

As this case clearly shows, human behavior is not so straightforward, as people can be easily persuaded by simple exposure to countering information. In a natural disaster, though a government calls on residents in potentially affected areas to evacuate early, some residents remain at home for many reasons and fail to get out in time. In an epidemic, despite being asked to stay self-isolated when exhibiting symptoms of being positive for a serious virus, people still go out to restaurants, gyms, or concerts and end up spreading the virus to others. Such human behaviors could cause negative impacts on the society and hinder disaster recovery, however, this is not due to the unavailability of appropriate information. In reality, of late, social media and mass media tend to provide early warning messages ahead of disasters, so that important information reaches the smartphone in our hand. Nonetheless, such important information is as good as being nonexistent unless end users process and integrate it into their consciousness. In this process, there are many factors that mediate human behavior such as the information source, personal interest, quality (Bordia et al. 2005; Einwiller and Kamins 2008), backfire effect of countering-message (Lewandowsky et al. 2012), and cognitive biases and heuristics (e.g., confirmation bias) that can influence the interaction of the user based on the design of the communicating technology (Metzger and Flanagin 2013).

8.6 Concluding Remarks

Information is important for efficient disaster management. Reliable information is needed not only for experts but also citizens to cope together with severe disasters. The present chapter has tried to summarize the potential role of social media in information sharing during disasters. Social media is promising for sharing disaster-related information rapidly and widely and enabling mutual help among citizens. On the other hand, this chapter also emphasized the repercussion of social media when it is used as a rumor mill. However, the negative impacts of social media during the past disasters might have contributed to clarifying the issue of rumor propagation because social media platforms allow users to reflect later whether or not, and how, they were involved in rumor transmission. The digital platforms enable researchers to demonstrate rumor propagation and to raise an alarm at disaster-related human behavior based on empirical evidences. Rumor will emerge again in the next disaster.

We still have much to learn from interdisciplinary research into utilizing social media during disasters.

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