Spreading Word: A Behavioral Theory of Online Message Retransmission in a Crisis

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Abstract

People’s ability of crisis response is affected by the information they got. In recent years, the explosion of information technology and the Internet makes online message retransmission prevalent in crisis. Because of the convenience of online message retransmission, spreading word is more feasible in online context for crisis management. However, the rapid and widespread propagation of misinformation online can be very destabilizing after a crisis, and controlling their retransmission online becomes even more challenging. Due to both opportunities and challenges brought by new information technologies in crisis, research explaining online message retransmission is becoming critical to crisis response. In this paper, we propose a behavioral theory of online message retransmission in crisis, including a process theory and a variance theory, in hopes of answering the following research question: how and why do message receivers retransmit a message online in crisis? We hope we contribute to online crisis communication, online information diffusion research and rumor theory literatures. Practically, our theory can inform online communication systems design, and has implications for different stakeholders involved in crisis management.

Keywords: Message retransmission, Crisis management, Online communication, Crisis communication
1. Introduction

A crisis, such as a major technical failure or natural disaster is “a specific, unexpected, non-routine event or series of events that creates high levels of uncertainty and a significant or perceived threat to high priority goals” (Sellnow & Seeger 2013). The new millennium has witnessed many crises, from climatic events such as floods, earthquakes, and fire, to ecological disasters such as biohazards and pandemics, to intentional acts like shooting and terrorism (Ping et al. 2011). To date, IS researchers have rarely studied crises, but there have been increasing calls for us to do so (Majchrzak et al., 2007; Pan et al., 2012).

Crises are a very relevant topic for IS researchers because the rapid distribution of high-quality information is critical for effective crisis management (Pan et al., 2012). If residents in a crisis cannot access high-quality information, they may feel unable to act, desperate, or even “kept in the dark” (ABC News, 2014). The right information needs to be spread as quickly as possible to improve consensual understanding and restore order (Brashers 2001; Hale et al., 2005; Pan et al., 2012).

In this paper, we propose a theory to explain how and why word spreads in a crisis. We focus on message retransmission: the act of relaying a received message on to others. Message retransmission is the basic mechanism of spreading word. It is an age-old behavior, symbolized in ideas such as the grapevine and the rumor mill. As we will show, message retransmission has not received much attention in the literature, and the theories that have been proposed for it are quite limited, especially in the context of crises. This is perfectly understandable because only quite recently has technology evolved to allow rapid, large-scale message retransmission and so only recently has it become an important phenomenon. With the emergence of online networks such as Twitter, Weibo, and Facebook, message retransmission has now exploded (Cheng et al., 2011). People can spread word (retweeting, sharing, and forwarding) faster and more broadly than ever. Depending on the messages
retransmitted, such behavior could prove helpful or destabilizing (Kane, 2010). As a result, there is great interest among crisis managers in understanding message retransmission behavior (Pan et al., 2012).

Currently, two bodies of work provide insights into online message retransmission. First, researchers studying the diffusion of information across online social networks and virtual communities have identified characteristics of messages that influence how word spreads (e.g., Kwak et al., 2010, Clemons et al. 2011). While most of these studies have been exploratory rather than theory-driven, many have used Roger’s (1983) diffusion of innovation theory as a metaphor or inspiration to explain diffusion (e.g. Gruhl et al. 2004). The second body of work stems from rumor theory, which focuses on the beliefs or attitudes that trigger individuals to spread rumors (Rosnow 1991). Rumor theory has a long tradition of explaining how and why people spread rumors in interpersonal situations, and Oh et al. (2013) recently showed how it could help explain how rumors spread online in a crisis.

Both of these bodies of work provide useful perspectives because a full understanding of online message retransmission requires attention to both message characteristics and recipients’ beliefs and attitudes (Sproull and Kiesler 1986). However, neither one is ideally suited to explaining message retransmission in a crisis. Research inspired by innovation diffusion theory implicitly assumes that recipients are adopting messages (Rogers 1998), but we will show that this will often not be the case in a crisis. Likewise, research using rumor theory focuses on uncertain situations (Rosnow 1991). This is relevant for the early stages of a crisis, but less so for later stages when certainty begins to return. We draw on both bodies of work and show how they can be adapted to suit the characteristics of crisis situations.

Our research question is: how and why do message receivers retransmit a message online in a crisis? To answer the how question, we propose a process theoretical model that clarifies key steps of message retransmission in a crisis. To answer the why question, we propose a
variance theoretical model that explains how message cues affect recipients’ perceptions which, in turn, drive message retransmission behavior.

Our study’s scope is set by the following considerations. First, we study message retransmission only, not the process of generating or transmitting a new message. Second, we focus on the response stage after a crisis has occurred. Message retransmission in other times (such as crisis prevention contexts) may require a different theory. Third, we focus on online contexts only. Thus, we examine message cues that can be conveyed online but not those that are conveyed only in face-to-face situations (Gunawardena 1995).

We intend our paper to make the following contributions. For researchers interested in message diffusion, we clarify the message retransmission process and explain what triggers retransmission at each stage. For researchers interested in rumor theory, we show how the theory can be extended to include relevant antecedents (message cues) and contexts (both certain and uncertain). More broadly, our work offers opportunities and new insights for research on online crisis communication and design science. Practically, our theory can inform online communication systems design and offer useful insights for stakeholders (such as public relations officials and emergency response teams) involved in crisis management.

The paper proceeds as follows. We first briefly review related research on information diffusion and rumor theory. We then propose our theory of online message retransmission, including a process and a variance theory, followed by two illustrations. Finally, we conclude the paper with contributions, agenda for future research, and practical implications.

2. Background

In this paper, retransmission means that a person who receives a message passes it on to another person. That is, if person B receives a message from person A, then, if person B passes this on to person C we say that person B “retransmitted” it (Stephen et al., 2010). This paper focuses on the behaviors of person B: the message receiver/potential re-transmitter.

We identified two main bodies of research that could inform theories of online message
retransmission in a crisis: a broad category of work on information diffusion and a more-focused body of work on rumor theory. We discuss each area below along with the issues that we had to address to use them to study message retransmission in a crisis.

2.1. Information Diffusion

When we initially searched for papers on message retransmission, many of the initial papers we found were from non-IS researchers studying how messages diffuse across social networks. Such researchers often use Roger’s (1983, 2003) diffusion of innovation (DOI) theory as a metaphor or inspiration, assuming that the spread of information through a social network can be viewed as the propagation of an innovation through a network (Gruhl et al. 2004). In such work, researchers tend to view retransmission as the basic mechanism driving diffusion (Kwak et al., 2010; Stieglitz & Dang-Xuan, 2013) and they build formal models to explain or simulate how messages diffuse, depending on the network’s structure (Kwak et al., 2010), e.g., its centrality (Canright & Engo-Mosen, 2006), density (Lerman & Ghosh, 2010), or strength of ties (Bakshy et al., 2009). Widely-used diffusion models in this tradition include the Threshold Model (Granovetter, 1978), Cascade Model (Goldenberg et al. 2001), and Susceptible Infected Susceptible Model (Murray, 1993). Many extensions have also been developed (e.g., Pastor-Satorras & Vespignani 2001; Kempe et al. 2003). Another line of work in this tradition has examined message-level features that encourage diffusion, such as emotional content (Berger & Milkman, 2010; Stieglitz & Dang-Xuan, 2013), topics (Cheng et al. 2011), and URLs and hashtags (Suh et al., 2011; Romero et al., 2011).

Although most of this work lies outside of the IS discipline, we were able to find instances of it within our discipline too. Specifically, we searched the AIS “Basket of Eight” journals (EJIS, ISJ, ISR, JAIS, JIT, JMIS, JSIS, and MISQ) over the last 10 years for papers studying “information diffusion” and “message retransmission” and found seven papers, listed in Appendix A. These seven papers can be roughly divided into the same two streams noted
above, most of them focused on social network features (e.g., nodes and paths) (e.g., Hinz & Spann 2008; Shi & Whinston 2014) with a smaller subset focused on message content (Cheng et al. 2011; Stieglitz & Dang-Xuan 2013). Only two of these papers, however, examined information diffusion in a crisis (Cheng et al. 2011; Pan et al. 2012).

Overall, when we examined research on information diffusion from outside and inside the IS field, we noted two issues that would need to be addressed if this work is to help explain message retransmission behavior in a crisis. We discuss each one, in turn, below.

2.1.1. **Difference in the Phenomenon Studied**

Most research on information diffusion has been exploratory in nature. Although Roger’s DOI theory is often used as inspiration in such work, its assumptions are typically not discussed or examined. In particular, it is important to recognize that in DOI theory, diffusion implies adoption, i.e., the diffusion of an innovation across a community reflects its adoption by individuals in that community (Rogers 1983, 2003). As a result, research motivated by DOI theory inevitably has to equate message adoption with retransmission, but to the best of our knowledge, no studies have acknowledged this to date. Even the most widely used message diffusion models, such as the Threshold Model (Granovetter, 1978), Cascade Model (Goldenberg et al. 2001), and Susceptible Infected Susceptible Model (Murray, 1993), only simulate the chance that a message receiver will adopt a message, not send it on. However, in reality, not all message receivers can or will retransmit a message after adoption (Wu et al. 2004). Moreover, message receivers may retransmit a message in a crisis without adopting it, e.g., if they believe it is potentially important to send on and they do not have time to consider it deeply (Brashers 2001). As a result, the phenomenon studied in information diffusion research is not quite the same as the phenomenon we need to address. Information diffusion research inherently assumes a focus on adoption, but we need a broader scope.

2.1.2. **Limited Explanation**
Another issue with research on information diffusion is that it can only provide a limited explanation of message retransmission. Although information diffusion models purport to explain a human phenomenon – why people retransmit messages – they do so without looking at the human perceptions (beliefs/attitudes) involved. They leave these mediating psychological aspects aside and focus on observable antecedents (structural features of the network and characteristics of messages) and outcomes (patterns of diffusion). While this approach offers parsimony and simplicity, it cannot fully explain message retransmission behavior. An approach is needed that considers the human psychological process as well.

2.2. Rumor theory

Rumors are a type of message (Berenson, 1952) often communicated when events are unstable, capricious or problematical (Rosnow 1988). Rumor theory was developed in social psychology to explain the propagation of rumors after an extreme crisis, World War II (Allport & Postman, 1946). Oh et al. (2013) recently introduced it to IS in their study of “rumor causing” (p. 407) factors on Twitter during social crises.

Rumor theory is a useful theory to draw on because it explains behavioral factors (e.g., anxiety and uncertainty) that are important in a crisis. Because rumors occur in almost every crisis (Prasad, 1950; Larsen, 1954), many studies have examined how and why rumors spread in such contexts (e.g., Larsen, 1954; Ma 2008; Oh et al. 2013). Rumor theory also appears complementary to the information diffusion literature in that it covers the psychological or behavioral factors that trigger individuals to communicate messages to others.

Although rumor theory was originally developed in the 1940’s, we found hardly any studies using it in IS journals other than Oh et al. (2013). To better understand the theory and past use of it, we conducted a detailed search (using Google Scholar) of past work using it. By reviewing the most-cited research on rumor theory published from 1946-2014 (see Appendix B for details), we found that four variables (uncertainty, anxiety, credulity, and
importance) were emphasized the most.

Uncertainty or ambiguity (Rosnow, 1991) refers to “a lack of secure standards of evidence” (Allport & Postman, 1947). When evidence is not available from formal channels, such as in news media and official sources, people compensate by developing and communicating their informal interpretation of the situation (Shibutani 1966). If individuals know the truth of an event, they lend no ear to rumor (Rosnow 1991).

Anxiety is the emotional, negative state of tension and apprehension about an impending, negative outcome (Norris & Murrell, 1988; Rosnow, 1980), which is the common negative mental health effect of exposure to crisis (Reijneveld et al., 2003). Rumors are more likely to be told and believed during crises (Kimmel & Keefer, 1991), because rumor mongering can soothe individuals’ tensions and relieve anxiety (Rosnow, 1988).

Importance refers to the caring or involvement evoked by a situation (Allport & Postman, 1947; Rosnow 1991). Rumors fly thick and fast when importance is high, such as in a disaster (Goode & Ben-Yehuda 1994). In such cases, people feel impelled to communicate; if they do not know the truth, they just improvise it (Bordia & DiFonzo, 2002).

Credulity, or a willingness to believe, refers to a tendency to not be questioning and skeptical about the truth of a message (Buckner, 1965). A critical mindset is the enemy of rumor, while credulity is a friend (Goode & Ben-Yehuda 1994). Rumors must seem at least partially true. If a rumor is not believable, it tends to be dead-ended rather than passed on.

Although rumor theory is a useful theoretical foundation for our paper, there are two issues need to be addressed that mirror those noted in our discussion of the information diffusion literature. We address each of these in turn below.

2.2.1. Difference in the Phenomenon Studied

Rumor theory was developed to explain situations full of uncertainty and doubt (Rosnow 1991). The theory’s basic premise is that rumor is generated and spread in highly
uncertain situations because individuals feel impelled to communicate even though they do not know the truth (Rosnow 1991). This is very relevant for the early stage of a crisis when there is great uncertainty (Comfort et al., 2004; Zook et al., 2010). However, uncertainty tends to decrease overtime in a crisis, as more evidence is released. Perceptions of uncertainty also differ among different stakeholders, e.g., between journalists witnessing first-hand evidence of a disaster compared to members of the public without such knowledge. In short, rumor theory appears to have less relevance for more-certain situations because there is less need in such cases to improvise truth. Thus, we need a theory that can go beyond rumor theory and address situations of high perceived uncertainty or low perceived uncertainty.

2.2.2. Limited Explanation

Much like the information diffusion literature, rumor theory can only provide a limited account of online message retransmission in a crisis. While the four factors in rumor theory account for the psychological perceptions that drive message retransmission, they leave aside environmental features, such as message-level characteristics. Few rumor-theoretic studies have examined environmental factors such as message cues even though information diffusion research has highlighted their importance (Stephen et al., 2010). Understanding the effects of message cues is essential because it can help us predict whether particular messages are likely to be retransmitted in a crisis. Current research on rumor theory is unable to support such work without changing its fundamental assumptions about the context being studied.

2.3. Summary and Solutions

Table 1 summarizes the issues we have noted with these two bodies of work and how we address them by proposing two new theoretical models: a process model and a variance model. As Mohr (1982) noted, process models explain outcomes in terms of a sequence of stages or steps, whereas variance models explain outcomes in terms of covariation among variables. The two types of models are complementary (Pare et al. 2008, Liang and Xue
2009), allowing us to address more fully the ‘how’ and ‘why’ aspects of our research question.

### Table 1 Issues in Prior Literature and Our Solutions

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<th>Issue</th>
<th>Body of literature</th>
<th>Solution in Proposed Theoretical Models</th>
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<td><strong>Scope of phenomenon studied</strong></td>
<td><strong>Information diffusion:</strong>&lt;br&gt;- This literature implicitly equates retransmission with adoption but message receivers may retransmit messages without adopting them.</td>
<td><strong>Process model:</strong>&lt;br&gt;- Distinguish between adoption and retransmission.&lt;br&gt;<strong>Variance model:</strong>&lt;br&gt;- Identify and explain factors related to adoption and retransmission respectively.</td>
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<td></td>
<td><strong>Rumor theory:</strong>&lt;br&gt;- This literature assumes that the situation is highly uncertain, but we need a model that can account for both highly uncertain and less uncertain cases.</td>
<td><strong>Process model:</strong>&lt;br&gt;- Explain the role of uncertainty in the message retransmission process.&lt;br&gt;<strong>Variance model:</strong>&lt;br&gt;- Explain how perceived uncertainty affects message retransmission and moderates other influences.</td>
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<td><strong>Limited explanation offered</strong></td>
<td><strong>Information diffusion:</strong>&lt;br&gt;- This literature fails to consider psychological/behavioral factors.</td>
<td><strong>Variance model:</strong>&lt;br&gt;- Identify relevant behavioral factors mediating the effects of message cues on retransmission.</td>
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<td></td>
<td><strong>Rumor theory:</strong>&lt;br&gt;- This literature largely fails to consider external factors such as message cues.</td>
<td><strong>Variance model:</strong>&lt;br&gt;- Identify message cues that can be conveyed in online communication systems as predictors.&lt;br&gt;- Extend behavioral variables in rumor theory to reflect perceptions related to these message cues.</td>
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Sproull and Kiesler (1986)’s information exchange framework provides an overarching foundation for the structure and content of our models. Their framework explains how environmental cues shape individuals’ perceptions which in turn drive behaviors. Thus, we needed to consider both environmental factors (such as message cues), as in the information diffusion literature, and individual perceptions, as in the rumor theory literature. Their framework also highlights the importance of the context being studied, which in our case involves accounting for the moderating role of perceived uncertainty. Finally, because message adoption and message retransmission are distinct behaviors, their framework also motivates us to consider the message cues and individual perceptions relevant for each one.

We begin our theory development by proposing a process model of online message retransmission that distinguishes between adoption and retransmission and highlights the role of uncertainty in determining the choice of behaviors. We then propose a variance model to
clarify factors related to adoption and retransmission, and how their effects vary depending on individuals’ perceptions of uncertainty. Overall, by drawing upon and extending two existing bodies of work, we seek to provide a more-complete and more-contextualized account of online message retransmission behavior in a crisis.

3. A Theory of Online Message Retransmission in a Crisis

The theory presented in this paper is a Type IV theory, a theory for explaining and predicting (Gregor 2006). Our paper seeks to explain why and how message receivers retransmit a message online in crisis. To better answer the research question and address issues discussed above, we posit both a process theory view and a variance theory view.

Before introducing our theory, we first clarify the key feature (uncertainty) in crisis to guide our theory development.

3.1. Understanding Uncertainty in crisis

As our research context is crisis, before developing our theory, we need to clarify the situational features and relevant assumptions of crisis. Particularly, what uncertainty is, and how it is related to crisis.

3.1.1. Definitions of Uncertainty

The term “uncertainty” has been used both as an objective environmental variable (e.g., Tung 1979) and as a perceptual variable (e.g., Milliken, 1987) in literatures. As a variable measuring the state of environments, uncertainty can be defined as a simple lack of information (Berger and Calabrese, 1975). As a perceptual variable, uncertainty can also be defined as “an individual’s perceived inability to predict something accurately” (Milliken, 1987, p. 136) due to the lack of sufficient information (Putnam and Sorenson, 1982; Bordia et al. 2004).

In this paper, we adopt the second view of uncertainty to define uncertainty as a perceptual phenomenon instead of objective reality, because the ability to access to information may very diverse among different stakeholders involved in crisis, it is almost no
way to measure uncertainty in crisis objectively. Particularly, we define uncertainty as a mental state in which an individual perceives himself or herself to be lacking of evidences about the crisis. To differentiate the notion from objective environmental uncertainty, in this paper, we call it “perceived uncertainty” to emphasize the perceptual nature of uncertainty.

3.1.2. Uncertainty in crisis

Since what is happening in crisis disrupts the basic capacity to understand, and little available information can assist message receivers to make prediction about the possible impacts or response options, crisis is the source of uncertainty (Sellnow & Seeger, 2013).

In this paper, we take a more dynamic view of the crisis. On one hand, individual’s level of perceived uncertainty is changing overtime in crisis. Although at the very beginning stage of a crisis, the emergent situation evoke high perceived uncertainty among message receivers, uncertainty has traditionally been considered a dis-preferred state motivating people to engage in coping strategies aimed at reducing such perceptions (Berger and Bradac, 1982). Individuals or groups experiencing uncertainty, therefore, are driven to seek information in an attempt to reduce this aversive state (Kramer 1999). Consequently, verified information will be accumulated and interpreted, sensemaking processes and responses will emerge, and individuals will perceive less uncertainty overtime. In other words, although crisis begins with uncertainty, confusion or high level of stress, these negative effects will gradually dissipate and some sense of order will be reestablished.

For example, right after a fire breaks out, as it takes time for authorities to confirm the damage or causes of the fire, message receivers cannot get enough information about the current state and the potential effects of the fire, so they feel high level of uncertainty. Over time, more relief and recovery operations are handled and a relatively stable order gradually returns (Alesch, 2005; Chang, 2009). Moreover, after finishing investigations, authorities release reports about the damage and causes of the fire, which equip message receivers with
enough information, and reduce their mental uncertainty.

On the other hand, as different stakeholders involved in crisis may get access to different amount of information, their perceptions of uncertainty also differ a lot. For instance, journalists or emergency response teams have more avenues to get first-hand information than the public, e.g., they can arrive at a crisis scene and collect information directly from local stakeholders. However, for the general public, the main channel of information collection is media, so they may hardly get updated information in time. As a result, the perceived uncertainty of the public may be relatively higher than those who can involve in crisis directly.

**3.1.3. Two Modes of Thinking and Uncertainty**

As message receivers may perceive different level of uncertainty in crisis, they may adopt different means to process a received message in crisis. Generally, people may adopt two modes of thinking to process information (Sloman 1996), holistic thinking and analytic thinking. Although both modes have elements of rationality, holistic or experiential thinking is more intuitive and affective based (Slovic et al. 2004) and associated with feelings and experience, while analytic or rational thinking is relatively affect-free, analytical and rational (Epstein 1994). The two modes of thinking captures the fundamental duality of how people apprehend reality, process information and make decisions in everyday life, and a substantial body of research supports this view (e.g., Epstein et al. 1996; Zhang 2002; McElroy & Seta 2003; Slovic et al. 2004).

Although the two modes of thinking are assumed to operate in parallel and may interact with each other (Epstein 1994; Finucane et al. 2003), reliance on affect and emotion is a quicker, easier, and more efficient way to navigate in an uncertain situation (Slovic et al. 2004). In crisis, when message receivers lack enough information and perceive high level of uncertainty, it is hard for them to make a rational analysis of a received message, so they rely on holistic thinking to guide their retransmission behavior.
In addition, holistic thinking is suitable for high uncertain condition, because time compression is always associated with high uncertainty (Sellnow & Seeger 2013). Messages transmitted in uncertain situations are time-sensitive in nature. Particularly right after a crisis, there is always a pressure for immediate explanations about cause and consequences of the crisis. If a particular message could not be transmitted and retransmitted in time, it would be outdated very quickly. Previous research suggests that holistic thinking is an effective tool of making more rapid processing of information and oriented toward immediate action (Epstein et al. 1996; Slovic et al. 2004); thus, holistic thinking is particularly relevant to decide which message to retransmit when a crisis just occurs.

In contrast, the increasing evidence available makes individuals perceive less uncertainty and boosts the value of analytic thinking. When message receivers perceive less uncertainty, people are more capable of justifying a received message via logic, and making reason-oriented decision, because they can utilize information published as evidence. Moreover, in later stage after a crisis, people get more information, and at the same time they may gain a sense of relief from the negative effects and more control over their environment. In such condition, message receivers’ behaviors are less likely to be driven by emotions. Instead, their behaviors are more driven by rational thinking. Thus, analytic thinking is more dominated than holistic thinking when perceived uncertainty is high, particularly in the latter stage of a crisis.

Figure 1 summarizes the two modes of thinking and the dynamic nature of perceived uncertainty in crisis. The vertical axis represents the proportion of holistic and analytic thinking used by the message receivers. The horizontal axis is the level of perceived uncertainty of message receivers. Accordingly, when message receivers perceive high level of uncertainty, particularly right after a crisis, they adopt more holistic thinking. As more evidence becomes available, message receivers may perceive less uncertainty, so the triangle
representing the proportion of holistic thinking gets larger, which means message receivers rely more on analytic thinking. Because it is unlikely that message receivers can employ analytic thinking only without any guidance from affective in the holistic thinking (Slovic et al. 2004), the two triangles in Figure 1 indicates message retransmission involve a complex mixture of both holistic and analytic processes of thinking. That is, although analytic thinking may be dominated when perceived uncertainty is low, message receivers may still resort to their holistic thinking to a certain extent.

![Figure 1 Two Modes of Thinking in crisis](image)

**Figure 1 Two Modes of Thinking in crisis**

### 3.2. Online Message Retransmission in crisis as Process Theory

Based on the assumption message receivers may be inclined to use two different modes of thinking in terms of the level of uncertainty changes in crisis, we first propose a process theory of message retransmission, which also serves as a basis for developing a variance theory.

Past research on information diffusion on social networks uses the spread of disease or virus as a metaphor to describe steps of message retransmission (Gruhl et al., 2004; Wu et al., 2004; Stephen et al., 2010; Koren et al., 2012). The virus propagation begins when a person is exposed to the disease. Then, the person may be infected and pass the disease to others. Analogously, message receivers are exposure to content posted online first, then adopt and retransmit it to others, which are elaborated in following paragraphs. It is worth noting that the process of message retransmission is more complex than virus diffusion (Wu et al. 2004). Particularly, in uncertain situations, the perceived uncertainty may affect their choices of steps
in the process of message retransmission, and adoption cannot be simply equal to retransmission.

Figure 2 depicts the process model of online message retransmission in crisis. Consistent with prior literatures on information diffusion, the first step of message retransmission is exposure. That is, message receivers need to be exposed to a message, particularly cues in a message. For instance, individuals can open a website, login their Twitter account, or open their email box to be exposed to a message. The exposure step is also consistent with Sproull and Kiesler (1986)’s information exchange framework, because in information exchange framework, exposure to environmental cues precedes communicators’ perceptions and behaviors. All of message receivers being exposed to a message are potential adopter and retransmitter of the message.

**Figure 2 Process Theory View**

The second step of message retransmission is adoption. To better understand this step, we need to define message adoption first. Because the process of message retransmission can
somewhat connect with diffusion of innovations (Romero et al. 2011), to define message adoption, we refer to the definition of adoption in the diffusion of innovation theory (Rogers 1962). Rogers (1962) defines the adoption process in innovations diffusion as "the mental process an individual passes from first hearing about an innovation to final adoption". Innovation adoption contains four major stages: knowledge, persuasion, decision, and implementation (Brancheau & Wetherbe 1990). The first three stages involve information gathering and attitude formation leading to the adoption decision; the fourth stage involves activities for putting the innovation to work. Different from innovation adoption, although message receivers can be persuaded and decide to adopt a message, they may not retransmit it (Stephen et al. 2010), since their contacts may not be interested in the message (Wu et al. 2004). Thus, the implementation step – retransmission – should be treated as a separate step in the whole process of message retransmission and be excluded in the definition of message adoption. As a result, we finally define message adoption as the mental process an individual passes from first exposure to a message, to being persuaded by a message (adopt it).

Sproull and Kiesler (1986)'s information exchange framework suggests that individuals’ perceptions and attitudes precede behavior, so in our process theory, message adoption is the formation of attitude towards the persuasiveness of a message. If a message receiver has a positive feeling about the persuasiveness of a message, he or she can pass from exposure to a message to the second step – message adoption. However, as shown in Figure 2, if message receivers feel negative about the persuasiveness of a message, they will not retransmit it.

**Proposition 1:** Message receivers adopt a message if they form positive attitudes towards the persuasiveness of a message.

Message retransmission is the final implementation step after adoption. Based on previous literatures (Koren et al. 2012) and the above definition adoption, we define message retransmission as the process an individual passes from first exposure to a message to a
decision to pass it on to others (retransmit it).

Because individuals’ attitudes precede their behavior (Sproull and Kiesler 1986), in our process theory, we posit that message retransmission is the formation of attitude towards retransmitting a message. As shown in figure 2, if message receivers feel negative about retransmission, they will not retransmit it, but if their feelings are positive they will pass through the third stage (retransmit a message). For example, if message receivers’ contacts or their potential audiences are also interested in the message they may form a positive feeling of retransmission, and subsequently retransmit it (Wu et al., 2004). On Twitter, message receivers can retransmit a message by clicking the “retweeting” button; in Email, people can click “forward” button to resend a message to their contacts.

**Proposition 2:** Message receivers retransmit a message if they form positive attitudes towards retransmission.

Given the level of uncertainty experienced by different individuals or in different time periods may be diverse, message receivers may resort to two different modes of thinking to process a received message in crisis. When message receivers perceive lower level of uncertainty, they are more likely to resort to their analytic thinking to process a received message. As attitude towards persuasiveness is a key element in message adoption, which requires reason-oriented, logical and analytic thinking (Peng, K & Nisbett 1999), we argue that message receivers are capable of using their analytic thinking to evaluate the persuasiveness of a message when the perceived uncertainty is low. To be more specific, in the latter stage of a crisis, available information about a crisis has been accumulated, people can utilize these evidences to help them rationally judge whether a message is persuasive or not. On the other hand, in the latter stage of a crisis, retransmitting message is not so time-sensitive, so message receivers have enough time to collect evidences from different channels to help them logically decide whether to adopt a message or not using their analytic thinking.
**Proposition 3a:** Message receivers adopt a message before deciding whether to retransmit it or not if they perceive low level of uncertainty in crisis.

However, in the earlier stage of a crisis, there is lack of enough information available, and people perceive higher level of uncertainty. As affective responses are always associated with uncertainty (Brashers 2001), message receivers are more likely to be influenced by their negative moods and behave based on their intuitions and emotions; that is, to decide whether to retransmit using their holistic thinking. In the earlier stage, since information about current states, causes or potential consequences about the change is still unavailable or unclear, it is difficult for message receivers to evaluate persuasiveness of a particular message by analytic thinking. Moreover, time compression is salient in the early stage (Sellnow & Seeger, 2013), so message receivers need to decide whether to retransmit a message immediately in case the message become outdated. Analytic thinking that is necessary in message adoption step requires message receivers to take time to collect evidences and make logical judgments (Epstein, 1994). Holistic thinking, instead, is quicker, easier, and more effective (Epstein et al. 1996; Slovic et al. 2004) for them to form the attitude towards retransmission without fully adopting or being persuaded by a particular message. Thus, we argue when message receivers perceive higher level of uncertainty, they may form their attitude towards retransmission directly based on their holistic judgments without adopt or fully adopt a message in crisis.

**Proposition 3b:** Message receivers do not necessarily adopt a message before deciding whether to retransmit it or not if they perceive high level of uncertainty in crisis.

Although we propose that there are two routes in the process of message retransmission in crisis, we still have to say that the two routes are not totally independent. Figure 3 indicates that theoretically message receivers may skip step 2 and retransmit a message directly. However, in reality, even in the earlier stage where the available information is limited, some of messages may still seem more persuasive than other messages, although message receivers
may not be sure of it since they are lack of enough evidences. Thus, even though people rely more on their intuition and emotions to guide their behavior in the early stage, their intuitions and emotions may still be influenced by the persuasiveness of a message (Schwarz & Bless 1991). Our theory is just to show that the adoption step is relatively more relevant when the perceived uncertainty of message receivers is low than when the perceived uncertainty is high.

3.3. **Online Message Retransmission in crisis as Variance Theory**

The above process-oriented view delineates clearly how message receivers dynamically engage in message retransmission in crisis. Understanding the process is only the first step to understand online message retransmission. To better facilitate controlling message retransmission, we need to identify key influencing factors of this process. Thus, based on rumor theory, we further propose a variance theory of online message retransmission in crisis, in which we identify a set of key variables (message cues and behavioral factors) and their relationships to explain why people retransmit a message in crisis.

Figure 3 summarizes the variance theory. In general, the variance theory is consistent with the past information exchange framework (Sproull and Kiesler 1986) – a basic framework explaining how cues conveyed through communication media affect perceptual variables and then influence communication behavior. Motivated by the information diffusion literatures, we focus on message cues. As information exchange framework (Sproull and Kiesler 1986) did, message cues in our theory are treated as environmental variables, and these message cues influence perceptions of message receivers, and then affect their retransmission behavior. All of perceptual variables in our model are originally drawn from rumor theory, but we extend these perceptual variables to reflect perceptions of message cues and the unique features of crisis.
The process theory introduced above suggests that the adoption step depends on the formation of attitude towards persuasiveness of a message, and the retransmission step depends on message receivers’ attitude towards retransmission. To stay consistent with the process theory, the variance theory needs to take into considerations of both factors reflecting attitude towards persuasiveness of a message and factors reflecting attitude towards retransmission. As shown in Figure 3, the variance theory contains three perceptual factors. Among them, perceived persuasiveness of a message represents attitude towards persuasiveness of a message, and explains the adoption step in the process theory. Anxiety and perceived importance of retransmission represents attitudes towards retransmission and explain the retransmission step in the process theory.

In the process theory, the perceived uncertainty determine the routes of message retransmission. In the variance theory, perceived uncertainty also occupies a very important and special position in the whole framework. As mentioned earlier, perceived uncertainty is the perception of the availability of information in the environment, which is irrelevant to a particular received message, but it can influence other perceptual variables and the

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1 The legends in Figure 3 are consistent with information exchange framework (Sproull and Kiesler 1986).
relationships between other perceptual variables and retransmission. The following subsections define and explain the pieces of the framework in more detail.

3.3.1. Effects of Perceptions on Retransmission

In this section, we explain the origin of each variable, how we extend and define them in our model, and then how these variables affect message retransmission.

3.3.1.1. Effect of Perceived Persuasiveness of a Message

Perceived persuasiveness of a message is adapted from the factor of credulity, or a willingness to believe, in rumor theory. In rumor theory, this variable is a personality trait reflecting an individual’s tendency to be questioning and skeptical about the truth of a rumor (Goode and Ben-Yehuda 1994).

However, consistent with Sproull and Kiesler (1986)’s information exchange framework, our variance model explains effects of perceptions of message cues rather than effects of message receiver’s personality trait. Thus, adapted from a willingness to believe in rumor theory, we introduce a new variable called perceived persuasiveness of a message to reflect message receiver’s perceptions of message cues. A willingness to believe in rumor theory suggests the kernel rationality of a message (Rosnow 1991). Consistently, the perceived persuasiveness of a message in our theory reflects message receivers’ perceived rationality of a message cues. Specifically, perceived persuasiveness of a message in our theory is defined as the degree to which message receivers feel persuaded by a particular received message.

Rumor theory suggests a clearly false rumor tends to be dead-ended (not retransmitted) (Goode & Ben-Yehuda, 1994). That point indicates that messages that can be retransmitted need to have some inherent rationality, while a complete unpersuasive message cannot be retransmitted. Although right after crisis occurs, verified information may be uncovered, some of the message may still seem more persuasive than other messages, and whether a message can be retransmitted still depends on whether a message receiver finds it trustworthy (Rosnow,
1991). Even rumor or misinformation need to contain “a kernel of truth” (Rosnow 1991, p. 487) to be passed on.

**Proposition 4a:** The perceived persuasiveness of a message leads to online message retransmission in crisis.

### 3.3.1.2. Effect of Perceived Importance of Retransmission

Perceived importance of retransmission is also adapted from rumor theory. In rumor theory literatures, importance is often conceptualized as personal involvement or outcome-relevant involvement to emphasize importance for the message sender (or message retransmitter) (e.g. Rosnow 1991; Oh et al. 2013).

However, involvement or importance for the message sender/re-transmitter only presents one aspect of the importance. In crisis, importance for others is also natural and can hardly be overlooked. For example, messages about shelter, fuel, food, and medical care are important for victims in crisis (Guha-Sapir & Lechat 1986; Qu et al. 2009), and messages related to situational updates are important for public because these message can increase the public’s situational awareness, which in turn can reduce public’s uncertainty and stress (Sonnenswald & Pierce, 2000). Hence, in this paper, we theorize importance as perceived importance of retransmission, which is more general than the importance in rumor theory. Specifically, *perceived importance of retransmission* is defined as the degree to which message receivers feel retransmitting a message is important to either themselves or their potential audiences.

The perceived importance of retransmission is another antecedent leading to message retransmission. On one hand, in line with rumor theory, a message that is felt by receivers to have little or no relevance for them, or to be unimportant to them, are far less likely to be passed on (Goode & Ben-Yehuda, 1994). On the other hand, no matter whether a message receiver is directly involved in crisis or not, crisis may still make message receivers feel retransmission is important to the public or others who are relevant to the event. Sometimes, a
message re-transmitter retransmitting a message because they feel the message is important to be broadcasted a message to as many people as possible. For example, people may retransmit a situational updates in the hope of improving situational awareness among public in emergent situations (Vieweg et al., 2010). People may also retransmit a message related to donation channels, because more people can offer support to help victims in crisis (Dunkel-Schetter & Skokan, 1990), even though the message re-transmitters themselves may not be in the affected area of crisis.

**Proposition 4b**: The perceived importance of retransmission leads to online message retransmission in crisis.

### 3.3.1.3. Effect of Anxiety

Anxiety in our theory is also adapted from rumor theory. In rumor theory, anxiety reflects individuals’ personal traits and their daily emotional states (Anthony 1973). As our research phenomenon is message retransmission in crisis, we are more interested in anxiety that is aroused by crisis and received messages rather than the general psychological anxiety. Hence, adapted from rumor theory, we define *anxiety* as the emotional, negative state of tension and apprehension about a crisis.

Anxiety is an emotion that is often associated with crisis (Jett & George 2003; Sellnow & Seeger 2013). In crisis, retransmitting a message help individuals vent and express their anxious emotions regarding anticipated disappointing outcomes (Allport & Postman, 1947; Festinger, 1957; Rosnow 1991). Message retransmission can also function as a tactic of providing a sense control among anxious people who lack enough social power to control negative events (Walker and Blaine 1991). The feeling of anxiety leads to message retransmission also because anxiety involves high levels of arousal or activation (Russell & Mehrabian 1974; Barrett & Russell 1998). Arousal is a state of mobilization, which has been shown to increase action-related behavior (Berger & Milkman 2010). Given that
retransmission a message is an action, a message receiver with higher level of anxiety is more likely to retransmit a message.

*Proposition 4c: Anxiety leads to online message retransmission in crisis.*

3.3.2. Effects of Perceived Uncertainty

In this section, we explain the effects of perceived uncertainty in the variance theory (three moderating effects and one direct effect). As perceived uncertainty has been defined in detail in the earlier part of this paper, we will not repeat it again in this section.

3.3.2.1. Effect on Persuasiveness-Retransmission Relationship

First, we posit that perceived uncertainty moderates the relationship between perceived persuasiveness of a message and message retransmission (shown in Figure 4). In earlier stage of a crisis, due to the lack of relevant evidences, message receivers feel high level of uncertainty. In such condition, rationally determining the persuasiveness of a message based on analytical thinking is hard (Slovic et al. 2004), so it is hard for them to retransmit a message based on the persuasiveness of a message. In the later stage of a crisis, however, individuals perceive less uncertainty and they have more evidences to assist their analytical thinking, so they can determine retransmission behavior based on the judgments of the persuasiveness of a message. Moreover, in the later stage, there is no time pressure for immediate explanations or responses about crisis (Sellnow & Seeger 2013), message receivers can take time to evaluate the persuasiveness of a message carefully and make a reason-based determination of retransmission (Epstein 1994).

Thus, the effect of persuasiveness of a message on message retransmission is more salient and message retransmission behaviors become more sensitive to changes in perceived persuasiveness of a message in low uncertain condition than in high uncertain condition. As shown in Figure 4, the slope of the relationship between message retransmission and perceived persuasiveness of a message is steeper when perceived uncertainty is low than
when perceived uncertainty is high. Because perceived persuasiveness of a message is a factor explaining adoption, this moderating effect is consistent with the process-oriented view. That is, although message receivers may not completely skip the adoption stage, the adoption step is relatively less salient when they perceive high uncertainty.

![Figure 4](image-url.png)

**Figure 4 The Moderating Role of Perceived Uncertainty on the Relationship between Perceived Persuasiveness of a Message and Message Retransmission**

The two lines in Figure 4 cross each other. That indicates when perceived persuasiveness of a message is very low, message receivers perceiving low level of uncertainty are less likely to retransmit a message than those perceiving high level of uncertainty. Because those perceiving low level of uncertainty have more evidences, so they are more confident that the received message is not persuasive or not true. In contrast, when perceived persuasiveness of a message is very high, message receivers perceiving low level of uncertainty are more likely to retransmit a message, because they have more evidences to verify a message, are more confident that the received message is persuasive or true.

**Proposition 5a:** The relationship between perceived persuasiveness of a message and message retransmission is negatively moderated by perceived uncertainty so that the relationship is weaker when perceived uncertainty increases.

### 3.3.2.2. Effect on Importance-Retransmission Relationship

Perceived uncertainty moderates the relationship between perceived importance of retransmission and message retransmission (shown in Figure 5). As discussed above, holistic
thinking is an intuition-based process. Research also suggests that intuition involves judgment of importance (Epstein, 2011). Judging the importance of retransmission, therefore, is a more holistic rather analytic process. As holistic thinking is dominated when perceived uncertainty is high (Slovic et al. 2004), message receivers may rely more on the importance of retransmission to determine their retransmission behavior. Moreover, as mentioned earlier, time compression is associated with high uncertainty (Sellnow & Seeger 2013). Making time-sensitive decision of retransmitting a message based on the holistic judgment of the importance of retransmission is more rapid and easier (Epstein 1994).

As a result, the effect of perceived importance of retransmission on message retransmission is more salient and message retransmission behaviors become more sensitive to changes in perceived importance of retransmission in high uncertain condition than in low uncertain condition. As shown in Figure 5, the slope of the relationship between message retransmission and perceived importance of retransmission is steeper when perceived uncertainty is high than when perceived uncertainty is low.

![Figure 5](image)

**Figure 5 The Moderating Role of Perceived Uncertainty on the Relationship between Perceived Importance of Retransmission and Message Retransmission**

Figure 5 also indicates if message receivers deem a message is very important, they are more likely to retransmit it in high uncertain situations than low uncertain situations. That is also because when a message receiver perceives higher level of uncertainty, particularly after crisis just occurs, other people may also feel very uncertain and are in urgent need of more

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messages (Kramer 1999). By retransmitting messages that is important for them in high uncertain situations, message re-transmitters can inform more people and help their potential audiences to address their lack of knowledge (Mishel 1988). For example, a message containing shelter locations is important for victims in crisis. Right after a crisis, most of victims do not know where these shelters are, so message receivers of the shelter information are more likely to retransmit it, because their retransmission behavior can inform more victims in need. However, in later stage of a crisis, although the message containing shelter locations is still important for victims, as most of victims have already know the shelter locations, it is no need for message receivers to spread that message again.

**Proposition 5b:** The relationship between perceived importance of retransmission and message retransmission is positively moderated by perceived uncertainty so that the relationship is stronger when perceived uncertainty increases.

### 3.3.2.3. Effect on Anxiety-Retransmission Relationship

Perceived uncertainty also moderates the relationship between anxiety and message retransmission (See Figure 6). In earlier stage of a crisis, message receivers perceived higher level of uncertainty. In such condition, holistic thinking is dominated. Because holistic thinking is more intuitive and affective based (Slovic et al. 2004), and anxiety is a typical emotion evoked by crisis, message receivers are more likely to be driven by their anxious feelings to determine their message retransmission behaviors.

Therefore, the effect of anxiety on message retransmission is more salient and message retransmission behaviors become more sensitive to changes in anxiety in high uncertain condition than in low uncertain condition. As shown in Figure 6, the slope of the relationship between message retransmission and anxiety is steeper when perceived uncertainty is high than when perceived uncertainty is low.
Figure 6 The Moderating Role of Perceived Uncertainty on the Relationship between Anxiety and Message Retransmission

Figure 6 also indicates that when message receivers feel very anxious, they are much more likely to retransmit a message when their perceived uncertainty is high than when perceived uncertainty is low. That may also because in low uncertain situations, people have many options to response to the crisis and relieve their anxiety by utilizing information they got other than message retransmission. For instance, after information about shelters and services are available, crisis victims can seek shelters and services to relieve their emotional tensions. However, in high uncertain situations, due to the cognitive ambiguity, people may hardly find other ways to vent their negative emotions, so they are more likely to give vent to their anxiety by retransmitting a message (Rosnow 1991).

**Proposition 5c:** The relationship between anxiety and message retransmission is positively moderated by perceived uncertainty so that the relationship is stronger when perceived uncertainty increases.

3.3.2.4. Effect on Anxiety

Besides the moderating effect, previous research suggests a positive association between anxiety and uncertainty (Gudykunst & Nishida 2001). The ambiguous situation and the lack of explanations in crisis often create anxiety (Jett & George 2003; Sellnow & Seeger 2013). Specifically, right after a crisis, anxious feelings tend to be greatest (Anthony, 1973). That is because in very high uncertainty situations, people lack necessary information to help them
response appropriately to the crisis, so they feel more “loss of control” (Walker & Blaine, 1991). When perceived uncertainty decreases gradually as more information is available overtime, message receivers can gradually regain the sense of control and their anxious emotions can be relieved gradually (Gudykunst & Nishida 2001). Empirical studies also show that anxiety levels decline dramatically when more information is published in crisis (Oh et al., 2010). Thus, consistent with previous studies, we also posit a positive relationship between perceived uncertainty and anxiety.

**Proposition 5d:** Perceived uncertainty positively influences the level of anxiety of message receivers.

### 3.3.3. Effects of Message Cues on Perceptions

This paper focuses on how message cues conveying in online communication tools affect message receivers’ perceptions. It is common belief that computer-mediated communication systems are not capable of conveying many of cues that are available in face-to-face communications (Sproull and Kiesler 1986; Rice and Williams 1984). Consequently, non-verbal signals such as facial expression, direction of gaze, posture, dress, and physical distance (Tanis & Postmes 2007), that are typical in face-to-face communication but not common in the online context are not our concern.

Table 2 summarizes message cues that can influence message receivers’ perceptions and provides examples of them. These message cues can be divided into four categories: arguments, identity cues, topics, and emotional cues. Among them, arguments, topics, and emotional cues are verbal cues expressed in the content of a message (Carlson et al., 2004), while identity cues are not part of the verbal or textual content of the message, but are cues characterizing message senders accompany the delivery of the message. In the following paragraphs, we explain how we identify these cues, and how these cues influence perceptions of message receivers.
Table 2 Summary of Message Cues

<table>
<thead>
<tr>
<th>Type</th>
<th>Message Cues</th>
<th>Examples in the online context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arguments</td>
<td>Statistics, Data, Visual aids (Petty et al., 1981; Lee, 2009; Hamlin 1990)</td>
<td>Message senders can attach a picture, video, or some data to support their ideas.</td>
</tr>
<tr>
<td>Identity cues</td>
<td>Message Sender’s Authoritativeness and Proximity of crisis (Sproull &amp; Kiesler 1986)</td>
<td>Message sender may include their information about organizational position and their location in their personal webpage or profile in social media.</td>
</tr>
<tr>
<td>Topics</td>
<td>Current States, Impacts, Response Options (Milliken 1987)</td>
<td>Message senders can discuss current states, impacts, and response options on social media, enterprise intranet, or other web page on internet.</td>
</tr>
<tr>
<td>Emotional cues</td>
<td>Anxiety Expressions (Berger 2011)</td>
<td>Message senders may include a facial expression, such as “☹”, to show their anxiety.</td>
</tr>
</tbody>
</table>

3.3.3.1. Effect of Arguments on Perceived Persuasiveness of a Message

We first look at message cues influencing perceived persuasiveness of a message. The perceived persuasiveness of a message is a key factor determining message adoption. Thus, we need to identify message cues pertaining to message adoption. Based on Elaboration Likelihood Model (Petty & Cacioppo, 1986), a well-developed theory of persuasion, Sussman and Siegal (2003) found two key antecedents leading to message adoption.

According to Sussman and Siegal (2003), strong argument is one of the two antecedents leading to message adoption. Arguments of a message are statements and series of reasons for or against a point (Online Etymology Dictionary), which belong to verbal cues conveyed by online communication systems. Informally, arguments are used to elaborate and support a point in a message. Strong arguments should contain persuasive evidences or relevant facts (Lee, 2009). Statistics or data are typical evidences available in a message (Petty et al., 1981).

In the online communication tools, visual aids in the message, such as a picture or video, are also demonstrative evidences (Hamlin 1990). As a result, consistent with Sussman and Siegal (2003)’s research, we posit messages with statistics, data, or visual aids are likely to be perceived more persuasive by message receivers.

*Proposition 6a: Messages containing statistics, data or visual aids lead to higher*
perceived persuasiveness of a message.

3.3.3.2. Effect of Identity Cues on Perceived Persuasiveness of a Message

In Sussman & Siegal (2003)’s model, source credibility is another factor determining adoption. For message re-transmitters, their message sources are message senders. Ma and Agarwal (2007) suggest that message receivers recognize senders’ credibility based on message senders’ identity cues. Specifically, identity cues help individuate a message sender (Tanis & Postmes 2003) by transmitting the social identity such as their personal information, reputation, and expertise (Ma & Agarwal 2007). In online context, people can build a personal web page (Dominick 1999) or create their own profile on social media (Kietzmann et al. 2001) to show their identity.

Sproull & Kiesler (1986) suggests two important types of identity cues: organizational position and geographic location. Organizational position is message sender’s organizational department, hierarchy, and job category (Sproull & Kiesler 1986), which indicate their authoritativeness of providing a message. Research consistently demonstrates that messages from authorities, such as popular news media, reporters with high reputation and expertise, local governments, or senior executives, are more likely to be perceived as credible (Rieh & Belkin 1998; Johnson & Kaye 2004) and preferred by message receivers (Zemborain, & Johar 2007).

However, in crisis, messages from authorities are slow to update and insufficient to meet the information demands of public (Sutton et al. 2008). Thus, message senders’ geographic location, particularly their proximity of a crisis, also plays an important role. Messages sent by people who are inside the affected areas, communities or organizations are more likely to be perceived as persuasive than other messages, since these message senders are thought to be insiders witnessing what is going on or knowing some inside stories. Based on the above discussions, we posit that two types of identity cues, message senders’ authoritativeness, and
their proximity of a crisis are highly related to perceived persuasiveness of a message in crisis.

**Proposition 6b**: Message senders’ authoritativeness and proximity of a crisis lead to higher perceived persuasiveness of a message.

### 3.3.3.3. Effect of Topics on Perceived Importance of Retransmission

The importance of retransmission can be judged by holistically checking message topics (Buckner 1965). Message topics are also verbal cues conveyed by messages posted online. The topic of a message is the subject or theme of a discourse from which arguments can be drawn (Online Etymology Dictionary). Informally, message topic is the main point of a message.

Messages related to the following three message topics – (1) the state of current situation, (2) potential impact of events, (3) available response options (Milliken 1987) – are important to be retransmitted in crisis, because the potential audiences of message re-transmitters are driven to seek messages related to the above topics in crisis (Berger and Calabrese 1975).

First, in crisis, people need messages about state of current situations because they may be unsure how components in crisis are changing or interrelated with each other (Milliken 1987). For instance, even though people receive warnings of floods, they might still not sure about the probability of experiencing floods and mudslides. Message receivers may feel retransmitting messages containing the state of current situations (e.g., updates about water levels) is important, because such messages can help increase the situational awareness among the public (Vieweg et al. 2010).

Second, individual need messages about potential impact of events, because it is always difficult for them to predict the impact or future state of crisis (Milliken 1987). For instance, even if a house owner knows that a flood is inevitable, he/she might be uncertain about how floods will affect a particular house. As people are eager to know impacts or implications
of a given crisis, message receivers may feel retransmitting messages relating to the nature, severity and timing of potential impact is important.

Finally, people are also willing to know possible actions or response options in crisis, because they need to take some actions to respond to a crisis (Milliken 1987). Message receivers may feel messages providing suggestions on possible response options are important to be retransmitted, because by retransmitting messages containing response options, more people can know how to cope with the threats brought by crisis, or how to utilize potential chances in crisis. For instance, after floods, messages containing places of shelters are important to be retransmitted, so that more victims can find appropriate places to get sheltered.

In summary, we posit three message topics are especially important in crisis: (1) the state of current situation, (2) potential impact of events or changes, (3) available response options.

**Proposition 6c:** Message topics related to current states, impacts, or response options of crisis lead to higher perceived importance of retransmission.

### 3.3.3.4. Effect of Emotional Cues on Anxiety

Although emotional/attitudinal cues are typical nonverbal cues in traditional face-to-face communication, these cues are expressed verbally (Walther et al. 1992; Lo 2008; Hancock 2007) by linguistic features (Carlson et al. 2004) in the online context because people adapt their language and style to convey their subjective feelings online (Walther et al. 2005). For instance, message senders online can use vocal spelling such as “weeeeeeellllll” to indicate vocal intonation or a tone, or they can use facial expressions or grammatical markers, such as “😊” and “!!!”, to show their emotions (Carey 1980).

Expressions of anger, anxiety, and happiness are all emotional cues, and they may have different influence on message receivers’ perceptions. To remain focused, in this paper, we only discuss the effect of anxiety expression, because since anxiety is the most typical emotions aroused by crisis (e.g. Sellnow & Seeger 2013), which is most relevant to our study.
and deserves our attention.

Anxious expressions in a message are arousal-inducing content, which are likely to evoke anxiety among message receivers (Berger 2011). Sometimes, message receivers’ feelings of anxiety can even be excessively influenced by senders’ negative emotional expressions. Research suggests that there is a tendency that message receivers perceive a particular message more negative than what message senders intend it to be (Byron 2008). Thus, we predict the anxious expressions in a message will affect message receivers’ anxious feeling.

**Proposition 6d:** Messages with anxious expressions lead to higher level of anxiety of message receivers.

In summary, we integrate both a process and a variance view to understand online message retransmission in crisis. Simply speaking, the process model captures key steps of online message retransmission in crisis and the variance model captures key variables affecting online message retransmission in crisis.

4. **Illustrating Factors Affecting Online Message Retransmission in crisis**

In this section, we provide two examples from real world to illustrate our theory, but not to test the theory. The two illustrations show how different factors (underlined in the following text) affecting online message retransmission in crisis. Although we illustrate our theory from variance view rather than process view, factors in the variance model also reflects steps in process theory.

The two illustrations are drawn from two crises occurred recently. The first illustration is about the Boston Marathon bombing on April 15, 2013. During the Boston marathon, two bombs exploded at 2:49 p.m. EDT. Three spectators were killed. At 7:41 pm and 8:18 pm, 15 Apr 2013, two fake tweets came from a twitter named Hope for Boston. The first tweet (shown below) said a girl was killed while running, and this tweet was accompanied by a
photo of a girl running. The second tweet was similar to the first one, but it said a boy was killed and had a picture of a running boy. In fact, there was a boy killed in the bombing, but he was killed while waiting for his father instead of running, and the boy in the picture of the second fake tweet was not the boy killed in Boston.

*HOPE FOR BOSTON* @HopeForBoston (7:41 pm 15 Apr 2013): R.I.P. to the 8 year-old girl who died in Boston's explosions, while running for the Sandy Hook kids. #prayforboston pic.twitter.com/WhaaTG3nSP

The fake tweet regarding the girl came out one hour earlier than the second fake tweet, and it was retweeted about 80,000 times. The later fake tweet concerning the boy was retweeted about 30,000 times. The main reasons for the high retransmission of these two rumors appear to be consistent with our theory of message retransmission in crisis. First, this message was posted soon after the bombing, and at that time, message receivers were lack of enough evidence and perceived high level of uncertainty. However, although it is hard for them to judge the persuasiveness of the message using available evidence in high uncertain situation, this message still looks persuasive (the perceived persuasiveness of a message is high), because the message contains a picture (visual aid) making recipients think that the twitterer had access to “the facts”. Second, the topic of this message is the updates of current state, which is important to be retransmitted (the perceived importance of retransmission is high), because it can increase situational awareness and reduce uncertainty (Sonnenwald & Pierce, 2000) among the public.

Gradually, many people noticed that @HopeForBoston was a Twitter account that just started up, and the two messages sent by it were fake. At the same time, many main media also utilized their website or their social media account to inform the public that the pictures in the two messages were not photos of the Boston Marathon; instead, they were taken at “Joe Cassella 5K” running held in May to raise money for families of sick children. As more
message receivers recognized the truth, their perceived uncertainty decreased gradually. Due to the moderating effect of perceived uncertainty on the relationship between perceived persuasiveness of a message and message retransmission, in low perceived uncertainty condition, people were more confident that the received message was not persuasive and were less likely to retransmit the message. Thus, these two messages were retransmitted less overtime.

On 8 March 2014, Malaysia Airways reported that they had lost all contact with flight MH370 at 2.40am. Flight MH370 was operated on a Boeing B777-200 aircraft. The flight was carrying a total number of 239 passengers and crew. Among them, 153 passengers were from China. When the airline was working with authorities in the search efforts to locate the aircraft, Boeing China President Marc Allen posted a following message on a Chinese microblogging system – Weibo at 11: 07 am 8 March 2014:

The plane is found but our sorrows grow. Our technical assistance team is en route to assist the investigating authorities off the Vietnamese coast.

In less than one hour, this message was forwarded by three thousands of times on Weibo. By searching this message in Google, we found that from 8 March to 9 March 2014, this message appeared in at least 110 web pages. That means that people not only retransmitted this message within Weibo, they even reposted it to other web sites.

The main reasons for the high retransmission are also consistent with our model. The first reason is sender’s authoritativeness. The sender of this message is Boeing China President Marc Allen whose account has been verified by Weibo. When message receivers received this message, they did not get any verified information about the location of the plane, and their perceived uncertainty was high. Although message receivers could not fully believe that the plane had been found, due to the authoritativeness of the sender, message receivers on Weibo thought this message was persuasive (the perceived persuasiveness of a
message is high) and then retransmitted it. Second, the content of the message include the current state and the corresponding response option, so the topic of this message is important to be retransmitted (the perceived importance of retransmission is high). The last reason for retransmission is about the anxious feelings among the message receivers. The above message was sent on a Chinese microblogging system – Weibo. For the reason that major victims of this accident are Chinese, Chinese message receivers on Weibo were waiting anxiously for the updates about the location of the aircraft (anxiety is high). The anxious expression “sorrows grow” in the message also increases anxious feelings of message receivers and drives their retransmission behaviors.

However, two hours later, Marc Allen corrected the above message by sending another message saying, “Early reports from local Southeast Asia news of found plane are in error. The search continues.” As more message receivers got this message and knew the truth, later on, due to the moderating effect of perceived uncertainty on the relationship between perceived persuasiveness of a message and message retransmission, message receivers were more confident that the earlier message was not true, and were less likely to retransmit the message. As a result, the message about the found plane became dead-end gradually.

5. Discussions

In this section, we first discuss our contributions to research and agenda for future research followed by the implications for both online communication systems design and management.

5.1. Contributions to Research

The contribution of this paper is to create a new theory of online message retransmission in crisis. By integrating both a process view and a variance view, this paper provides a more complete understanding of our research phenomena and sheds light on online crisis communication and online communication systems use research. In particular, the process
theory clarify steps of online message retransmission, and the variance theory indicates how message cues available online can affect message receivers’ perceptions and then affect their retransmission behavior. The proposed theory also shows that steps of online message retransmission and effects of perceptual variables differ when message receivers’ perceived uncertainty changes in crisis.

Our theory builds upon and extends two distinct bodies of literatures, information diffusion literatures and rumor theory literatures. The theoretical contributions to the two bodies of literatures can be summarized as follows.

Our study contributes to online information diffusion research by clearly clarifying steps of message retransmission that has long been confused by online communication researchers. The process theory proposed in this paper clarify that adoption and retransmission are two different steps, and the choice of these steps are affected by the level of perceived uncertainty in crisis. By proposing a variance theory, we show that perceived persuasiveness of a message is a factor reflecting adoption step, while anxiety and perceived importance of retransmission are factors reflecting retransmission step. Hence, researchers may not simply equal message adoption to retransmission, particularly in crisis.

Our study contributes to online information diffusion research also by explaining the causation of message retransmission after a crisis. The variance theory proposed in this paper helps to identify and explain behavioral factors leading to message retransmission that cannot be explained by existing information diffusion research. To our knowledge, this is the first attempt to build theory that explains behavioral factors affecting online message retransmission in crisis.

This paper contributes to rumor theory by extending it into a general theory of online message retransmission in crisis. Although many studies on rumor theory are performed in crisis, rumor theory only explains one side of the whole story of message retransmission in
crisis – message retransmission in high uncertain situations. By elaborating effects of both high and low level of uncertainty, the proposed theory in this paper offers a more complete way to look at online message retransmission in crisis than rumor theory.

As exposure to message cues is the first step of message retransmission, our study also contributes to rumor theory by identifying key message cues as antecedents affecting behavioral variables. In particular, we identify message cues that can be conveyed by online communication systems and explain how these message cues influence behavioral variables and subsequently influence message retransmission behavior. We also extend behavioral variables in rumor theory to reflect perceptions of message cues.

5.2. Agenda for Future Research

This paper provides opportunities and new insights for future study on online crisis communication, design science and technology diffusion, which are discussed below.

5.2.1. Opportunities for Online Crisis Communication Research

Given the increasing cost and frequency of crisis in recent years, it is urgent for IS researchers to understand communication system use in crisis. This paper takes the first step by building a theory on online message retransmission in crisis.

However, in this paper, we only provide illustrations of our theory. Our theory still needs to be subjected to formal empirical testing. Richer measurement scales for variables in our theory could be developed in future, and survey or lab experiments could be performed to test the theory in this paper. As we offer both a process and a variance theory, future empirical study can test the theory by both process research and variance research.

Future research can also theoretically extend our theory. In this paper, we discuss effects of message cues. Since message cues are enabled by communication tools, future study can extend our theory by considering how features of communication systems enable different message cues online.
In addition, this paper discusses the general online message diffusion of messages in crisis, and other topics related to online crisis communication also deserves the attentions of information systems researchers. Online message generation, online problem-solving and sense-making behaviors in crisis are all important topics. By examining various topics related to online crisis communication, researchers can better understand how people utilize online communication systems in crisis, and how online communication systems facilitate crisis communication.

5.2.2. New Insights on Technology Diffusion

Our research phenomenon is message retransmission in crisis. Because message retransmission is somewhat similar to technology diffusion (Gruhl et al. 2004), our study offers new insight on technology diffusion research. Current studies on technology diffusion mainly focus on technology adoption; however, our theory suggests that adoption may not be equal to retransmission, and factors affecting adoption and factors affecting retransmission are different. That is, although individuals may adopt a technology, they may not recommend this technology to others. Future research on technology diffusion can further examine factors driving individuals to recommend a specific technology to others after adoption. Our theory suggests that the importance of passing a technology on may play a significant role in technology diffusion after adoption.

5.3. Implications for Online Communication Systems Design

This study discusses the effects of message cues on message retransmission. Since these message cues are enabled by online communication tools (Tanis & Postmes 2003), our study yields pragmatic guidelines on how to promote active and successful message retransmission using online communication tools. In other words, the design of online communication systems is informed by our theory.

First, emotional cues, particularly anxiety expressions enabled by communication media
can facilitate message retransmission in crisis. To facilitate exchange of emotions, features supporting emotion transmissions should be offered by designers of online communication tools. For instance, designers can allow users to insert emoticons in their messages, because emoticons mimicking human facial expressions make it easy for people to transmit emotions. Moreover, these emoticons should be vivid, intriguing and diverse, so message receivers can easily notice these icons, and subsequently can be influenced by emotions from message senders.

Second, to assist message receivers to judge the importance of message topics, tagging systems need to be developed. Many online communication systems allow message senders to add free-form tags to a post. By checking these tags, message receivers can quickly know the message themes without spending time to read the whole messages, so that they can make a quicker decision on whether to retransmit it or not, particularly under high time pressure in crisis. Moreover, in crisis, official tags indicating keywords related to the event are more demanding than free-form tags, since search engines can index them to make relevant materials related to the event searchable in a uniform way. Official tags can be treated as part of a controlled vocabulary. Based on these official tags, auto-tagging systems need to be developed. If every post online can be tagged automatically using official tags, individuals can easily locate messages of certain topics that are important to be retransmitted and retransmit it.

Third, designers of communication systems should offer “richer” systems allowing message senders to provide strong arguments. Picture uploading features are widely available in most online communication tools, but some communication systems only allow users to insert one pictures. New features allowing users to insert multiple photos, videos, and audios should be developed. In recent years, audio and video have become increasingly common in recent years, as they can effectively enhance the strength of message arguments. Moreover,
communication systems should provide more user-friendly presentations of tables containing statistics and data in order to enhance the perceived persuasiveness of a message.

Finally, online communication systems need to develop features to assist the transmission of identity cues, particularly, the transmission of message senders’ authoritativeness and their proximity of crisis. To be more specific, first, verification systems that can confirm message senders’ organizational positions are important to help the message receivers accurately judge the authoritativeness of message senders. Besides verification, online communication systems may also need to allow message senders to link their account or profile to an official website to confirm their authoritativeness. Second, location-based services, particularly, mobile location-based services, should be promoted so that message senders can broadcast their places to show whether they are in the proximity of crisis. Then message receivers can easily judge whether a particular sender is qualified to send a persuasive message.

5.4. Implications for Management

This study also contributes to the practice of crisis managements. This paper sheds light on how to utilize online communication systems to facilitate useful message retransmission, and control the retransmission of misleading messages.

One task for public relation officials and emergency response teams is to facilitate their official information retransmission online in crisis. First, public relation officials and emergency response teams need to enhance the persuasiveness of their message. Photos, images, and videos are excellent resources not only for creating an attractive and interesting design, but also for effective communication purposes, because they can often communicate a message more clearly and more emphatically than text. If possible, public relation officials and emergency response teams also need to add statistic and data as evidences to enhance the persuasiveness of their messages. Moreover, to better convey the authoritativeness, public
relation officials and emergency response teams may need to get their account verified on social media, or provide links to their official website.

Second, public relation officials and emergency response teams also need to enhance message receivers’ perceived importance of retransmission. Human nature is to want to know something quickly, and especially when online. Particularly, in crisis, people often feel high time pressure, and need to judge the importance of retransmission quickly (Sellnow & Seeger 2013). Titles and headers help to communicate major points and ideas to visitors, and they tell message receivers what to expect from the rest of the content. Thus, public relation officials and emergency response teams need to try to make their message titles clear and informative. They may also use headers and sub-headers, which can not only help to make the text more readable by creating white space, but also can communicate a structure of the content and summarize the primary points of the content.

Third, public relation officials and emergency response teams may attempt to deliver certain emotions, particularly anxiety, in their messages to make their messages arousing. So that message receivers can be evoked by emotions in a message and then retransmit it.

The other important task for public relation officials and emergency response teams is to control the propagation of misleading messages in crisis. Our theory suggests perceived uncertainty is a moderator affecting how message receivers retransmit a message. Based on our theory, people are more likely to retransmit a piece of misinformation, when they perceive high level of uncertainty right after a crisis, because when the perceived uncertainty is high, people are less likely to judge the persuasiveness of a message accurately, but retransmit it directly based on the importance of retransmission and their negative emotions. Hence, the best strategy of fighting misinformation is to try to reduce message receivers’ perceived uncertainty in crisis. The most effective way to do so is to increase the availability and media exposure of official information. To ensure that the potential message re-transmitters can get
the most important official information to reduce their perceived uncertainty, public relation officials and emergency response teams need to cooperate with news media, especially online news media, to make the official information nearly impossible to miss. They could ask online news media use large text, colored text, automatically loading audio, video and pop-ups or some other design technique to highlight particular information.

6. Conclusion

Message retransmission in crisis is important for crisis management, as they can construct consensual understanding between different stakeholders and communities, and subsequently help rebuild organizational or social order. This paper develops a behavioral theory to explain online message retransmission in crisis. Our theory integrates a process theory and a variance theory view. The process theory captures key steps and two routes of message retransmission and clarifies the choice of route in terms of levels of perceived uncertainty. The variance theory captures both environmental factors (message cues) and behavioral factors leading to message retransmission and their associations, and it also explains why message receivers rely on different variables when their perceived uncertainty changes.

This paper contributes to both information diffusion literatures and rumor theory. It breaks ground for future research to empirically test and theoretically extend our theory. It also provides exciting opportunities to future research on crisis communication, technology diffusion and design science research. Online communication system designers and stakeholders involved in crisis management can also benefit from this paper.
### Appendix A

**Summary of Papers on Information Diffusion in the Basket of Eight Journals**

<table>
<thead>
<tr>
<th>Stream of Research</th>
<th>Key Factors</th>
<th>Journal</th>
<th>Title</th>
<th>Authors &amp; Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social network features</td>
<td>Nodes</td>
<td>ISJ</td>
<td>Digitising the R&amp;D Social Network: Revisiting the Technological Gatekeeper</td>
<td>Whelan et al., 2011</td>
</tr>
<tr>
<td></td>
<td>Centrality</td>
<td>JAIS</td>
<td>Crisis Response Information Networks</td>
<td>Pan et al., 2012</td>
</tr>
<tr>
<td></td>
<td>Central node</td>
<td>JAIS</td>
<td>Crisis Response Information Networks</td>
<td>Pan et al., 2012</td>
</tr>
<tr>
<td>Path</td>
<td>Weak ties/Connections</td>
<td>JMIS</td>
<td>Measuring Information Diffusion in an Online Community</td>
<td>Garg et al., 2011</td>
</tr>
<tr>
<td></td>
<td>Weak ties</td>
<td>MISQ</td>
<td>Content Sharing in a Social Broadcasting Environment: Evidence from Twitter</td>
<td>Shi &amp; Whinston, 2014</td>
</tr>
<tr>
<td>Message-level features</td>
<td>Sentiment occurring in social media content</td>
<td>JMIS</td>
<td>Emotions and Information Diffusion in Social Media—Sentiment of Microblogs and Sharing Behavior</td>
<td>Stieglitz &amp; Dang-Xuan, 2013</td>
</tr>
<tr>
<td></td>
<td>Topics</td>
<td>JAIS</td>
<td>An Information Diffusion-Based Recommendation Framework for Micro-Blogging</td>
<td>Cheng et al., 2011</td>
</tr>
</tbody>
</table>

### Appendix B

#### Relationships of Rumor Theory Literatures & Key Variables in Rumor Theory

<table>
<thead>
<tr>
<th>Rumor Theory Literatures</th>
<th>Key Variables in Rumor Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Uncertainty</td>
</tr>
<tr>
<td>Allport &amp; Postman, 1946</td>
<td>X</td>
</tr>
<tr>
<td>Allport &amp; Postman, 1947</td>
<td>X</td>
</tr>
<tr>
<td>Chorus, 1953</td>
<td>X</td>
</tr>
<tr>
<td>Schachter &amp; Burdick, 1955</td>
<td>X</td>
</tr>
<tr>
<td>Buckner, 1965</td>
<td>X</td>
</tr>
<tr>
<td>Shibutani, 1966</td>
<td>X</td>
</tr>
<tr>
<td>Anthony, 1973</td>
<td></td>
</tr>
<tr>
<td>Jaeger et al., 1980</td>
<td>X</td>
</tr>
<tr>
<td>Rosnow, 1980</td>
<td>X</td>
</tr>
<tr>
<td>Rosnow et al., 1986</td>
<td></td>
</tr>
<tr>
<td>Walker &amp; Beckerle, 1987</td>
<td></td>
</tr>
<tr>
<td>Rosnow, 1988</td>
<td>X</td>
</tr>
<tr>
<td>Rosnow, 1991</td>
<td>X</td>
</tr>
<tr>
<td>Kimmel &amp; Keefer, 1991</td>
<td>X</td>
</tr>
<tr>
<td>Goode &amp; Ben-Yehuda, 1994</td>
<td>X</td>
</tr>
<tr>
<td>Bordia, 1996</td>
<td>X</td>
</tr>
<tr>
<td>DiFonzo &amp; Bordia, 1997</td>
<td>X</td>
</tr>
<tr>
<td>Fine &amp; Turner, 2001</td>
<td>X</td>
</tr>
<tr>
<td>Bordia &amp; DiFonzo, 2002</td>
<td>X</td>
</tr>
<tr>
<td>Rosnow, 2011</td>
<td>X</td>
</tr>
<tr>
<td>Oh et al., 2013</td>
<td>X</td>
</tr>
<tr>
<td>Kimmel, 2013</td>
<td>X</td>
</tr>
</tbody>
</table>
References


Ma, R. “Spread of SARS and War-related Rumors through New Media in China”, *Communication Quarterly* 56(4), 2008, pp. 376-391.


