



Segmenting and Understanding Publics in a Social Media Information Sharing Network: An Interactional and Dynamic Approach

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ABSTRACT

This study segments social media publics and analyzes their informational behaviors during organizational crises. With a public-centric perspective, our study highlights how social media publics interact with each other (i.e., interdependence) and share different information through crisis stages (i.e., dynamics). Following the situational approach to segmentation, we identify different types of social media publics (i.e., influentials, broadcasters, and followers) based on their informational behaviors and their positions in an information sharing network. Crisis managers are recommended to pay more attention to publics with higher influence, namely key influentials and broadcasters. In addition, we try to understand social media publics' changing concerns by analyzing whether and how publics share messages of different themes and forms in different stages of a crisis. Crisis managers are recommended to customize crisis communication content to fit publics' needs, prioritize organizational resources, and maximize positive communication effect. With big data from Chipotle's *E. coli* crisis, we analyzed the Twitter activities surrounding this crisis over a 6-month period. Our segmentation receives initial support from the network analysis and content analysis on the Twitter data, which lays the foundation for effective social media crisis management.

Introduction

Organizations operate within a complex environment with a myriad of publics. Segmenting and prioritizing publics for strategic management have been a central topic for public relations, management, marketing, and social media research (e.g., Freeman, 1984; Grunig, 1997; Kim, Ni, & Sha, 2008; Payne, Ballantyne, & Christopher, 2005; Sedereviciute & Valentini, 2011). Social media facilitates the interactions between different stakeholders and empowers online publics to challenge the agenda set by organizations (Hunter, Van Wassenhove, & Besiou, 2016; Li, 2016). Particularly during a crisis, publics participate in content gatekeeping and narrative construction by creating, disseminating, and sharing crisis information (Chewning, 2015; Ott & Theunissen, 2015; Veil, Buehner, & Palenchar, 2011). With the prevalence of social media among communication managers (Wright & Hinson, 2014), identifying key social media publics for relationship building in a crisis becomes even more important.

A series of theories and models have been developed to promote our understanding of the segmentation of stakeholders and publics (e.g., Grunig & Hunt, 1984; Jin & Liu, 2010; Rawlins, 2006; Rowley, 1997). However, few studies examine the segmentation of social media publics in a crisis from a public-centric perspective that highlights the interdependence and dynamics between publics (Fraustino & Liu, 2017; Schultz, Utz, & Göritz, 2011). On social media, as the intermediary

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role of media agency decreases (Holtzhausen & Zerfass, 2015), stakeholders and publics directly influence each other through information forwarding, sharing, or commenting (Ji, Li, North, & Liu, 2017; Lovejoy, Waters, & Saxton, 2012; Veil et al., 2011).

Scholars from multiple disciplines share the consensus that organizations should go beyond a dyadic perspective of the relationship between stakeholders and organizations (Mariconda & Lurati, 2015; Rowley, 1997; Sedereviciute & Valentini, 2011) and look into the interactions of multiple and interdependent publics in a crisis on social media (Chewning, 2015; Frandsen & Johansen, 2016; Liu, Fraustino, & Jin, 2016; Schultz et al., 2011; Utz, Schultz, & Glocka, 2013). Answering this call, we segment social media publics based on how their shared information flows in a social media network. Following the situational approach to segmentation (Grunig, 1997; Kim et al., 2008), we argue that the influence of publics may change in a complex and turbulent environment, such as a crisis on social media. Crisis managers should pay more attention to social media publics with higher influence at a particular crisis stage.

In addition, we explore the implications of our segmentation for crisis management by examining how social media publics' shared information change based on crisis stages (Coombs, 2014; Reynolds & Seeger, 2005; Sturges, 1994). The effectiveness of social media for strategic management has been controversial (e.g., Lovejoy et al., 2012; Taylor & Kent, 2010). We argue that practitioners should enact strategic social media management to address publics' needs and concerns at a particular crisis stage, which are reflected in the themes and forms of messages shared by publics. Crisis managers should develop messages based on "what the target audience most needs to know or wants to know." (Covello, 2007, pp. 2–7).

With the public-centric perspective, our study has two purposes. On the one hand, we segment and prioritize publics based on their informational behaviors and their positions in an information sharing network. On the other hand, we aim to understand and address publics' evolving informational needs based on whether and how they share different messages in different crisis stages. With big data from Chipotle's *E. coli* crisis, we analyzed the Twitter activities surrounding this crisis over a six-month period. In particular, we conducted social network analysis and content analysis to examine different types of publics and their shared information by crisis stages. We believe our multimethod approach can offer a systematic and dynamic picture of networked social media publics in a corporate crisis, which lays the foundation for effective social media crisis management.

Social media publics and social-mediated crises

Public relations researchers borrowed the concept of stakeholder from management literature and developed the idea of publics (Grunig & Repper, 1992). Stakeholder theory centers on the identification and prioritization of stakeholders, constituted by "any group or individual who is affected by or can affect the achievement of an organization's objectives." (Freeman, 1984, p. 46) Following stakeholder theorists, public relations scholars argued that stakeholders evolve to publics when stakeholders recognize problems in their relationship with an organization and make the effort to solve the problem (e.g., Kim et al., 2008).

Defining social media publics

Social media publics are publics represented by their social media accounts. Social media publics include not only message receivers (i.e., audience), but also message producers (e.g., media agencies, Austin, Liu, & Jin, 2012; Fraustino & Liu, 2017). Social-mediated crisis communication indicates crisis communication on social media, which covers social media publics' communicative behaviors on social media (Austin et al., 2012).

A public-centric perspective to social-mediated crisis communication

Many scholars believe that crisis communication research should adopt a public-centric perspective (e.g., Chewning, 2015; Frandsen & Johansen, 2016; Liu et al., 2016; Luoma-Aho & Vos, 2010; Lyu,

2012) and crisis communication content should be developed based on publics' thoughts, feelings, and behaviors (e.g., Covello, 2007; Fraustino & Liu, 2017; Seeger, 2006). With the new media landscape, organization centrism has been replaced by the new situation that publics interact with organizations in a more active way, and their voices become more salient (Frandsen & Johansen, 2014; Hunter et al., 2016; Luoma-Aho & Vos, 2010).

Publics rely on the Internet even more than traditional media during an organizational crisis (Lyu, 2012). Moreover, social media allows publics the same level of influence as organizations, by rendering them the voice. For example, Chewning (2015) found that public's voice on social media "makes a salient semantic contribution to the overall crisis narrative." (p. 6) Thus, the public-centric perspective should be especially useful in social-mediated crisis communication research. In addition, the *homo narrans* perspective (Vasquez, 1994) suggested that publics actively make sense of the crisis and construct their symbolic reality (Lee, 2004). Thus, using a public-centric perspective may help scholars understand publics better and generate insights for strategic crisis communication.

Segmentation of publics in social-mediated crises

Segmentation in corporate management

According to stakeholder theory, organizations with high stakeholder management capacity are expected to understand different stakeholders' needs and allocate resources in a manner consistent with these stakeholders' concerns (Frandsen & Johansen, 2014; Freeman, 1984). Much literature in stakeholder management segments stakeholders based on their attributes that can generate influence (e.g., resource-dependency theory; see Pfeffer & Salancik, 2003). Going beyond the organization-centric perspective, stakeholder scholars have examined how multiple interconnected stakeholders influence an organization with network analysis (Mariconda & Lurati, 2015; Rowley, 1997; Sederevičute & Valentini, 2011). As suggested by Rowley (1997), organizations should transcend the dyadic ties between an organization and each of its individual stakeholder and respond to "the interactions of multiple influences from the entire stakeholder set." (p. 890) For example, Rowley (1997) employed the network measures of density and centrality to describe an organization's position in the stakeholder structure and the organization's ability to resist the stakeholders' influence. Applying network analysis to social media publics, Sederevičute and Valentini (2011) segment stakeholders based on both their positions in a social media network as well as the content they propagate on social media.

Segmentation in communication

Public relations scholars argued that the segmentation of publics should depend on the situation for predicting publics' communicative behaviors (Grunig, 1997; Grunig & Hunt, 1984; Kim & Ni, 2013; Kim et al., 2008). Different from the management segmentation based on relatively static attributes, the situational segmentation is determined by publics' activeness of communicative behaviors, which may change in a crisis. Within a problem or crisis, the situational theory of publics identifies latent, aware, and active publics, who communicate differently in a problematic situation (Grunig, 1997; Grunig & Hunt, 1984). More recently, the situational theory of problem solving expands the situational theory of publics by considering a larger set of communicative actions of publics who engage in problem solving, emphasizing publics' information forwarding and sharing (Kim & Grunig, 2011; Ni & Kim, 2009).

However, these theories were not developed in the context of social media publics in crises. Applying the situational approach to social media, social-mediated crisis communication (SMCC) model segments publics based on their informational behaviors on social media during crises (Austin et al., 2012). SMCC theorizes three types of publics based on their production and consumption of crisis information: Influential social media creators create crisis information for others to consume; social media followers consume the crisis information; and social media inactives

consume the information from social media followers through word-of-mouth and/or traditional media.

One limitation of the SMCC typology is that there may be social media publics who both produce and consume crisis information. For example, specialists or opinion leaders who consume crisis information from mass media and produce their own opinions for members of their community to consume. These publics play an intervening role in social media content propagation (Wilson, 2005) and act as links between subgroups of publics (Mariconda & Lurati, 2015; Rawlins, 2006).

In addition, SMCC assumes that all influentials are equally important because they engage in content production on social media. This assumption is challenged by the finding that publics engage in selective consumption and sharing of information on social media (Berger, 2014; Kim, 2015). In particular, information perceived more important by publics is shared more on social media in a crisis. Based on the information utility perspective (Atkin, 1973), information shared more by publics tends to have higher information utility, which is the perceived usefulness of the information in fulfilling people's needs in crises (Atkin, 1973; Berger, 2014; Kim, 2015). We argue that the sources of high utility information constitute key influentials in a social-mediated crisis. Key influentials produce content that contains high information pass-on value and is shared massively among their followers. As such, crisis managers should pay more attention to key influentials.

The interdependent and situational approach to segmentation

Based on the literature reviewed, we propose a segmentation model for social media publics during crises. Applying an interdependent and situational perspective to social media, we segment publics based on their information sharing behaviors in a social media crisis network. In this network, users form informational connections with each other (Himmelboim, Golan, Moon, & Suto, 2014) because information flows from users to users through the communicative behaviors (e.g., commenting). With social media big data, users' communicative behaviors materialize as digital traces that can be visualized as information flows in the social media network.

We consider three types of social media publics in the information sharing network. First, social media *influentials* produce content shared by followers. Among them, key influentials produce content that has high pass-on value and is shared massively by followers. Second, social media *broadcasters* share the information from influentials and produce the information for certain stakeholders to consume. Broadcasters depend on influentials for informational resources. Based on these resources, broadcasters produce their information or opinions with their expertise in the domain (e.g., a food safety lawyer, a financial content aggregator on Twitter). Some followers rely on broadcasters for interpreting the relevance or authenticity of the information from influentials (Rawlins, 2006; Wilson, 2005). Third, social media *followers* only share information from influentials. Last, *inactives* do not produce or share information. Therefore, crisis managers should invest more resources and build relationships with (1) influentials, particularly key influentials, and (2) broadcasters. Organizations should place the highest priority on key influentials, whose content reach more social media publics. Managers should also build relationships with broadcasters, whose content reach fewer publics but may be perceived more relevant or credible by certain members of publics.

Based on our discussion on social media publics and SMCC, we examine the following research question:

RQ1. Are there influentials, broadcasters, and followers in the social media information sharing network during crises?

We expect these publics to occupy different positions in the information sharing network. Followers may form various communities with certain influentials as the centroid. Followers have their own informational needs and predispositions in a crisis. So followers may choose to follow certain influentials who share their information orientations, including topics, stances, and genres

(Dichter, 1966). For example, a public relations practitioner may prefer PR Week as an information source in a crisis whereas a Republican consumer may turn to Fox for crisis information. Research also shows that Twitter users tend to form communities with those with similar needs, beliefs, and interests (i.e., homophily, Meraz, 2009). As such, followers may selectively choose information from their preferred sources, and thus form various communities surrounding certain influential in the network. In addition, broadcasters serve as links between influentials and followers both within and across the various communities in the network (Mariconda & Lurati, 2015; Rawlins, 2006; Wilson, 2005).

RQ2. Are there communities formed by influentials and followers in the social media information sharing network during crises? Do broadcasters connect these communities?

A dynamic perspective to social-mediated crisis communication

Crises progress over time and develop mostly in systematic and predictable ways (Reynolds & Seeger, 2005). With a dynamic perspective, the Crisis and Emergency Risk Communication (CERC) model (Reynolds & Seeger, 2005) divides crisis into different stages and suggests different communication strategies for each stage. Similarly, Sturges (1994) indicated that organizations should customize strategic communication to address users' needs and concerns that arise at particular stages of the crisis.

Evolution of social-mediated crisis

Social media enables multiple voices to be heard (Chewning, 2015; Frandsen & Johansen, 2016). These diverse voices compete or merge, together co-construct the crisis narratives on social media (Chewning, 2015). Narratives are the symbolic representation of events. Through narratives, social media publics seek to make sense of a crisis by voicing their thoughts, concerns, and needs in a crisis. How well an organization addresses social media publics' concerns and needs determines publics' attitude toward the organization and their willingness to continue their relationship with the organization (Coombs, 2007). Thus, understanding social media crisis narratives is essential for the organization in a crisis.

Narratives consist of one or more message themes, which allow publics to interpret and respond to the crisis from a certain point of view (Fishman, 1980). For example, in the message theme of the legal issue, the legal implications of the *E. coli* crisis (e.g., consumers who suffered from *E. coli* sued Chipotle) are emphasized. As for the theme of financial loss, the financial aspects of the crisis (e.g., how the stock price fell) are emphasized. In particular, we examine two characteristics of message themes. *Diversity* indicates the variety of message themes. *Prevalence* indicates the predominance of a message theme. When the diversity of themes becomes low, a dominant theme emerges with high prevalence. When the diversity is high, multiple dominant themes may coexist. In addition, we examine message *forms*. Some messages contain facts, whereas others present readers with opinions.

Limited crisis communication research examines whether and how social media publics share different message by crisis stages. Based on the preceding discussion, we argue that different message themes and forms may exist in different crisis stages. In particular, the diversity and prevalence of the shared message themes may change based on crisis stages. Given that shared message theme is an indicator of publics' needs and concerns, organizations should customize communication content based on the themes to fit publics' needs, prioritize organizational resources, and maximize positive communication effect.

Three stages in social-mediated crisis

Based on CERC, we consider publics' shared information in three crisis stages: initial event, maintenance, and resolution. Although CERC has five stages, we focus on the three stages of

CERC because the first stage (precrisis) and the fifth stage (evaluation) capture strategic communication before and after the actual crisis. The precrisis and postcrisis stages are beyond the scope of this paper (i.e., publics' informational behaviors during a crisis). In addition, public's presence on social media is especially salient during a crisis, which may provide us the opportunity to study publics' needs and concerns.

Publics' shared information reflects their needs and concerns in a certain stage, and the organization should act to address them either in a retrospective or prospective way. A triggering event marks the initial event stage (Reynolds & Seeger, 2005). "A problem does not exist until we recognize it." (Kim & Grunig, 2011, p. 128) Publics, as problem solvers, recognize the problem first and then take active communicative actions, such as information forwarding. Realizing a crisis, publics expect organizations to communicate rapidly to reduce uncertainty, establish self-efficacy, and provide reassurance (Reynolds & Seeger, 2005). Publics may show a predominant preference for information serving these goals, such as real-time crisis-related information and news. Following this logic, during this stage, we expect more general crisis-related information to be shared from general-interest media sources, such as daily news covering what happened.

During the stage of maintenance, publics seek to understand the ongoing crisis more accurately and get to know the background issues (Reynolds & Seeger, 2005). Publics' shared information may revolve around the "why" question. Correspondingly, information that satisfies publics' needs and had high informational value may include more background and attribution information, which helps people make sense of the crisis and conduct crisis-related decision-making (Rudat, Buder, & Hesse, 2014). During this stage, we expect the shared information to be more detailed and in-depth crisis-related information, which may address more diverse aspects of the crisis, such as financial analyses of the crisis' impact.

During the resolution stage, as time goes by, attention toward the crisis fades and the volume of shared information may decrease. At this stage, publics stop making sense of the crisis. During this stage, publics may expect crisis communication effort that facilitates open discussion, resolves issues, and provides a closure. Thus, the shared crisis information may become less diverse.

Based on the previous discussion on the stage-based model (Reynolds & Seeger, 2005; Sturges, 1994) and the situational theory of publics (Grunig, 1997), as publics' informational needs change, their influence varies based on crisis stages. This is because publics choose to share different information by following different sources. As such, we propose the following research question:

RQ3. Are there different publics (i.e., influentials, followers, and broadcasters) in each stage?

Based on the stage-based model (Reynolds & Seeger, 2005; Sturges, 1994), different themes and forms of publics' shared messages may exist in different stages. By understanding the change of publics' shared information on social media, organizations will be able to customize communication content to the changing public opinions and maximize communication effectiveness in different stages (Sturges, 1994). Thus, the following research question is proposed:

RQ4. Are there changes in publics' shared messages (i.e., diversity of the message themes, the prevalence of message themes, and forms of the messages) on social media?

The Chipotle *E. coli* crisis as a case

From October to December in 2015, two *E. coli* outbreaks affected approximately 60 people. According to the report by Center for Disease Control (2016), in the initial larger outbreak in October 2015, 55 people in 11 states were infected by STEC O26, a rare strain of *E. coli*, with 21 of them hospitalized. The majority of the illnesses were reported in Washington and Oregon during

October 2015. And 43 Chipotle restaurants in the surrounding areas were closed for over a month, waiting for health authorities' investigation results. In a later smaller outbreak in November 2015, five people in three states were infected, with one of them hospitalized.

Twitter is a unique and useful platform for investigating crisis communication on social media. Twitter is very popular with 320 million users worldwide (Twitter, 2016). Among public relations practitioners, Twitter is the most accessed social media platform (Wright & Hinson, 2014). More important, Twitter enables us to investigate publics' interactions in a real crisis, because it is functionally interactive (Saffer, Sommerfeldt, & Taylor, 2013) and allows ongoing and immediate dynamic communicative behaviors (Smith, 2010).

We chose the Chipotle *E. coli* crisis on Twitter to study publics' informational behaviors on social media for a few reasons. First, the Chipotle crisis was influential and typical. The *E. coli* outbreak affected people in more than 11 states and was one of the most breathtaking crises of 2015 (Holmes Report, 2016). The Chipotle crisis was also a very typical accidental crisis, a type of crisis emphasized in the crisis communication literature (Ma & Zhan, 2016).

Moreover, a heated discussion that involved multiple publics appeared on Twitter. From November 1, 2015, to February 1, 2016, there were more than 40,000 tweets that included "Chipotle" and "*E. coli*." This discussion involved not only Twitter accounts of individuals, but also accounts of media (e.g., newspaper, television, electronic media), government agencies, activist groups, and lawyers. The coexistence of multiple publics in the dialogue enables us to investigate their roles during a crisis.

Last, the social media discussion of the *E. coli* crisis spanned six months, from October 2015 to February 2016, which allows us to study the dynamics of publics and their share information. Based on our stage-model framework, we divided the Chipotle crisis into three stages (see Figure 1). The first stage, initial event stage, was marked by the triggering event (Reynolds & Seeger, 2005). On October 31, 2015, a total of 22 people got infected with *E. coli* at Chipotle in Oregon and Washington. The crisis transitioned to the second stage (i.e., maintenance stage,) when the initial outbreaks were over and Chipotle declared that no more cases were found in early November. The third stage, resolution stage, was marked by CDC's statement that the Chipotle-linked outbreak of *E. coli* appeared over in February 2016. By issuing the statement, CDC provided a closure for the crisis. At the same time, Chipotle developed several initiatives to solve the issues in the crisis.

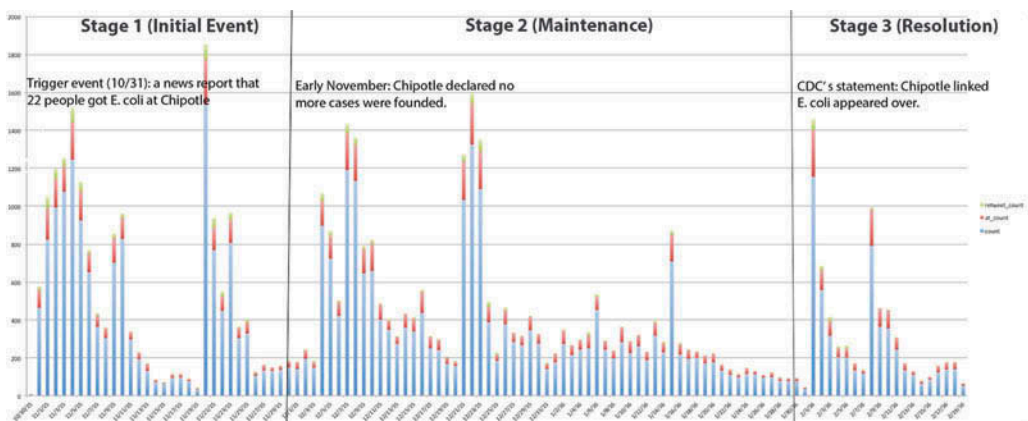


Figure 1. Chipotle *E. coli* crisis on Twitter timeline.

Note. The green bar indicates number of retweets, the red bar indicates number of mentions, and the blue bar indicates number of tweets with no retweets or mentions. The three add up to the total volume of tweets on a daily basis from October 30, 2015, to February 14, 2016.

Methods

Our study aims to segment social media publics based on their shared information in a crisis and to examine the shared message themes in different crisis stages for strategic social media management. A multimethod approach combining network analysis and content analysis was employed to achieve our purposes. On the one hand, we conducted network analysis to segment and prioritize publics in the Twitter-mediated crisis by the interactions among users who retweeted the keywords for our study. On the other hand, we performed content analysis to analyze whether and how publics and their shared message characteristics (i.e., prevalence, diversity, and form) changed in different crisis stages. The case of the Chipotle crisis on Twitter was used.

Data collection

We collected crisis-related tweets from October 31, 2015 to February 14, 2016. Because we aim to assess publics' informational behavior in the crisis, we are only interested in the crisis-related tweets rather than the whole universe of tweets during the crisis. Operationally, tweets that match at least one of a set of predefined keywords (e.g., "Chipotle *E. coli*") within the crisis period were collected. To capture different expressions of the same concept, variations of the keyword were incorporated by using regular expressions, a well-established pattern matching algorithm (Thompson, 1968). For example, the regular expression "[Ee] (\.) (\s*)coli" would match "e.coli", "E. coli", "E.coli", and "E. coli" (i.e., [Ee] matches "E" or "e", (\.) matches the dot, and (\s*) matches zero whitespace or more). Twitter only provides open access to a sample of tweets in the past week through Search API. To overcome this limitation and capture a full set of crisis-related tweets, we archived the search results returned by twitter.com and then parsed the web archiving WARC files into JSON format data frames with text and metadata (e.g., tweet unique number, time posted). After cleaning, the dataset has 40,610 unique tweets for the Chipotle crisis.

In addition, for all users who tweeted at least once in our dataset, we fetched their user information and profiles through the R package of TwittR and linked their information with their tweets. As we are interested in users' informational network, only a subset of tweets that had both senders and receivers was used in this study (see Figure 1). Receivers are operationalized as those to whom a tweet is directed through a *retweet*. A retweet is a re-posting of a tweet from another Twitter account through markers including *RT*, *via* or *by*. Retweet indicates users' consumption of information from a source and their subsequent dissemination and sharing of such information. A mention tweet contains another user's name anywhere in the body. Mention indicates the relevance and importance of a source (which does not necessarily produce content) in the crisis. To capture the content-level influence emphasized by SMCC, retweet was used as a proxy for influence in our study.

Network analysis

Scholars have used centrality measures to assess a node's influence based on its position in the network (Himmelboim et al., 2014; Rowley, 1997; Sedereviciute & Valentini, 2011). We employed the network degree centrality to differentiate publics. Degree centrality indicates the number of connections one has with other nodes in the network. In Twitter's information sharing network, nodes are Twitter users and edges are users' retweeting behavior. In-degree centrality is the number of retweets one receives and out-degree is the number of retweets one sends in the network. On one hand, the magnitude of degree centrality captures the salience of a node in the network; on the other hand, the in-degree and out-degree measures differentiate information production and sharing. Those who share information have out-degree scores and those whose information is shared have in-degree scores.

First, influentials are characterized by retweet in-degree, the number of retweets one receives. Nodes that receive relatively high in-degrees (20 in this case¹) and low out-degrees are identified as top influentials. Second, followers are characterized by retweet out-degree, the number of retweets one sends. Followers are expected to have both low out-degree and in-degree scores. Last, broadcasters are expected to have moderate or high in-degree and out-degree scores (3 in this case). They connect influentials and followers both within and across communities in the network.

We constructed our Twitter network based on the retweet relationships between Twitter users. Each connected sender or receiver is considered as a node in the network ($N = 1,568$). An edge that links a sender and its receiver indicates a directional informational connection between two nodes ($N = 1,455$). Density indicates the level of interconnectedness of a network as a whole. Rowley (1997) believed that publics are more likely to establish shared behavioral expectations toward the organization in a denser network. So, we calculated density as an indicator of the overall social media public environment for an organization.

Content analysis

Coding characteristics of publics

We performed content analysis on a total of 482 tweets directed to the top influentials ($n = 20$) that we identified in each stage. A codebook was developed by the researcher based on literature on crisis communication and a general examination of the current data for the Chipotle crisis. To assess the change of publics, we coded two characteristics of publics: roles and predispositions. Two independent coders coded roles of publics into one of following categories: (1) print media (newspaper/magazine/news agency); (2) television/radio; (3) online news media/media blog; (4) companies/corporations; (5) government, association, and other legislative organizations; and, (6) individuals. Additionally, publics' predispositions (i.e., interested topics and needs) were coded from their Twitter profiles into the following 10 categories: journalism/hosting/publishing; strategic communication (i.e., public relations, marketing, advertising); business/finance/enterprise/consumer; health/nutrition/pharmacy/science; agriculture/produce/farming; dining/food/restaurant; entertainment/humor/sarcasm; law/attorney/politics/civil rights; general source of information (e.g., Twitter content aggregators and distributors who provide updated information in a variety of areas); others.

Coding message characteristics

Based on the codebook, there are two types of message characteristics: themes and forms. Two coder coded the major and secondary message theme of a tweet from the following nine categories: public health crisis (e.g., *E. coli* outbreak expanded), legal issue/consumer's rights (e.g., victims sued Chipotle), financial loss (e.g., the stock price fell), business operation (e.g., Chipotle closed stores), strategic communication (i.e., public relations, marketing, communication), search of the source (e.g., CDC located the source), humor/satire, conspiracy theory (e.g., Chipotle's competitors plotted the corporation sabotage), and others. For example, a shared piece of news discussing the lawsuits amid a public health crisis was coded to have the major them of legal issue/consumer's rights and the secondary theme of public health crisis. If there was only the major theme, the coder could indicate N/A on the secondary theme. Furthermore, the form of a tweet was coded from the following three categories: live coverage (e.g., factual information such as news), opinioned commentary (e.g., in-depth information that provides opinions for reads), and others.

¹The specific number of in-degree that defines key influentials depends on publics' activity surrounding the crisis. In a crisis where the volume of tweets gets larger, the criteria for identifying key influentials should change. 20 is not a definitive number. The same principle applies to the identification of broadcasters, too.

Coders and intercoder reliability

Two coders were trained for the purpose of content analysis. We had two rounds of coder training. For coding publics, after the second round of training, Krippendorff's Alpha as a reliability check was calculated on 20% of the original data ($\alpha = 0.88$ for types of publics and $\alpha = 0.77$ for predispositions of publics). Having achieved satisfactory intercoder reliability, the two coders split the task and coded the remaining data separately. For coding message characteristics, after training, both coders coded all the tweets in the subset (i.e., the highest level of reliability). Disagreement between the coders was resolved by discussion. For a total of two tweets, two coders' disagreement cannot be solved. So an additional coder was introduced and the final labeling of a tweet was decided by majority votes.

Measures of message themes: prevalence and diversity

With the coded nine types of message themes, we established two measures for quantitatively measuring message themes. First, *prevalence* measures the dominance of a single message theme, by counting the number of times a particular message along with its theme was retweeted. The publics on Twitter typically pick up a limited number of news articles and retweeted these themes multiple times. The most prevalent message themes were detected through the mode and its lower 20% numbers.

Second, *diversity* measures the variety of message themes as a whole in a certain stage. Diversity discounts the number of times a particular message was retweeted. For example, a prevalent news article was retweeted 40 times but only represented one major message theme. So the diversity of themes is likely to be low if there is only one dominant message theme in a stage. To quantify diversity, we introduced entropy, which captures the randomness in an information system (Cover & Thomas, 2012) and has been applied by social scientists to measure cultural diversity (e.g., Niebuhr, 2010). A higher entropy value indicates a higher diversity of message themes.

Analytical strategies

To answer RQ1 and RQ2, we first constructed the retweet network through Gephi, open-source social network analysis software. Then we calculated the in-degree and out-degree centrality measures for each node in the network. Based on the calculation, we visualized nodes in a two-dimensional space where the x-axis represents retweet in-degree and the y-axis represents retweet out-degree for differentiating publics (Figure 2).

For RQ3, several pairwise chi-squared tests were performed to examine whether there is any significant relationship between publics (i.e., roles and predispositions) and crisis stages. Similarly, to answer RQ4, chi-squared tests were conducted to examine whether there is any significant relationship between message characteristics and crisis stages. Three message characteristics were examined: prevalence, diversity, and forms.

Results

We constructed our retweet network through Gephi (see Table 1). Our retweet network had a total of 1,568 nodes and 1,455 edges. The overall network had a very low density (0.001). For in-degree centrality, the mean was 0.93 and the median was zero. 26.76% ($n = 419$) nodes received at least one in-degree, meaning that they were retweeted at least once. For out-degree centrality, the mean was 0.93 and the median was one. 76.02% ($n = 1,192$) nodes retweeted at least one message. To note, the retweet relationship is nonreciprocal: those retweeted other users was not retweeted back. The one-directional edges between suggested asymmetrical relationships between nodes in our network. Below we detailed the results for each RQ.

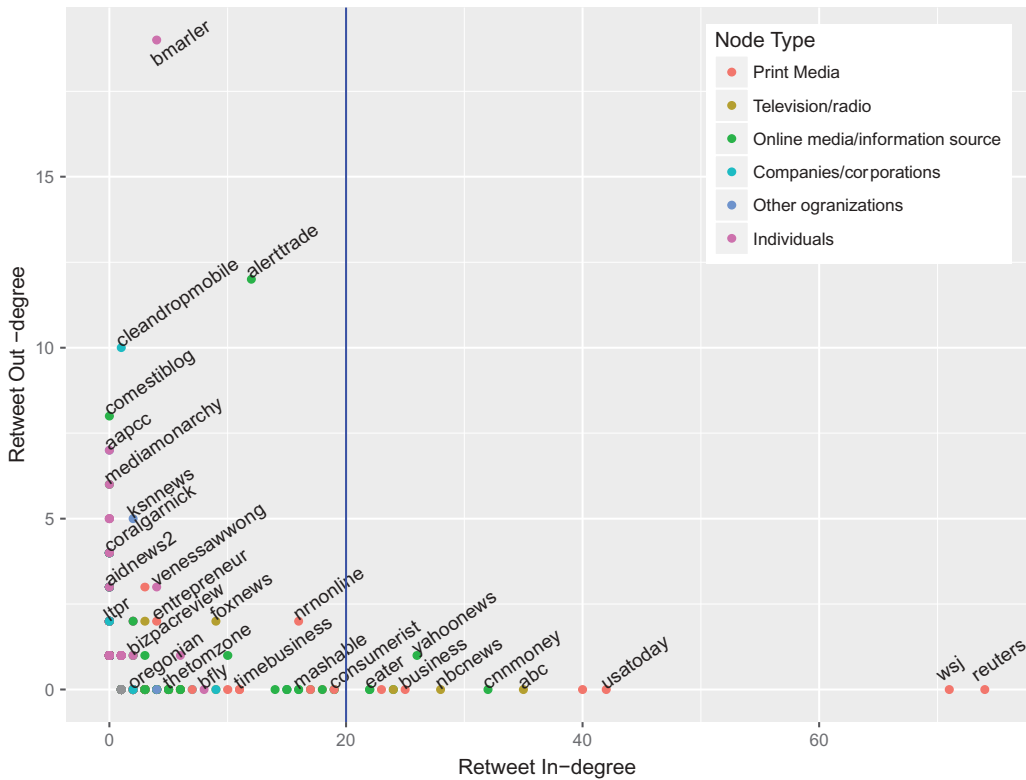


Figure 2. Publics by usernames and node types in the chipotle network.

RQ1&2. Types of publics in the social media network

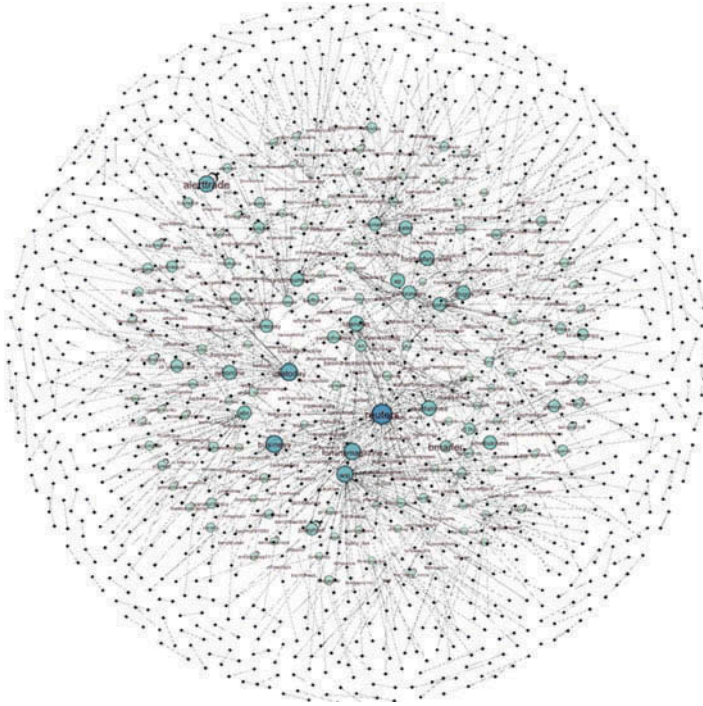
Influentials

We identified influentials from their relatively high in-degree (i.e., the number of retweets one receives) and very low out-degree (i.e., the number of retweets one sends). In the information-sharing network, influentials occupied the central positions (Table 1). Within their egocentric network (i.e., a node's network within one step for describing the ties around an individual node), influentials were also centroids surrounded by followers. Top influentials, such as Reuters, Wall Street Journal, and USA Today, received a minimum of 20 in-degrees. All 14 top influentials were media outlets (see Table 2). Among the top influentials, 43% ($n = 6$) top influentials were print media and news agency, including newspaper, magazine, or news agency; 21% ($n = 3$) top influentials are television or radio; and the remaining 36% ($n = 5$) top influentials were online news media or media blog. Regarding the two crisis-related organizations, CDC had 15 in-degrees and Chipotle's official Twitter account had 9 in-degrees and were thus not listed as top influentials.

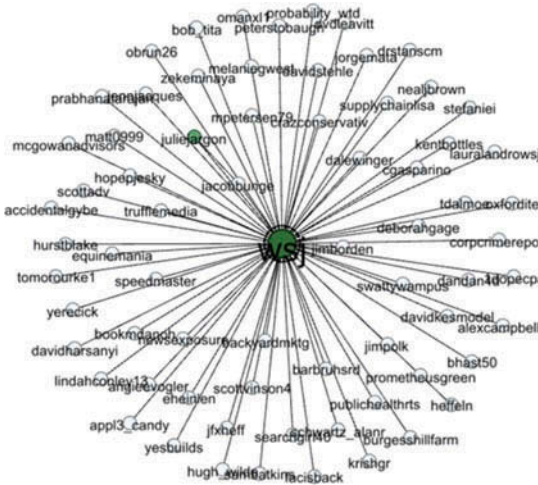
Followers

Those who have low out-degree and in-degree scores were identified as followers. Interestingly, most followers only retweeted one or two influentials in the crisis. And most followers had zero in-degree, indicating their extremely weak influence over other nodes in the network (Table 2). Followers occupy peripheral positions and circle around influentials (Tables 1 and 2). Together, followers and influentials formed various communities in the network. In Figure 2, we can further differentiate followers from their clustering at the very lower left bottom of our plot (close to the origin point). 75% Twitter users ($n = 1180$) were identified as followers. Most followers were individuals.

Table 1. Publics' retweet network on Twitter.



Wall Street Journal: Egocentric Network



CDC: Egocentric Network

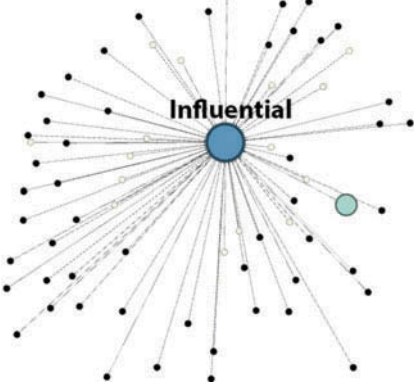
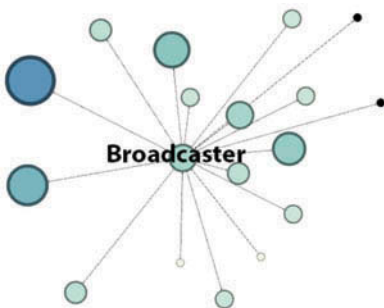
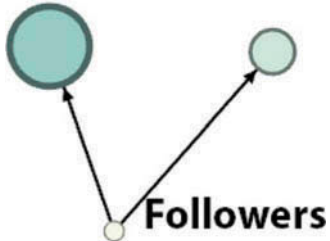


Note. Egocentric network means a node's network within one step. It is used for describing the ties around an individual node. Social media publics include both message receivers (i.e., audience), but also message producers (e.g., media agencies).

Broadcasters

Broadcasters had moderate or high out-degree and in-degree scores (see Table 2). Compared with followers who commonly retweeted from one or two influentials, many broadcasters retweeted multiple influentials. At the same time, broadcasters themselves were also retweeted by followers. Broadcasters are more “influential” than follower because they created contents picked up by other publics. But with less influence than top influentials, some broadcasters retweet themselves multiple

Table 2. Types of social media publics in the Chipotle crisis.

	Characteristics	Egocentric Network	Top Users
Influentials	(1) A central position in the network; (2) A relatively high in-degree; nearly zero out-degree; (3) Be visually separable with followers on the plot.		@reuters (ind = 74) @wsj (ind = 71) @usatoday (ind = 42) @fortunemagazine (ind = 40) @abc (ind = 35) @cnnmoney (ind = 34) @nbcnews (ind = 28) @yahoonews (ind = 26) @business (ind = 25) @yahoohhealth (ind = 24) @cbsnews (ind = 24) @seattletimes (ind = 23) @youtube (ind = 22) @eater (ind = 22)
Broad-casters	(1) Relatively high out-degree compared to followers (they usually retweeted multiple influentials); (2) At least one in-degree; (3) Be visually separable with followers on the plot.		@bmarler (od = 19; ind = 4) @alertrade (od = 12; ind = 12) @cleandropmobile (od = 10; ind = 1) @ksnnews (od = 5; ind = 2) @venessawong (od = 4; ind = 3) @denverpost (od = 3; ind = 3)
Followers	(1) Have at least one out-degree; (2) Have nearly zero in-degree; (3) Lump at the lower left bottom of the plot; Be visually separable with influentials and broadcasts.		@calestous (ind = 0; od = 5) @medpagetoday (ind = 0; od = 4) @lisabaertlein (ind = 0; od = 3) @scottadv (ind = 0; od = 2) @komonews (ind = 1; od = 1) @serpentine202 (ind = 0; od = 1)

Note. Egocentric network means a node's network within one step. It is used for describing the ties around an individual node. Ind = In-degree; od = out-degree. In-degree centrality is the number of retweets one receives and out-degree is the number of retweets one sends in the network.

times (i.e., self-loops in the network) to gain more followers. In the network, broadcasters connected different communities (Table 1).

In Figure 2, important broadcasters included @bmarler, an opinion leader on food safety and lawsuit, and @alertrade, a Twitter information aggregation source. For instance, @bmarler, a Seattle-based food poisoning lawyer, retweeted 19 messages from multiple influentials such as Reuters, Fortune Magazine, Time Magazine, and Seattle Times. At the same time, @bmarler received 4 retweets of his food safety blog content. Another user, @alertrade, a trading information aggregation source, sent out 12 self-retweeting messages.

RQ3. Change of publics by stages

Influentials

Our descriptive statistics showed that top influentials changed based on crisis stages (Table 3). Most top influentials in the initial stage were general-interest media (89%), including print media/news agency (e.g., Reuters) and television/radio (e.g., NBC News). In the maintenance stage, top influentials were traditional (55.6%) and online (44.4%) media outlets with specialty, such as business (e.g., Wall Street Journal), finance (CCN Money), public relations (e.g., PR Week), and health (r.g., YahooHealth). Surprisingly, two hoax news websites (e.g., @HealthRanger) became top influentials. In the resolution stage, most top influentials became online media (67%). Across stages, Reuters and Wall Street Journal were the only influentials that maintained their popularity. Commonly, new influentials emerged in the subsequent stage and replaced these influentials in the prior stage.

Followers

Our chi-squared results also showed that followers significantly changed across stages (chi-squared value = 18.56, $p < .01$). Particularly, among the followers of the top influentials, 96%, 99%, and 88% of them were individuals in Stages 1, 2, and 3 respectively. There were more followers of organizations (i.e., companies, governmental sectors, or associations) in Stage 3 (11.67%), as compared to those in Stage 1 (3.13%) or Stage 2 (1.44%). Furthermore, our results showed that there was a significant relationship between followers' predispositions (i.e., interested topics and needs) and the crisis stages (chi-squared value = 30.61, $p < .001$ for comparing themes in stages 1&2; chi-squared value = 20.67, $p < .01$ for comparing themes in stage stages 2&3; chi-squared value = 6.72, $p > .05$ for comparing themes in stages 1&3). The most dominant followers' interested themes were general information, health and journalism in the first stage and strategic communication in the second stage. In the final stage followers' interested themes distributed more equally.

Broadcasters

Across stages, broadcasters can be individuals, organizations, or financial content aggregators. But broadcasters only existed in the initial event and maintenance stages of the crisis (Table 3).

RQ4. Change of message characteristics by stages

Prevalence of themes

In the crisis, the most popular themes at all times were public health crisis ($n = 176$), search of the source ($n = 109$), business operations ($n = 103$), and strategic communication ($n = 80$). But our pair-wise chi-squared tests showed that the prevalence of message themes significantly changed by crisis stages. First, there were significant associations between the prevalence of major message themes and crisis stages, namely for Stages 1 and 2 (chi-squared value = 149.49, $p < .001$), Stages 1 and 3 (chi-squared value = 100.00, $p < .001$), and Stages 2 and 3 (chi-squared value = 56.68, $p < .001$). We used mode (and any number below 20% of the mode) to identify the dominant message themes for each stage.

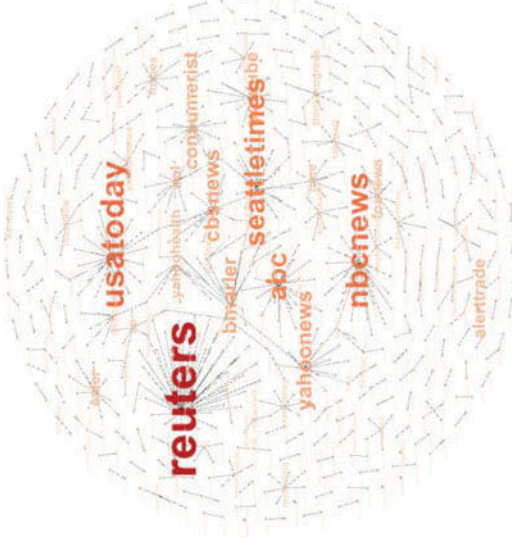
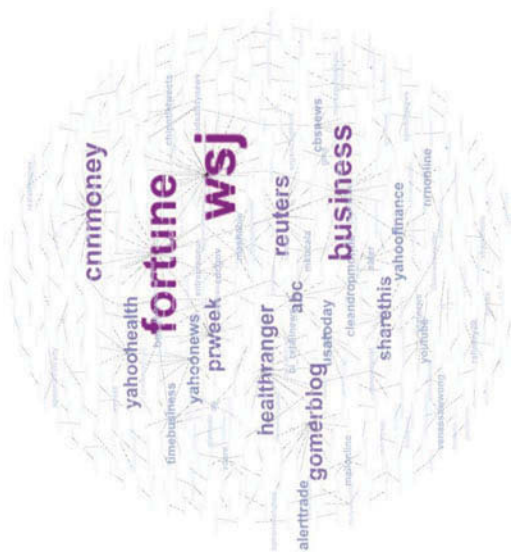
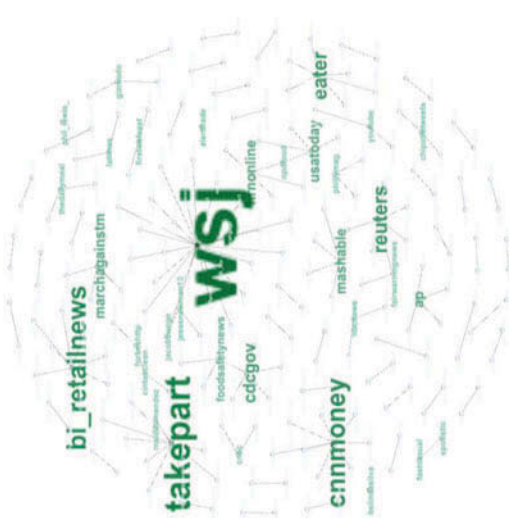
As shown in Figure 3a, in the first stage, the dominant major theme was the public health crisis. In the second stage, the dominant major themes were the financial loss, the operation of business, and strategic communication. The search of the source was the dominant theme in the third stage. In addition, there were also significant associations between the prevalence of secondary message themes and crisis stages (all chi-squared p -values $< .001$; see Figure 3a).

Diversity of themes

Our pair-wise chi-squared tests showed that the diversity of major themes was significantly associated with the crisis stages, particularly for Stages 1 and 2 (chi-squared value = 33.06, $p < .001$), for



Table 3. Evolution of the social media information sharing network.

Initial Event (10/31–11/01/2015)	Maintenance (11/02–01/31/2016)	Resolution (02/01–02/14/2016)
		
<p>Top Influentials Reuters (51) USA Today (28) NBCNews (26) Seattletimes (23) ABC (22) CBSNews (16) YahooNews (16) Consumerist (14) Youtube (13)</p>	<p>Top Influentials WSJ (42) Fortune Magazine (35) Business (23) CNNMoney (20) Reuters (17) GomerBlog (16) HealthRanger (15) PRWeek (15) YahooHealth (13)</p>	<p>Top Influentials WSJ (25) TakePart (11) BL_RetailNews (8) CNNMoney (8) Eater (6) Reuters (6)</p>
<p>Broadcasters @bmarler @Alerttrade @icpress @medicker</p>	<p>Broadcasters @CleanDropmobile @Alerttrade @bmarler @Venessawwong @Entrepreneur</p>	<p>Broadcasters None</p>

Note. Only in-degrees are provided in the brackets for top influentials.

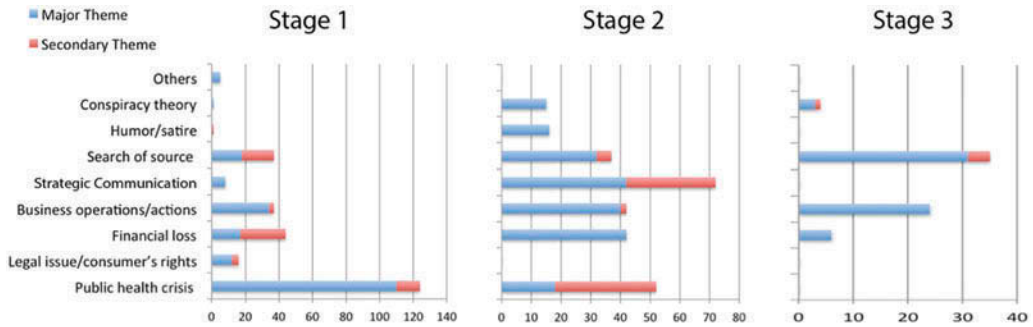


Figure 3a. Prevalence of message themes by stages.

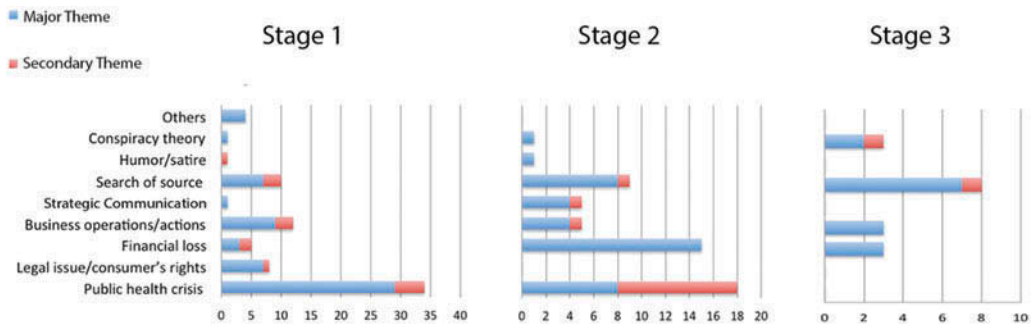


Figure 3b. Diversity of message themes by stages.

Stages 1 and 3 (chi-squared value = 26.03, $p < .001$), but not for Stages 2 and 3 (chi-squared value = 12.07, $p = .06$). Specifically, there was a higher diversity of major message themes in Stage 2 (entropy = 2.37) as compared to Stages 1 (entropy = 2.30). In Figure 3b, we can see that the public health crisis theme dominates the initial stage; and there was a much higher diversity of major themes in the subsequent stage (i.e., Financial loss, search of the source, and public health crisis). And there was a higher diversity of major message themes in Stage 1 (entropy = 2.30) as compared to Stage 3 (entropy = 1.83). In Figure 3b, we can see that the diversity of major themes decreases with search of the source being the most dominant major theme. Additionally, the diversity of secondary themes was only significantly associated with the crisis stages 2 and 3 (chi-squared value = 10.67, $p < .05$).

Message form

From our chi-squared tests results, the form of a message was also significantly associated with crisis stages (chi-squared value = 18.56, $p < .01$). Specifically, in Stage 1, all coded tweets ($n = 188$) were live coverage stories that stressed factual information; in Stage 2, 41.80% of tweets ($n = 79$) were in-depth reports whereas 58.20% ($n = 110$) were live coverage stories; in Stage 3, half of tweets ($n = 34$) were live coverage stories and the remaining half ($n = 30$) were in-depth reports.

Discussion

By applying an interactional and dynamic perspective to the Twitter data of the Chipotle *E. coli* crisis, our study provides a typology of social media publics based on their shared information in a

network. Results from social media big data support the validity of our typology by empirically identifying influentials, followers, and broadcasters in the social media network. Crisis managers should pay more attention to publics who have higher influence, namely top influentials and broadcasters. Results from the content analysis showed that social media publics and their shared information changed based on the crisis stages. Crisis managers should deliver messages based on what the target audience needs to know at a particular crisis stage. With our segmentation, crisis managers can make a more strategic choice in dealing with publics at a certain crisis stage.

First, our segmentation of social media publics receives empirical support from Twitter big data. In the information-sharing network of the Chipotle crisis, three types of social media public were identified, including influentials, broadcasters, and followers. In the network, there were multiple communities with a single influential as the centroid surrounded by its followers. Broadcaster connected influentials and followers across communities. Partially consistent with SMCC, influentials in our crisis were organizations, mostly traditional and online media outlets (Austin et al., 2012). Unexpectedly, Chipotle and governmental agencies such as CDC were not key influentials in the crisis. This could be a reason for the spread of false information and even rumor (e.g., Chipotle used dog and cat meat in food) from hoax news websites in the crisis. Followers in the crisis were mostly individuals, lending support for SMCC. Interestingly, broadcasters in our crisis are domain experts, including individuals, organizations, and financial content aggregators.

Furthermore, we found that key influentials changed by crisis stages. In the initial event stage, most influentials were general-interest traditional media. In the maintenance stage, more influentials became media with a specialty, such as business, public relations, or health. In the final stage, there were fewer key influentials and most of them were online media. Regardless of crisis stages, most followers were individuals. But there the predispositions of followers changed by crisis stages, accompanying the change of top influentials. For example, followers were interested in the areas of general information, health, and journalism in the initial event stage, but followers were interested in strategic communication in the maintenance stage. Broadcasters were only found in the initial event and maintenance stages. Together, these findings suggest the importance of adopting a situational perspective to manage social media publics in our crisis.

Last, our results unveiled that social media publics shared different message themes and forms in different crisis stages. In the initial event stage, publics predominantly shared factual news reports with the theme of public health crisis. In the maintenance stage, publics preferred sharing a variety of more opinionated messages, including those with the themes of financial loss, operation of business, and strategic communication. One reason for the change may be that after the initial breakout, publics tried to make sense of the crisis by seeking more in-depth media coverage and a diversity of opinions (Reynolds & Seeger, 2005). In the resolution stage, diversity of themes again became quite low.

Our results extended the stage-based model emphasizing the changing nature of a crisis (e.g., Reynolds & Seeger, 2005; Sturges, 1994) to the social media context. Given that social media publics' shared messages reflect their needs and concerns, Chipotle should enact social media crisis management to address publics' changing concerns in a crisis. Namely, Chipotle can customize their crisis communication by considering the diversity, prevalence, and forms of shared messages. For example, publics had a diversity of interested topics in the maintenance stage. So Chipotle should tailor their communication to target a particular group's informational needs.

Theoretical implications

Based on literature from public relations, crisis communication, and management, our typology of social media publics in organizational crises refines our understanding of stakeholder segmentation and dynamics in the social media context. New influentials emerge on social media. Followers form diverse informational communities by selectively sharing crisis information from their preferred sources. Broadcasters connect different communities in early stages of a social-mediated crisis. The

massively shared information may affect publics' understanding of the crisis and their evaluation of the organization. So the organization in a crisis should strategically manage influentials and broadcasters on a certain social media platform in a crisis.

Furthermore, our study highlights the efficacy of a situational perspective to crisis management on social media (Grunig, 1997; Jin & Liu, 2010; Kim et al., 2008). Due to the wane and wax of multiple voices throughout crisis stages, there may be different key influentials and broadcasters in each stage. These entities' messages impact the predominance and diversity of crisis narratives. As such, crisis managers should adjust their prioritization of publics based on crisis stages and customize response strategies for different publics by addressing narratives shared by these different publics.

In summary, an organization's message targeting and mapping strategies should be more inter-*actional* and dynamic in the social media crisis context. Future research should empirically test the effectiveness of message targeting and mapping on social media based on our typology to bridge formative research (i.e., segmentation of publics) and evaluative research (i.e., effectiveness of such segmentation).

Managerial implications

Numerous managerial implications can be derived from the typology of social media publics developed and tested in this study. First, organizations should place the highest priority on key influentials, whose content can reach more social media publics during crises. Crisis managers should still emphasize media relations. In addition, organizations should build relationships with broadcasters. Although broadcasters reach fewer publics, information or opinions from broadcasters may be perceived as more relevant or credible by certain members of publics. For example, an investor may seek information both from financial news media and an opinion leader with financial expertise. If the investor has little knowledge in finance, he or she may rely on the opinion leader to interpret the information from media.

Second, crisis communication managers should enact strategic social media management to address (1) different publics' needs in a certain stage, (2) publics' concerns in different stages. On one hand, publics have high uncertainty in the initial event stage. Organizations should provide instructing information and corrective action through traditional media. Given the low diversity and high dominance of certain message themes in the first stage, organizations do not need to tailor content for different publics. During the maintenance stage, organizations should provide information that help publics make sense of the crisis. If there is a high diversity of message themes, an organization may need to provide information from different angles for different communities of publics. For example, for health-related media outlets, an organization should prepare press release from the angle and implications of health. Furthermore, organizations should handle incredible influentials that spread false information by debunking the rumor on their own or through influentials/broadcaster.

Limitations and future directions

Our study has several limitations. First, only Twitter data were used in our study. Future studies should use data from other social media platforms, such as Facebook or Instagram. Second, social media publics can form connections through a verity of informational behaviors, including sharing and commenting. Future studies can explore additional informational behaviors such as commenting. Third, researchers should generalize our results to other crisis with caution, because the Chipotle crisis is a single case of organizational crises. Future studies should test our segmentation in different crises. Last, those who did not express any opinion (i.e., inactives, Austin et al., 2012) or did not use any crisis-related keyword were not included in our dataset. Future studies should examine these inactive publics on social media during crises.

Conclusion

With a public-centric perspective highlighting publics' interaction and dynamics, our study segments and analyzes social media publics based on how their shared information flows in a network. Twitter big data of the Chipotle crisis provides initial support for our segmentation. Researchers should work on refining our typology of social media publics and generalizing our results to different strategic communication contexts. With the segmentation, an important question becomes how an organization can more effectively engage these different publics. To answer the question, future research should test the effectiveness of social media message targeting for different publics.

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Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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