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Developing a multi-level organization-public dialogic communication framework to assess social media-mediated disaster communication and engagement outcomes

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ABSTRACT

Dialogic communication has long been viewed as vital for effective organization-public relations. Yet, it is under-theorized whether and how organizations' disaster communication messages may embody dialogic communication principles, and how various dialogic features are associated with different public engagement outcomes on social media. Extending the Organization-Public Dialogic Communication (OPDC) framework to the context of social media-mediated disaster communication, we propose a multi-level framework to assess the dialogic capacity of Facebook messages sent by disaster management organizations during a natural disaster. Three levels of dialogic communication characteristics (i.e., message structure-level, topic-level, and linguistic level) are examined using content analysis and Linguistic Inquiry and Word Count (LIWC). Results identified media richness, correcting, and confirming topics as three consistent predictors of public engagement of all types. Meanwhile, there exhibit greater variations regarding how other topical features and linguistic characteristics are related to public's cognitive, emotional, and behavioral engagement during a disaster.

1. Introduction

Dialogues and public engagement have been viewed as the sine qua non for meaningful stakeholder relationships and effective organization-public communication (Bruning, Dials, & Shirka, 2008; Kent & Taylor, 1998, 2002; Taylor & Kent, 2014). Defined as open, honest, ethical, and respectful communication oriented towards genuine dialogue with the public (Kent & Taylor, 2002), dialogic communication has the potential to generate positive public relations outcomes such as improved customer satisfaction, citizen-government relationships, and organizational image (Canel & Luoma-aho, 2018; Kelleher, 2009; Men & Tsai, 2014). The growing attention on dialogic communication coincides with the rapid adoption of social media among organizations (Avery et al., 2010; Nah & Saxton, 2013). The connective features of these networked platforms afford promising opportunities for two-way, interactive communication between organizations and their publics, which is often the precursor of dialogue (Kent, 2013).

However, dialogic communication via social media is still underutilized during everyday organization-public communication (Bortree & Seltzer, 2009; McAllister, 2012; Waters et al., 2009). There is even less scholarly attention paid to dialogic communication during disaster situations, as conventional disaster management focuses more on delivering unequivocal information than maintaining dialogues with the affected publics (Seeger, 2006). Nevertheless, dialogic communication during a disaster can bring enormous benefits. For government and emergency management organizations, the practice of dialogic communication is not only vital for the organizations to identify and respond to public needs amid chaos, but it also enhances the public's accountability perception of an organization (Yang, Kang, & Johnson, 2010).

Given there is little empirical work investigating the dialogic orientation exhibited in social media messages for strengthening community resilience in the context of natural disasters, the current study seeks to bridge this gap by extending the organization-public dialogic communication framework (OPDC) (Kent & Taylor, 2002; Yang et al., 2010; Yang, 2018) to the realm of social media-mediated disaster communication. It is among the first to 1) conceptualize a multi-level dialogic communication framework to analyze social media messages

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from public agencies during a natural disaster, and 2) explore the empirical relationships between various dialogic features of social media messages and the subsequent engagement outcomes.

Below, we first review the concept of engagement, situating it specifically in the context of social media-mediated communication. We then introduce the general OPDC framework, expanding it as a multi-level framework to measure social media messages for disaster communication. Lastly, we randomly selected and analyzed a sample of 1,360 Facebook posts from 55 government and emergency management organizations during a natural disaster. Results identify significant divergence in terms of which message, topical, and linguistic features are associated with each type of public engagement on Facebook.

2. Literature review

2.1. Social media-mediated engagement

The definitions of engagement vary across diverse strategic communication literature (Johnston & Taylor, 2018; Kang, 2014). In a comprehensive review of current conceptualizations of engagement, Taylor and Kent (2014) identified different forms of engagement from social media engagement, employee engagement, CSR engagement, civic engagement, to dialogic engagement. Under each one of these conceptualizations, engagement may be differently viewed as a process, an outcome, or a state.

In the context of organization-public communication, Johnson and Taylor (2018) define public engagement as a "dynamic multi-dimensional relational concept featuring psychological and behavioral attributes of connection, interaction, participation, and involvement, designed to achieve or elicit an outcome at individual, organizational, or social levels" (p. 18). Three dimensions of engagement emerge from this definition, *cognitive*, *affective*, and *behavioral* (Johnson & Taylor, 2018). Cognitive engagement refers to individuals' attention to develop the understanding of knowledge; affective engagement includes positive and negative emotional reactions; and behavioral engagement embodies actions such as interaction, participation, or collaboration.

A similar distinction has been made between the *behavioral* versus *psychological* dimension of engagement online. Men and Tsai (2012, 2015) conceptualized public engagement as a behavioral continuum characterized by varying levels of activity, ranging from passive message consumption, two-way conversation, participation, to online recommendation. Behavioral engagement is thus operationalized as "the physical manifestation of an engaged state", reflected by online metrics such as the number of clicks, comments, retweets, or the amount of content generated by users (Kang, 2014, p. 400). Meanwhile, psychological engagement is indicated by the emotional or affective reactions emerging from organization-public encounters, such as absorption (i.e., paying attention to an organization's activities), attachment (i.e., a sense of belonging), or affection (i.e., feeling of like and support) (Kang, 2014).

As one of the most widely adopted social media platforms (Kim, Kim, & Nam, 2014), Facebook provides multiple ways for the public to follow, comment on, and share organizational content, as well as emotionally react to messages through functions such as "like," and recently more reaction categories from "love," "sad," to "angry" (Facebook, 2016). Kim and Yang (2017) clarified the distinction between engagement behaviors ranging from *like, comment*, to *share*. They argued that these engagement behaviors not only captured different levels of activity, but different engagement mechanisms might also drive them. For example, richer message content, such as the inclusion of visual content, was positively associated with the number of "likes," but the same relationship was not observed for behaviors like "comment." The authors thus concluded that "like is an affective response to messages, whereas comment is a cognitive one" (Kim & Yang, 2017, p. 446).

As public engagement with organizations increasingly moves online, Bonsón and Ratkai (2013) developed a *popularity-commitment-virality* model to measure the level of engagement between organizations and their stakeholders on Facebook. This framework measures the tier-one engagement as proposed by Johnson and Taylor (2018), but it provides a more nuanced conceptualization of individuals' cognitive, affective, and behavioral engagement. Specifically, in this framework, popularity refers to the frequency at which social media messages attract public's affective reactions, operationalized as the average number of "likes" per post, or the percentage of total posts liked. Meanwhile, commitment indicates a higher level and more sustained reaction, measured by the number of "comments" received by the posts. Finally, virality taps into the *scope of reach* of messages and can be indicated by the number of "shares" in the context of Facebook use.

Guided by the behavioral and psychological dimensions of online public engagement, the current study adopts Bonsón and Ratkai's (2013) *popularity-commitment-virality* model to examine engagement in the form of "like," "comment," and "share" on Facebook. The model proposes a set of validated constructs to measure public reactivity, dialogic communication, and stakeholder engagement, and it has been applied in similar contexts such as government-citizen engagement (e.g., Haro-de-Rosario, Sáez-Martín, & del Carmen Caba-Pérez, 2018), corporate-consumer engagement (e.g., Agostino & Sidorova, 2017) and beyond.

In the following, we discuss how organizations' practice of dialogic communication, particularly in the context of natural disasters, may have different implications for social media engagement.

2.2. Organization-public dialogic communication during natural disasters

As a fundamental shift from the one-way approach of relationship management to the two-way relationship building, the dialogic theory of organization-public relations (OPR) focuses on a series of external organizational communication practices that aim to engage in an open, honest, and ethical relationship with its publics (Bortree & Seltzer, 2009; Heath et al., 2006; Kent & Taylor, 1998, 2002). Of central importance to the theory is the concept of dialogue, which is broadly defined as "any negotiated exchange of ideas and opinions" between an organization and its publics (Kent & Taylor, 1998, p. 325). Through the enactment of dialogue, it is theorized that organizations and their publics are better able to exchange ideas, negotiate and co-construct meanings, and acknowledge the value of both parties (Hong, Yang, & Rim, 2010; Kim et al., 2014). Dialogic communication is therefore of vital importance for ethical and mutually satisfying OPR (Bruning et al., 2008).

Although dialogic communication is often conflated with Grunig's (2001) symmetrical communication (Sommerfeldt & Yang, 2018), the concept of dialogue proposed by Kent and Taylor (2002) is carefully formulated with the following five core tenets: (1) *mutuality*, the awareness and acknowledgment of the publics in OPR, which further consists of *collaboration* and the spirit of *mutual equality*; (2) *propinquity*, the orientation for organizations to consult the publics, and the willingness for the publics to articulate demands; (3) *empathy,* the dialogic environment of support and trust; (4) *risks*, the willingness for organization to engage with the publics despite risks and uncertain situations; and (5) *commitment*, the extent to which organizations are committed to genuineness, conversation, and interpretation.

Building on the core tenets of dialogic communication, Yang, Kang, and Cha (2015) developed and validated an empirical measurement of organization-public dialogic communication competency (OPDC), defined as "the orientation of mutuality and the climate of openness that an organization and its publics hold in communication to bring about mutually beneficial relationships" (Yang et al., 2015, p. 176). In this multi-dimensional scale, *mutuality* and *openness* emerged as two central components constituting the dialogic performance of an organization. Specifically, mutuality consisted of six aspects ranging from *collaboration*, *grounding*, *empathy*, *equality*, *responsiveness*, and *respect,* and

openness was comprised of three dimensions, including *accessibility*, *genuineness*, and *transparency* (see Yang et al., 2015 for detail).

Since the initial development of the scale, the relationship between OPDC competency and various public relations outcomes have been empirically assessed. For example, Yang et al. (2015) identified the significant relationships between general OPDC and public trust and distrust. In the context of government-public risk communication, specifically during the outbreak of the Middle East Respiratory Syndrome in South Korea, Yang (2018) found that the dialogic competence of government could boost perceived credibility of risk information among the affected publics, which further mitigated the adverse outcomes of OPR such as distrust, dissatisfaction, and control dominance.

Indeed, the role of dialogue in crisis communication should not be under-estimated. Studies indicate that during a crisis, an organization's openness to dialogic communication is critical for enhancing public engagement and the subsequent post-crisis perceptions. In particular, public engagement becomes a mediating mechanism through which dialogues, as exhibited in blog narratives, can reduce negative emotions and strengthen public identification with the focal organization (Yang et al., 2010). Furthermore, imbued with a conversational human voice, dialogues can also lower the public's perceptions of the severity of a crisis (Kelleher, 2009; Sweetser & Metzgar, 2007), and it thus helps better manage a crisis and prevent public anxiety. Finally, Stephens and Malone (2009) found that dialogues helped organizations to make rectification statements—that is, the assurance to the public that the crisis will not happen again. Organizations could use dialogic practices, such as including dialogic links, to "translate" and make technical explanations more accessible to the public.

Existing literature on organizational dialogic communication practices during a crisis has focused on the "Web 1.0" platforms, such as websites (e.g., Stephens & Malone, 2009) and organizational blogs (e.g., Sweetser & Metzgar, 2007; Yang et al., 2010). Although social media are increasingly adopted as a risk and crisis communication tool (Veil, Buehner, & Palenchar, 2011), it is not yet fully understood how organizations incorporate multiple dialogic principles simultaneously in their social media-based disaster communication messages. One study that investigates how two-way social media communication may impact the management of the corporate crisis is the content analysis conducted by Ki and Nekmat (2014). By analyzing Fortune 500 companies' Facebook messages, the authors identified a positive relationship between organizations' engagement in dialogic communication and the positive tone expressed by the audience. It should be noted, however, that the study measured dialogic communication in a reductive form, as "whether or not the message made reference to any previous messages" (Ki & Nekmat, 2014, p. 143).

As social media provide more sophisticated ways to make a message dialogic—from embedding hyperlinks and multimedia content in a message to curating a message using conversational human voice (Park & Cameron, 2014), it is, therefore, essential to broaden the operationalization of dialogic communication on social media. In the following, we synthesize existing literature to propose a multi-dimensional framework of dialogic communication in the context of social media-mediated disaster communication.

2.3. Social media-mediated dialogic communication framework and engagement outcomes

While a reliable Organization Public Dialogic Communication Scale has been developed to assess general organization-public communication, such as between the government and the public (Yang et al., 2015; Yang, 2018), there lacks a disaster-specific OPDC framework to theorize the unique communication priorities in meeting citizen needs during a catastrophic disaster (Houston et al., 2015). Recognizing this gap, the current study proposes an integrated framework to assess the dialogic features of organization-public disaster communication on social media (see Fig. 1 for the proposed framework), and specifically with government organizations. This framework extends prior work on the dialogic communication principles (Kent & Taylor, 1998), the OPDC framework (Yang et al., 2015), and the typology of social media use for disaster planning and responses (Houston et al., 2015).

Research has suggested that the structure, content, and style of a message are all important elements in understanding the effect of the message. For example, the structure, content, and style of messages could significantly predict how well official warning tweets were shared among the public during the Boston Marathon Bombing disaster (Sutton et al., 2015). The proposed framework thus adapts these three components to the context of disaster-related social media messages. The first component deals with the message- or structure-level dialogic features, which include the dimension of *information specificity* and *media richness*. Information specificity refers to the degree to which a message provides concrete, useful, and readily accessible information to the public. In the context of disaster communication, a social media post with detailed "when," "where," "who," "what," and "how" is considered as the core mechanism for increasing the level of preparedness and mobilizing local communities to mitigate negative impacts. According to Kent and Taylor (1998), organizations should strive to fulfill the public's information needs by providing relevant and helpful information.

Meanwhile, media richness denotes the variety of media forms used in a message. Richer media enable more cues to be included in a message (Daft & Lengel, 1986), thereby reducing equivocality and uncertainty experienced by the public. A social media message thus exhibits a higher level of media richness if it includes the use of hyperlinks, visuals, or even multimedia content.

We hypothesize that both information specificity and media richness are positively related to the level of public engagement with the focal message. By providing the much-needed information on disaster preparedness and damage mitigation, a detailed and specific message may elicit a sense of appreciation from the public where they show endorsement (e.g., through Facebook "like") or even voluntarily facilitate the dissemination of the message (e.g., through Facebook "share"). Media richness, on the other hand, enables a message to engage the public not only through the cognitive route, but also through activating the affective route of information processing (O'Keefe, 2008). The use of multimedia content, especially videos, is found to have the strongest effect in terms of arousing audience interests and intensifying emotional responses through the "three Vs' of communication—verbal, vocal and visual" (Waters & Jones, 2011, p. 249). We thus hypothesize:

H1a. The level of information specificity of government social media messages is positively related to the level of public engagement on Facebook during a natural disaster.

H1b. The level of media richness of government social media messages is positively related to the level of public engagement on Facebook during a natural disaster.

In addition to the structural features, the topical content of a message represents the second-level dialogic feature. Disaster communication scholars point out the importance of providing context-specific content for the public (Spence, Lachlan, Lin, & del Greco, 2015), as the public's information needs vary from disaster to disaster, as well as across different stages of the same disaster (Spialek & Houston, 2018). Therefore, we argue that the topic-level dialogic features are context-dependent. Specifically, the theme of a message should be relevant for a given communication context for the message to spark and sustain dialogues. During a natural disaster, for example, the public is less likely to respond to social media messages that educate about the benefit of recycling, due to the mismatch between the message theme and focal communication priorities.

In the context of citizen disaster communication, Spialek and Houston (2018) identified a set of stage-specific communication goals that help affected communities to cope with the threat and negative

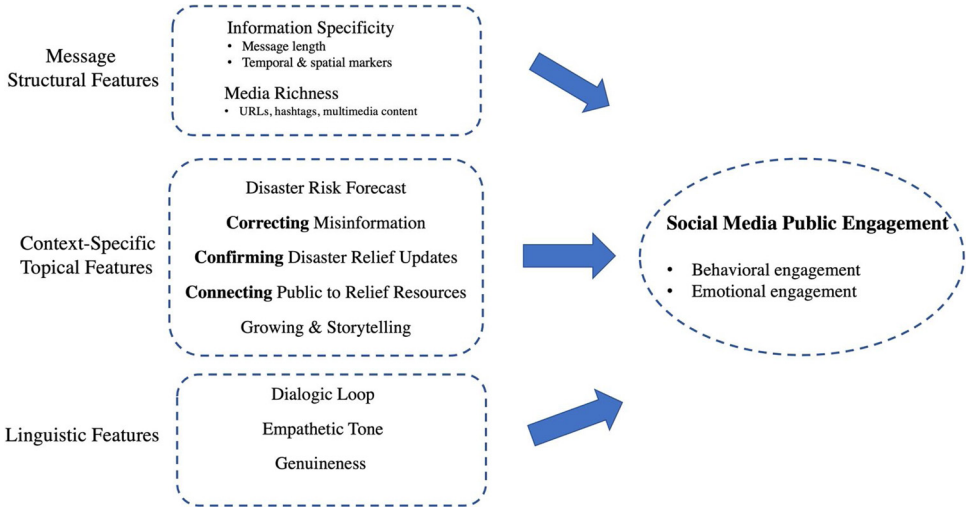

Fig. 1. The proposed multi-level framework of social media-mediated dialogic communication during natural disasters and public engagement outcomes.

consequences of a disaster. In the pre-disaster stage, the most important function of disaster communication revolves around *risk forecasting*, which includes both weather forecasts and instruction for damage control. As the disaster progresses, citizens perceive *correcting*—the action of clarifying misinformation, *connecting*—the action to connect individuals with various resources to ensure safety, and *confirming*—updating the status of the disaster and rescue efforts, as three most essential needs. In the post-disaster stage, *assisting relief*, *growing a community*, and *storytelling* are three types of communication most valued by citizens.

Based on Spialek and Houston's (2018) typology of citizen disaster communication needs, we posit that government social media messages are more likely to generate behavioral and affective responses when fulfilling these disaster communication needs from the public. To explore which topic is more likely to promote public engagement, we propose the following research question:

RQ1: Which topics of government social media messages are more likely to promote public engagement on Facebook during a natural disaster?

Finally, the third-level dialogic features revolve around the style of a message, and particularly the linguistic features of government social media messages. On top of examining *what* a message communicates, it is equally important to investigate *how* the message is crafted. Guided by Yang et al.s' (2015) OPDC framework, we focus on the following three aspects of linguistic features, (1) the presence of a dialogic loop, (2) the use of empathetic tone, and (3) genuineness. Dialogic loop, according to Kent and Taylor (1998), refers originally to the use of technological or design features on websites to encourage questions and invite feedback from the publics. In the current study, we operationalize a dialogic loop as a linguistic feature that verbally urges the public to access information, provide feedback, as well as contribute to disaster relief efforts. This linguistic feature well reflects the mutuality dimension in terms of showing respect and invite for public collaboration (Yang et al., 2015). We hypothesize that a presence of dialogic loop in disaster-related messages is more likely to promote engagement from the public.

H2. The presence of dialogic loop in government social media messages is positively related to the level of public engagement on Facebook during a natural disaster.

The second linguistic feature of interest is the use of an empathetic tone. The importance of expressing sympathy and emotional support has been theorized as part of the adjusting information strategy according to the Situational Crisis Communication Theory (Coombs, 2007). Furthermore, the OPDC scale identified empathy as an essential component of mutuality, an important aspect of an organization's dialogic communication competency (Yang et al., 2015). During a natural disaster, government and emergency management agencies are often expected to express empathy to help the public to cope with the psychological threat of a disaster. As empirical studies suggest, empathetic communication, such as the expression of understanding and positivity, not only significantly boosts organizational reputation, but it could also nurture supportive behaviors among the community (Coombs, 2007). To explore the relationship between the empathetic tone and public engagement level, we hypothesize the following:

H3. The presence of empathetic tone in government social media messages—including both positive (H3a) and negative (H3b) emotional expressions—is likely to predict the level of Facebook engagement during a natural disaster.

Finally, the sense of genuineness emerging from organization-public disaster communication is important. Yang et al. (2015) define genuineness as a climate of communication "that generates authentic interest in communication between the participants" (p. 179). The public's perception of authentic interest is conducive to sustaining trust between an organization and its public, which can be especially crucial for combating rumors and gaining public cooperation. An effective way to foster the sense of genuineness is to use personal and conversational tone (Tsai & Men, 2017). Traditional government communication tends to be formal and routinized (Liu & Horsley, 2007), which has experienced a significant shift as the public increasingly expects personalness from organization-public encounters (Men & Tsai, 2014). As language styles can reveal personality, characteristics, and shape the perception of trustworthiness and relatability (Parhankangas & Renko, 2017), organizations can create a positive public image by taking advantage of certain language styles. In terms of creating a sense of genuineness, research finds that it is more effective to use informal and intuitive writing, as opposed to analytic and formal style, in order to promote engagement (Hwong, Oliver, Van Kranendonk, Sammut, & Seroussi, 2017; Pennebaker, Booth, Boyd, & Francis, 2015). We thus present the last set of hypotheses:

H4a. The use of analytic tone in government social media messages is negatively related to the level of Facebook engagement during a natural disaster.

H4b. The use of informal tone in government social media messages is positively related to the level of Facebook engagement during a natural disaster.

3. Methods

3.1. Sampling and data

Hurricane Harvey struck the Gulf Coast of Texas on August 25, 2017, when it made landfall as a category three hurricane. The disaster brought strong winds and record-level rainfall to the metropolitan area of Houston, causing an estimated $125 billion in damage, 13 million persons directly affected (Shultz & Galea, 2017), and at least 88 deaths (National Hurricane Center, 2018). The unprecedented impacts by Harvey led to large-scale disaster responses. During and after the disaster, city, county, and federal-level government and emergency management organizations actively utilized social media, such as Facebook, to communicate with the public. Such communication thus produced a rich dataset for developing a framework to assess dialogic communication features and public engagement in response to one of the costliest US disasters.

To identify a list of active government agencies on Facebook, the current study performed the following procedures. First, the authors used the disaster declaration map released by FEMA (FEMA, 2017) to locate all government organizations operating in the disaster-impacted regions. This step generated a list of 74 organizations. Second, the authors manually checked each organization for its presence on Facebook and identified a total of 67 active Facebook accounts.

The time frame for data collection was set between August 21 and September 8, 2017, which covered approximately one week before and one week after the disaster event. Via Facebook's public API, a customized Python script (available from authors upon request) was written to collect posts sent by the 67 organizations, identifying a total of 7,463 Facebook posts. A random number generator was used to select about 20 percent of the entire sample. Among the 1,500 chosen posts, 140 were identified as not relevant thus removed before the subsequent data analysis. The final sample consisted of 1,360 posts from 55 government and EM agencies, and the unit of analysis was each individual Facebook post.

3.2. Measurement

3.2.1. Message structure-level features

Information specificity was measured by two indicators. First, *word count* (WC) was calculated for each Facebook post to measure the level of specificity of a message[1] (M = 50.85, SD = 82.87). Second, based on the disaster communication context, we coded each post for the presence of *time* and *location* markers. Posts with greater word count and included specific time (N = 564, 41.47 %) or locations (N = 480, 35.29 %) were considered to exhibit a higher level of information specificity.

Media richness was indicated by the forms of medium included in a post. Each post was coded into one of the following four categories ranging from the lowest to the highest level of media richness: 1) text only (N = 305, 22.43 %); 2) with hyperlinks (N = 275, 20.22 %); 3) with photos or other visual content (N = 781, 57.43 %); and 4) with videos or live streaming (N = 139, 10.22 %).

3.2.2. Topic-level features

Message topics. Adapting the items from Spialek and Houston (2018), we developed a seven-category typology to capture the scope of topics covered in government-public Facebook messages, including: 1) risk and disaster information forecasting (N = 325, 23.90 %); 2) clarifying and correcting misinformation (N = 70, 5.15 %); 3) connecting the public to resources (N = 659, 48.46 %); 4) confirming organizational actions (N = 612, 45 %); 5) calling for public participation in disaster reliefs (N = 255, 18.75 %); 6) growing community (N = 255, 22.43 %); and 7) storytelling of community members (N = 23, 1.69 %). The seven categories were not mutually exclusive, and a Facebook post thus can be coded to contain multiple topics.

3.2.3. Linguistic-level features

Dialogic loop. Although dialogic loop has commonly been operationalized as a technological feature of online platforms (Kent & Taylor, 1998, 2002), the current study operationalized dialogic loop as a linguistic feature, arguing that when the unit of analysis is at the message level, a linguistic nudge can serve a similar function as technological features. Specifically, the presence of a dialogic loop was indicated by phrases that invited the public to access information provided, contacted the organizations, or contributed to disaster-relief activities. Examples of such a linguistic feature included "check out the information…", "please contact us via…", or "help spread the words." One hundred forty posts (10.29 %) were identified to include a dialogic loop as part of the linguistic features.

The rest of the variables pertaining to linguistic characteristics were measured through the computational linguistic analytical framework, Linguistic Inquiry and Word Count (LIWC).

Empathy. We used the LIWC count of positive and negative emotions as the proxy to measure empathy. The positive emotion dictionary in LIWC contains 620 words and includes example words such as love, sweet, and nice. The negative emotion dictionary includes 230 words that express anger (e.g., *hate*, *kill,* and *annoyed*), 116 words that convey anxiety (e.g., worried and fearful), and 136 words for expressing sadness (e.g., *crying*, *grief*, and *sad*).

Genuineness was indicated by two LIWC indicators, first by the Analytic rating, which measures the extent to which a piece of communication text is formal, logical, and analytic. Public communication that is genuine and relationship-oriented is expected to be less analytic. The *analytic* score is calculated based on the frequency of articles, prepositions, and conjunctions, which are found to be highly correlated with logic and sophisticated thinking (Pennebaker, Chung, Frazee, Lavergne, & Beaver, 2014). Second, genuineness was measured by the *informal* score. This LIWC dimension consists of 380 words, including Swear words, Netspeak (e.g., btw, lol, thx), Assent (e.g., agree, OK, yes), Nonfluencies (e.g., er, hm, umm), and Fillers (e.g., I mean, you know).

3.3. Intercoder reliability

Two authors coded the initial sample of 1,500 Facebook posts manually. After several rounds of training and practice coding, two authors both coded ten percent of the selected sample (n = 150, 10 %). The coding reached an acceptable level of intercoder reliability as judged by Cohen's Kappa. Cohen's Kappa values greater than .75 represented excellent agreement beyond chance, and .40 to .75 indicated fair to good agreement (Neuendorf, 2008). Table 1 presented the specific Cohen's Kappa values for all ten variables, which ranged between .83 and .96. After the intercoder reliability check, the two coders divided up the remaining 1,350 posts and coded independently.

3.4. Analysis strategies

Both manual content-coding and LIWC (Pennebaker et al., 2015) were used to identify the message structural, topical, and linguistic features of each Facebook post in the sample. We used LIWC2015 to measure the two linguistic features, positive and negative emotions (for the construct of empathy), analytic and informal tone (for the construct of genuineness). Relying on a set of independently validated semantic dictionary, LIWC scans textual content and calculates the prominence of about 90 linguistic categories related to personality traits, social identity, power dynamic, emotional, and cognitive processes

[1] Although longer posts (i.e., posts with more words) do not necessarily contain more specific information, word count has been identified as a parsimonious and valid proxy for attributes such as content quality (e.g., Blumenstock, 2008).

Table 1
Percentage of Agreement and Cohen's Kappa Values for the Ten Variables Manually Coded.

	Cohen's kappa	% of Coding Agreement
Risk forecasting topic	0.83	93.33 %
Correcting topic	0.85	98.67 %
Connecting topic	0.84	92.00 %
Confirming topic	0.92	96.00 %
Assisting relief topic	0.86	96.00 %
Growing topic	0.96	98.67 %
Storytelling topic	0.80	99.33 %
Dialogic linguistic topic	0.86	94.67 %
Time marker	0.93	96.67 %
Location marker	0.92	96.00 %

(Pennebaker et al., 2015). The fundamental assumption of LIWC states that an actor's linguistic choice can reflect attitudes, emotional states, personality, as well as the way the audience perceives social reality (Smirnova, Laranetto, & Kolenda, 2017).

After coding each post for various features, we performed three negative binominal regressions simultaneously to test the research question and all hypotheses. Since all dependent variables (i.e., number of likes, number of comments, and number of shares) in this study were highly dispersed (i.e., the variances are significantly larger than the means), negative binomial regression was considered as the appropriate statistical method. Negative binomial regression is similar to regular multiple regression except that the dependent variable is an observed count that follows the negative binomial rather than a normal distribution (Hilbe, 2011). This statistical technique has been used in similar studies such as in Saxton and Waters (2014), where the authors modeled the extent to which Facebook message types and organizational features predicted public responses.

4. Results

The first set of hypotheses explored the relationships between message structure-level features and public engagement during a significant disaster. H1a posited that messages with a higher level of specificity, indicated by word count and the presence of time or location markers, were more likely to receive a higher level of public engagement, and this hypothesis received mixed support. Specifically, results from the binominal regression indicated that word count, which typically indicated the length of a Facebook post, was only marginally associated with the number of comments and shares of a post (β = .00, p < . 001), but the same relationship was not observed for the number of likes. Meanwhile, H1b hypothesized that media richness was positively associated with Facebook-based public engagement, which turned out to be a highly consistent predictor. Across all three public engagement types, the use of richer media such as videos was significantly associated with more likes, comments, and shares than posts that used "lean" media (see specific coefficients in Table 2).

Among the seven commonly used topics for organization-public disaster communication, RQ1 explored which thematic topics were more likely to solicit public engagement. Results from the three negative binomial models suggested diverging patterns. Specifically, messages that contained *correcting* and *confirming* topics attracted more likes, comments, and shares across the board. Meanwhile, risk forecasting messages were negatively associated with the number of likes (β = -.46, p < . 001) and comments (β = -.40, p < . 01) received. The topic that called for public action in disaster reliefs, which often appeared in EMOs' disaster communication, was only significantly related to the number of shares received (β = .41, p < . 01). Finally, community growing messages significantly elicited more likes (β = .59, p < . 001), had no significant relationship with the number of comments, but was negatively associated with the level of shares (β = -.42, p < . 01). Finally, the topic of *connecting*, the type of messages that connected the public with various disaster preparedness and relief resources, was significantly and positively associated with the number of comments (β = .38, p < . 01), but not with the other two types of engagement behaviors.

In terms of the role of linguistic features, the results identified both convergence and divergence when predicting different engagement outcomes. Dialogic loop (H2), the linguistic feature that invited public input and feedback, was only significantly associated with more shares that a post received (β = .56 p < . 001). Meanwhile, positive emotional tone (H3a), rather than negative emotional tone (H3b), sparked more likes (β = .04, p < . 001) and shares (β = .04, p < . 01) but did not make any difference when predicting comments. Analytic tone (H4a), on the other hand, was negatively associated with the number of likes (β = -.01, p < . 001) and shares (β = -.01, p < . 001), though the magnitude of such associations was both minimal. Finally, informal tone (H4b) was positively associated with the number of likes (β = .05, p < . 05) and comments (β = .00, p < . 05).

5. Discussion

Through examining the structural, topical, and linguistic features of disaster management organizations' Facebook messages, the current study develops a multi-level framework to assess the dialogic communication level of social media messages during a natural disaster, establishing the empirical relationships between various dialogic characteristics and public engagement outcomes.

Three major findings emerge from the current study. First, in terms of how the informational value of a message predicts public engagement during a disaster, the results suggest that a more detailed social media message, indicated by word count, is more likely to generate behavioral engagement including "comment" and "share," but not affective engagement as shown by Facebook's "like." Meanwhile, media richness emerges as a highly consistent predictor. Using richer media, such as incorporating Facebook's live streaming videos, photos, or even merely hyperlinks in a message, can significantly boost the level of public engagement during a disaster.

Second, the topic of a social media message can significantly predict the likelihood of a message being liked, commented on, or shared. During a natural disaster, one topic that is essential for instructing information, but appears to deter public engagement is risk forecasting; whereas the topics of correcting information and confirming actions taken by EMOs are the two types that consistently spark all kinds of Facebook engagement. Furthermore, we find that the topic of growing, such as the expression of collective identity or gratitude, is particularly effective to generating emotional engagement; whereas the topic of calling for public participation (the assisting relief topic) is instrumental in generating sharing behaviors, which means such messages can help improve the outreach of official disaster messages via public's personal networks.

Third, the linguistic features of organizations' social media messages can make a significant difference. The language of inviting feedback and participation (i.e., the dialogic loop linguistic feature) is directly associated with a greater number of shares, but this feature does not impact the extent to which the public like or comment on the message. Meanwhile, empathic tone, especially the use of positive emotions, can encourage both emotional and behavioral engagement. Informal tone also turns out to be more effective than formally crafted organizational messages regarding informing and engaging the public during a natural disaster.

Our findings advance the current theoretical understanding of dialogic communication in the context of crisis OPR. The study also offers actionable insights for government organizations to develop citizen-centric social media strategies that will strengthen the capacity building for disaster management. Below, we discuss these theoretical and practical implications in detail.

Table 2
Negative Binomial Regression Results Predicting Government and EM Agencies' Facebook Posts Likes, Comments, and Shares during Hurricane Harvey (N = 1,360).

Message Structure-Level Features	# of Likes	# of Comments	# of Shares
(Intercept)	4.05 (0.23) ***	2.13 (0.30) ***	5.85 (0.29) ***
Information specificity			
Word Count	0.00 (0.00)	0.00 (0.00) ***	0.00 (0.00) ***
Time markers	−0.31(0.08) ***	−0.13 (0.10)	0.06 (0.10)
Location markers	0.21 (0.08) **	0.00 (0.10)	−0.06 (0.10)
Media Richness			
Text-only	−0.59 (0.15) ***	−0.84 (0.19) ***	−1.31 (0.18) ***
URLs	−1.28 (.015) ***	−1.89 (0.19) ***	−1.87 (0.19) ***
Photos and other visual	−0.48 (0.13) ***	−1.10 (0.17) ***	−1.00 (0.17) ***
Videos (reference group)			
Context-Specific Topical Features			
Risk forecasting and updates	−0.46 (0.10) ***	−0.40 (0.13) **	−0.14 (0.13)
Correcting	0.74 (0.17) ***	0.72 (0.22) ***	0.91 (0.21) ***
Confirming	0.75 (0.09) ***	0.94 (0.11) ***	0.62 (0.11) ***
Connecting	0.05 (0.09)	0.38 (0.12) ***	0.03 (0.11)
Assisting Relief	−0.22 (.12)	0.15 (0.15)	0.41 (0.14) **
Growing	0.59 (0.10) ***	0.15 (0.13)	−0.42 (0.13) **
Storytelling	0.16 (0.28)	0.90 (0.36) *	0.56 (0.35)
Linguistic Features			
Dialogic loop	0.09 (0.10)	−0.10 (0.12)	0.56 (0.12) ***
Empathic tone-positive	0.04 (0.01) ***	0.02 (0.01)	0.04 (0.01) **
Empathic tone-negative	0.01 (0.01)	0.01 (0.02)	- 0.02 (0.02)
Analytic tone	−0.00 (0.00) ***	0.00 (0.00)	−0.01 (0.00) **
Informal tone	0.05 (0.02) *	0.05 (0.02) *	0.01 (0.02)
Control Variables			
Pre-disaster	0.53 (0.15) ***	1.26 (0.18) ***	0.48 (0.18) **
During disaster	0.64 (0.09) ***	0.93 (0.11) ***	0.56 (0.11) ***
Post disaster (reference group)			

Note: *** $p < .001$, ** $p < .01$, *$p < .05$.

5.1. Theoretical implications for OPDC during natural disasters

Revolving around the concept of organization-public dialogic communication, the current study sheds light on how such a concept is manifested at multiple levels in social media messages. Our findings contribute to the current understanding of organization-public dialogic communication in the following ways. First, traditional OPDC relies on self-reported measures from the public. Although OPDC is well understood as the general orientation of mutuality and the climate of openness (Yang et al., 2015), it is not clear how such orientation can manifest itself in specific organizational discourse. By proposing a discourse-centric framework, we illustrate how an organization can utilize multiple types of media, topical, and linguistic features to construct a discursive sphere conducive to the growth of public dialogue and engagement. We thus shift the unit of analysis from organizations to organizational discourse, reinforcing the argument that dialogue is fundamentally grounded in the communicative action between an organization and its publics (Kent & Taylor, 2002). An organization's dialogic communication capacity, therefore, is not conceptualized as a static attribute of any organization, but a dynamic process that needs to be strategically managed.

Second, we extend the OPDC framework to the disaster communication context, taking into consideration the public's communication needs during a disaster. Providing the public with relevant and accessible information has always been the prerequisite for dialogic communication (Kent & Taylor, 1998), and it is therefore important to incorporate the *content* or *topics* of organizational disaster communication into the overall framework of dialogic communication. By incorporating the typology of citizen disaster communication needs (Spialek & Houston, 2018), the proposed framework can assess whether organization-public communication is actually meeting these communication needs, such as risk forecasting, confirming, or growing.

On top of presenting a comprehensive OPDC framework, the current study further evaluates the empirical relationships between dialogic features of social media messages and various engagement outcomes. The results presented here provide both diagnostic and prognostic insights on how disaster management organizations can more effectively build trusting relationships with the public. After all, positive public reception and cooperation are especially needed when a disaster strikes a community (Kapucu & Van Wart, 2006).

Methodologically, we combine manual content analysis and automated text analysis to investigate overlapping layers of message characteristics. Content analysis has been a widely adopted method to classify and numerate themes, which enables the identification of prominent themes from selected communication texts (Neuendorf, 2016). However, traditional content analysis is limited in detecting more nuanced textual features, such as the display of emotions. LIWC, on the other hand, supplements by detecting and categorizing tones and sentiments in texts. LIWC has been fruitfully used to identify individuals' reaction toward a traumatic event (Back, Küfner, & Egloff, 2011), to study the relationship between age and language (Pennebaker & Stone, 2003), and to compare the change in sentiments toward Islam before and after 9/11 (Smirnova et al., 2017). The current study thus makes a methodological synergy to simultaneously examine a wide range of thematic and linguistic components in the organizational discourse, enabling a more comprehensive and scalable assessment of the dialogic features of such discourse.

5.2. Practical implications for effective disaster communication

While the organization-public relationship may be especially delicate during a natural disaster, the current study suggests a few communication strategies that disaster organizations can utilize to build rapport with the community via social media. In terms of gaining

positive public reception, our findings are consistent with the crisis communication literature in that the role of instructing information and adjusting information is important (Coombs, 2007; Liu, Austin, & Jin, 2011). Specifically, we find that to keep the public apprised with recent rescue actions (i.e., the use of confirming topic) and correct misinformation are two most effective topical strategies to promote online public engagement. Furthermore, our findings indicate that what matters is not just *what* is communicated in organization-public disaster messages, but *how* these messages are communicated. It is recommended that disaster management organizations take advantage of rich visual content, emergent storytelling formats (e.g., lives streaming relief actions), and communicate with informal and positive emotional tones to boost individuals' confidence to manage stressful disaster situations (Zulch, 2019).

In addition, our results confirm that one-way communication, which happens to be how most risk forecasting messages are composed, are generally less well-received by the public. One-way messages, even with great information, may act like the traditional "bulletin board" that segregates rather than connects the organization and its public. A simple yet more effective way to deliver the same message is to incorporate dialogic features, which has shown to generate greater public engagement without compromising the information quality of the message. For example, disaster management agencies may include phrases that encourage the public to follow, talk back, or even contribute to the information production of disaster updates. The inclusion of a dialogic loop can be especially effective in mobilizing relief action and creating a sense of empowerment among the public.

Finally, while the current study does not directly test the role of disaster phases, the results suggested that all forms of public engagement are consistently higher at pre- and during-disaster stages than the post-stage. In light of this finding, it may be cost-effective for disaster management organizations to devote more resources to manage social media communication at earlier stages of a disaster to achieve desirable engagement outcomes.

6. Conclusion

By conceptualizing dialogic communication as message-level, topical, and linguistic features of organization-public messages, the current study advances the OPDC framework in the context of natural disasters. With various contributions made, we need to acknowledge a few limitations. First, we test the theoretical framework using a single disaster case, which may cause some of the current findings less generalizable to other crises. Future research may replicate the current model to study other crisis events, further explaining how crisis context may encourage or constrain the degree to which certain dialogic features promote public engagement. Second, the current study does not distinguish disaster communication across multiple stages, whereas existing literature suggests that citizens' communication needs, as well as disaster management priorities, may shift over time. It is worth examining how dialogic communication features may differently impact public engagement outcomes as a disaster moves from one stage to another. Indeed, as disaster management organizations increasingly employ interactive technologies to connect with the public, more research is needed to fully unleash the dialogic potential of these technologies.

Declaration of Competing Interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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