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Opinion Paper

Retweets of officials’ alarming vs reassuring messages during the COVID-19 pandemic: Implications for crisis management

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**ABSTRACT**

Coronavirus related discussions have spiraled at an exponential rate since its initial outbreak. By the end of May, more than 6 million people were diagnosed with this infection. Twitter witnessed an outpouring of anxious tweets through messages associated with the spread of the virus. Government and health officials replied to the troubling tweets, reassuring the public with regular alerts on the virus's progress and information to defend against the virus. We observe that social media users are worried about Covid 19-related crisis and we identify three separate conversations on virus contagion, prevention, and the economy. We analyze the tone of officials' tweet text as alarming and reassuring and capture the response of Twitter users to official communications. Such studies can provide insights to health officials and government agencies for crisis management, specifically regarding communicating emergency information to the public via social media for establishing reassurance.

1. Introduction

The 2019 coronavirus outbreak has had serious public health and economic consequences across the world. Initial reports began to surface in early January 2020 about the infectious disease, which resulted in unprecedented lockdown and quarantine across multiple nations. The infection reached around 6 million people due to COVID-19 by the end of May¹. During this crisis, people have relied on Twitter as a communication tool for improving visibility into the coronavirus pandemic. Twitter is a social media platform that can expose many people to important information instantly. The simple concept of posting short messages (currently 280 characters), organized by topic handles, commonly known as “hashtags”, makes Twitter unique, organized, and suitable for information dissemination. These features drive its popularity among officials and traditional news media outlets during emergencies, risk situations and crises (Kim, Bae, & Hastak, 2018).

In recent years, the utility of Twitter has expanded far beyond socializing to “essential” communication in the information age, as the platform plays complementary roles to traditional media (Mills, Chen, Lee, & Rao, 2009). For instance, with the current COVID-19 pandemic, Twitter has witnessed an influx of messages that sensitize and educate people about the state of the disease, its spread, dread factors, and mitigation strategies. This communication facilitates key information (using hashtags) to reach the public on time. In emergencies, social media allows people to interact with each other and with officials for sharing and consuming information (Palen, Vieweg, Liu, & Hughes, 2009). Under crises conditions, information sharing among response teams, officials, and the public are critical in expediting the discovery of solutions.

In examining how to leverage social media during COVID-19, it is appropriate to note that the outbreak of Coronavirus is not the first to arrive in the age of social media. Thus, we learn from at least three other significant epidemics that occurred in the few years preceding COVID-19, including the H1N1 (swine flu), the Ebola epidemic and the Zika virus outbreak, on which a wide variety of social media information is readily available. Researchers have examined trends in communication in these contexts (Crook, Glowacki, Suran, K. Harris, & Bernhardt, 2016; Nolasco & Oliveira, 2020; Ungar, 2008). According to these studies, alarming content broadcasts at a greater speed than reassuring content (Ungar, 2008). However, the need to control alarm has echoed in these studies, with suggestions for balancing panic-predicting alarming coverage with reassurance (Li, Vishwanath, & Rao, 2014; Ungar, 2008).

In this paper, we suggest leveraging of Twitter for crisis management by government and public officials and for broadcasting critical communications, both alarming and reassuring, to the public. To...
illustrate our point, we take advantage of the rich information on Twitter collected from January 2020 to June 2020 in the context of Covid-19. We examine the use of Twitter for official communications as the disease evolves. We utilize a broad classification scheme of categorizing tweets into alarming and reassuring messages through an automated process. Then we further examine alarming trends and reassurance trends under three distinct topics, similar to Ghamson and Modigliani (1989). To summarize, the broad objective of this paper is to examine alarming and reassurance communication trends, independently, examining "retweets" or re-posting trends from 'officials' twitter accounts' as it relates to Covid-19. Further, we examine how much the messages are "retweeted" or re-published by non-official accounts. In our study, 'officials' accounts' refer to those accounts that belong to government officials responsible for the management of Covid-19 such as the President's Coronavirus taskforce, the Center for Disease Control, (CDC), the World Health Organization (WHO), city and state taskforce officials including Governors. The specific questions we aim to address are as follows: 1) What is the trend of alarm-tone retweets vs. reassurance-tone retweets, taken in the course of the COVID-19 outbreak? 2) What underlying topics (issues) do officials respond to during such an outbreak? 3) How do public health and government officials’ alarming vs. reassurance responses on Twitter differ regarding the underlying topics?

We organize the succeeding sections as follows. Section 2 summarizes the literature on collective communication, alarming vs. reassurance during virus outbreak; Section 3 provides an overview of the methodology and analysis. In Section 4, we give a brief description about government vs. non-government official's responses, and we conclude the paper in Section 5 and provide limitations and future work in Section 6.

2. Literature review

Although research into the use of digital media for risk communication dates back more than a decade with tools like wikis (Yates & Paquette, 2011), the use of social media such as Twitter for such communication is a growing trend among governments, response teams and the public (Chen, Sharman, Rao, & Upadhyaya, 2008). Social media limits the delay in the flow of information from traditional mass media to individuals and from individuals to others (Li & Rao, 2010). One of the benefits of Twitter for such communication purposes is collective communication, previously highlighted in related research (Li & Rao, 2010) and (Wang & Zhuang, 2017). Twitter allows re-posting or retweeting information from the parent account by one or multiple users. Collective communication facilitates key information sharing using hashtags and retweets to reach a broad audience on time. That is, through retweeting, people can take note of valuable information, and continue conversations in real-time as data-rich and contextual information are disseminated (Palen et al., 2009). In situations, such as the current on-going COVID-19 pandemic, social media has its benefits in offering governments and response officials direct access to individuals, allowing them to disseminate messages of assurance and comfort to the victims of the disease, as well those living in fear. Due to the prolonged duration of the pandemic and the uncertainties around it, responsible officials and leaders can temper the challenge by counter-acting the widespread panic through constant communication, but importantly also, through offering reassurance amidst the caution and alarm.

We build on this rationale and prior research on alarm and reassurance, to examine the retweet pattern of alarming vs. reassuring content during the COVID-19 pandemic. One of the earlier studies focusing on traditional media examined media reassurance under 'hot crisis' conditions, trying to identify the scenarios in which reassuring coverage is more likely than alarming coverage in the media (Ungar, 2008). By tracing media coverage of emerging diseases' and comparing them to coverage of the Ebola outbreak in Zaire, the authors found that reassurance is much less likely in the immediate aftermath of a disaster when panic is spreading quickly. Interestingly Li et al. (2014) find a counter evidence while comparing alarming vs reassuring in the case of Japan’s Fukushima radiation. During the immediate aftermath of the disaster, government officials withheld the alarming information regarding the radiations and later provided details due to the media intervention.

This paper provides a case for examining the public officials' response in conjunction with the news media response towards alarming vs. reassurance communication. In defining what constitutes alarm or reassurance, we base our selection on the linguistic aspects of tweet text. Drawing on Ghamson and Modigliani's (1989)'s work on interpretative packages as a framework for unfolding alarming and reassurance retweet trends into topics relevant to the concepts and themes within tweets text. Ungar (2008) examined three topics while examining bird flu virus, i.e., mutation contagion, the continuation of threat, and hot-crisis or containment. Generalizing the prior research to the continually increasing social media data poses a challenge in objectively extracting the underlying topics. A popular way to extract these underlying topics is through probabilistic topic modeling. Latent Dirichlet Allocation (LDA) (Blei, 2012) is one such widely used topic modeling algorithm that extracts underlying topics from unstructured information, which we also adopt.

3. Methodology

3.1. Data collection

We analyzed tweets produced from January 20, at the time China officially confirmed infection outside Hubei province. We constructed our dataset based on five months of tweets from Twitter. We utilized the Twitter REST search APIs and developed a set of web scraping tools to extract official tweets from Twitter based on the twitter handles of the official accounts. We identified the twitter handles of the officials communicating over conventional news media about COVID-19 situations during coronavirus outbreak. A consolidated final list of 80 twitter handles of government and response officials communicating via Twitter is shown in Table 1.

Table 1

| Official Twitter Handles Communicating COVID-19 messages. | Description |
|----------------------------------------------------------|-------------|
| CDC,NCEZID                                               | CDC Emerging Infections |
| STCEID                                                   | South Texas Center for Emerging Infectious Diseases (STCEID) |
| Thehill; Reuters; TheAtlantic; washingtonpost            | Source for policy and political news on Twitter; New York governor Andrew Cuomo |
| NYGovCuomo                                               | Digital & social media updates from @NYGovCuomo |
| CDC,eHealth                                              | Official Twitter account of the National Institutes of Health |
| WHO                                                      | World Health Organization |
| HHSgov                                                   | News and information from the U.S. Department of Health & Human Services (HHS) |
| POTUS                                                    | 45th President of the United States of America, @realDonaldTrump |

*The Twitter handles provided in the table represents a subset of our total 80 official twitter accounts.*
handles was chosen. Based on these twitter handles, we collected 26,264 tweets over five months, making our dataset a representative sample. Table 1 provides some of the official tweet handles we used.

3.2. Alarming and reassurance tweets extraction

For this research, we follow Li et al. (2014), where the authors examine the use of Twitter by the Japanese government in crisis communication. In their research, authors used retweets as an indicator for collective information sharing. A Retweet is a re-posting or forwarding of a "Tweet" or message on social media application Twitter; a message posted by another user.

To classify the tweets into reassurance and alarming types, we need to understand the text features mentioned in the tweet. However, features are subjective measures; for example, the notion of fear within the text may vary from one reader to the next. To avoid subjectivity and create an objective measure of the features, we decided to classify the tweets into reassurance and alarming messages based on the contextually similar words or cluster of word representations that these tweets carry in comparison to all other tweets related to COVID-19. Clusters of words representation of contextually similar tweets are known as word embedding, and we used word2vec a popular word embedding technique based on shallow neural networks. Word2Vec focuses on the shared meaning of the words rather than on links. For example, two words are closely related and appear together in the word representation, when these two words share contextually similar meanings.

In this study, the GenSim Word2Vec model, a Python-based content analysis program, was employed for the analysis of the text. GenSim Word2Vec is a self-organizing artificial neural network program. It can be used for analyzing text such as news stories, speeches, and other communication contents. Our aim in this process was to find the words used in a similar context as reassurance and alarming in tweets. We trained a word2vec model using the skip-gram algorithm, which predictively learned the word embedding or the numeric vector representation of words. The algorithm was trained with a window of 5, i.e., the context spans over to at max 5 words to the left and 5 words to the right of the target word during training. The trained model provided words that are contextually similar in meaning to alarming and reassurance, as shown in Table 2.

Based on these contextually similar words, we searched for the words in the tweet text and categorized the tweets as reassurance and alarming tweets if the reassuring and alarming words were present. In the appendix, we have provided a visual representation of the percentage of alarming and reassurance tweets over the outbreak timeline. In Table 3, we provide some sample tweets related to alarming and reassurance categories. We separated the tweets posted by government officials and news media by highlighting the latter ones in green.

3.3. Extracting topics

After collecting the data, pre-processing, and then categorizing tweets into alarming and reassurance, we extract the trending topics to explore the distribution of alarming and reassurance tweets. In this study, we applied the Latent Dirichlet Allocation (LDA) topic modeling technique to identify discussions within alarming and reassurance tweets (Blei, 2012). We measured the coherence score of the LDA model, assuming there were two topics and continued this process until we reached ten topics. The coherence score was low for the LDA model with one topic and was highest for a model with three topics and then started declining. We selected the LDA model with three topics based on the best coherence score of 0.34. We systematically analyzed the words under each topic and assigned the topic labels as virus contagion, mitigation, and economy to reflect our interpretation of their meaning. Based on the generated LDA model and the bag of words of each tweet, we classified each individual tweet into the respective topic.

Table 2 provides a percentage distribution of tweets based on the retweets of official tweets about the three topics. Retweeting is a common Twitter behavior that involves users to share the information posted by some other user. Retweeting indicates that the user is influenced by the original tweet and wants to spread the information within the community. The total number of retweets represents a collective behavior, making retweets more reflective of and influential on the mood of the general population.

We represent two key timelines for representation purposes of the graph. The blue dotted line represents the time when the coronavirus was officially named COVID-19, which also marks the beginning of the pandemic, and the orange dotted line represents the unprecedented increase in cases to over a million.

3.4. Statistical analysis

We conducted a Non-parametric analysis, Kruskal-Wallis test in SPSS to determine if the three topics “contagion”, “mitigation”, and “economy” reflect different patterns over time in terms of communicating a median number of retweets. The test statistic from our non-parametric test is an H value of 81.757 significant at 0.05 level, meaning that the median difference in the three topics is significantly different. It also conveys that the general public responded differently to each of the topics. Refer to the appendix for the topic-wise distribution of retweets. Public response to virus “contagion” was high during the initial few weeks of the outbreak, followed by the “mitigation” and “economy”-related topics. The “mitigation” topic received a greater response when the public was worried about the vaccine for the disease. However, when the news about vaccine took time, and discussions about lockdown, reopening markets received traction, economy-related topics received a greater response. However, the alarming and reassurance trend within each of these topics remain different.

To understand the alarming vs. reassurance retweet distribution pattern within each of the topics, we conducted two samples non-parametric analysis, Wilcoxon rank test between retweets of alarming and reassurance tweets for each of the three topics separately. We present the test results in Table 4. There is a significant difference between the median distributions of alarming and reassurance retweets in contagion and mitigation topics, respectively, while there is no significant difference in economy-related topics. Fig. 1, provides visual confirmation to our statistical results that the distribution of retweets percentage with respect to alarming vs. reassurance in economy-related topics significantly remained constant, while this is not the case with contagion and mitigation topics.

| Table 2 | Contextually Similar Keywords Based on Word2Vec Model. |
|---------|-----------------------------------------------------|
| Alarming | Reassurance |
| fear, confusion, panicking, panicbuying, coronavirusinduced, fallout, upset, signals, suffering, bodies, exhausted, indore, lifting, layoff, laboratories, accusations, conspiracies, diagnosed | comforting, offers, calming, pharmaceutical, adapting, clean, medicine, respirators, protections, solidarity, stood, deflation, medicaid, dentists, lufthansa, corrected |
4. Government vs. non-government official tweets

While news media shares the information that the government and health officials provide, the tone in which they share the messages on the social media platform might be different. Also, the government must maintain reassurance through their communication during the time of an outbreak to maintain peace in the society. Hence, to investigate the difference between the government and non-government alarming and reassuring messages, we separated the tweets based on the official twitter handles used to share information.

Fig. 2 shows the percentage of retweets for alarming and reassuring messages of government and non-government twitter handles. Both the graphs show that during the initial phases of the virus outbreak, the percentage of...

Table 3
Sample Alarming and Reassuring Tweets.

| Alarming | Reassurance |
|----------|-------------|
| The first human infection with new #coronavirus (#2019-nCoV) has been reported in the US in a person who recently traveled to Wuhan, China. Additional cases in travelers have been reported in Thailand, Japan, and The Republic of Korea. | We also issued an EUA to Advanced Sterilization Products for the STERRAD Sterilization Cycles, which has the potential to decontaminate approximately 4 million N95 or n95-equivalent respirators per day in the U.S. for reuse in hospital settings. |
| Cruise operator Carnival sees hit to earnings from coronavirus fallout [https://reut.rs/2SjNViq](https://reut.rs/2SjNViq) | Fed’s Clarida says central bank has tools to avoid deflation: BBG [https://reut.rs/3eeFLdT](https://reut.rs/3eeFLdT) |
| Today’s emergency orders will allow the @HHSgov Secretary to waive applicable rules and regulations to give doctors, hospitals, and healthcare providers maximum flexibility to respond to the virus and care for patients. | Health screenings of travelers arriving from #Wuhan, China is part of a layered approach used with other public health measures already in place to slow and reduce possible spread of #2019nCoV into the United States. |
| Georgia man faked covid-19 diagnosis, panicking co-workers and costing employer, prosecutors say. | According to Saffron Cordery, Deputy Chief Executive, NHS Providers, “The government will announce later whether it hit the target 100,000 daily coronavirus tests by the end of April.” |
| After 2 residents of a skilled nursing facility tested positive for #COVID19, all residents & staff were tested. 27 cases were diagnosed. COVID-19 spreads quickly in skilled nursing facilities. Universal & serial testing are important. More from @CDCMMWR: [http://bit.ly/MMWR52220](http://bit.ly/MMWR52220). | CDC thanks all nursing home staff. You are #healthheroes, comforting residents and keeping communities safe from #COVID19. CDC has resources to help: [https://bit.ly/2Wve4RJ](https://bit.ly/2Wve4RJ). |

Fig. 1. Percentage of Alarming vs. Reassurance retweets by each topic.

Table 4
Wilcoxon Signed Test Results between Alarming and Reassurance for three topics.

| Statistics       | Contagion | Mitigation | Economy |
|------------------|-----------|------------|---------|
| N                | 4287      | 2091       | 3309    |
| Total positive differences | 55       | 42         | 78      |
| Standardized Z-value | −3.283   | 2.639      | 0.65    |
| P-value          | 0.001***  | 0.008**    | 0.948   |

*** Significant at 0.001 level; ** significant at 0.01 level.

4. Government vs. non-government official tweets

While news media shares the information that the government and health officials provide, the tone in which they share the messages on the social media platform might be different. Also, the government must maintain reassurance through their communication during the time of an outbreak to maintain peace in the society. Hence, to investigate the difference between the government and non-government alarming and reassuring messages, we separated the tweets based on the official twitter handles used to share information. Fig. 2 shows the percentage of retweets for alarming and reassuring messages of government and non-government twitter handles. Both the graphs show that during the initial phases of the virus outbreak, the percentage of...
alarming messages is high while it decreased by the end of May. However, the percentage of alarming messages in media is significantly high during the initial weeks of the outbreak, which is when government officials try to downplay the impact of the virus. During the following weeks, the tone of the message in government tweets shifted towards reassurance.

5. Implications for research and practice

5.1. Implications for research

Our study suggests that in crisis management, both the public officials and the conventional news media response affinity towards communicating alarming and reassurance messages should be tracked. We build on past research in this area, also making use of existing frameworks such as the interpretative packages proposed by Gamson and Modigliani (1989) and later used by Ungar (2008). We empirically test the framework using social media data and extend its usage in this context.

During any public health outbreak, the public may perceive a predominant alarming tone in the communication on social media platforms. Officials need to balance this alarming tone by providing reassurance through useful information. Often times, the public official’s response and news media response contradicts each other at the onset of the outbreak. This gap is likely to create confusion and breach trust. Hence, to address this disparity in the changing tone of media and public official’s communication, it is important to analyze Twitter responses of both groups to uncover the trend.

Understanding the role of public officials and news media channels during various intervals of an outbreak provides an opportunity to formulate an effective outreach model for calming public and controlling chaos. It is important for these organizations to engage citizens in cognitive-behavioral thinking for decision making during the time of uncertainties by relevant information sharing on social media platforms.

5.2. Implications for practice

The practical contributions of our study are that we provide insights in identifying the widening gaps in alarming message communication by comparing alarming vs. reassuring tweets. We also have an important methodological contribution by introducing the word co-occurrence model to extract the alarming vs reassurance messages that were traditionally extracted using manual coding.

This study can offer directions to practitioners and policy makers to promote mitigation of alarming and worrisome tweets post pandemic incidents. For example, educational or awareness campaign may be employed to flag highly alarming messages and proving reassuring and informative messages in order to reduce chaos and uncertainty related to the event.

Social media engages the general public and reassures them in times of chaos. By examining the role of tweets and retweets as major channels of communication, policy makers and health officials can suggest interventions and strategies for enhancing resilience of communities. Furthermore, it is important to demonstrate the need for partnerships between health officials and news media outlets to rebuild communities affected in the aftermath of such pandemic events.

6. Conclusion

We investigate the reassurance, and alarming tone perceived in the text messages shared by official Twitter handles during the evolution of the COVID-19 outbreak. Specifically, it is aimed at examining how alarming messages due to retweets of official’s messages may vary in comparison to reassurance message retweets. In essence, how much do people respond to alarming messages vs. reassuring messages from their leaders during a pandemic such as COVID-19?

In conclusion, providing reassurance during an outbreak such as COVID-19 is paramount for officials, including government, health experts, and national news media. The duration of an event plays a critical role as the ever-growing information on social media could
easily change the manageable situation into an adverse one. In this paper, we examined alarming and reassurance messages of official communication throughout the COVID-19 outbreak. We provided essential insights about how they change and explored them based on critical discussions topics that the public, in general, are concerned about.

We have demonstrated that there is a statistically significant difference in the way social media users retweet about the alarming and reassurance messages related to various topics. Our study provides valuable insights to officials in managing the virus outbreak. However, there are limitations in our study. Even though we have objectively categorized the tweets into reassurance and alarming based on the word co-occurrence considering all the official tweets, we have not considered the emotions embedded in the tweets. Adding emotions and sentiment to tweet categorization might give a different perspective. Second, COVID-19 is an ongoing event. With the addition of new information, the results might change, and new topics might come up in the alarming and reassurance discussions.

In future research, we propose to use a linguistic-based framework in developing features from the text, avoiding human annotation, and validate it with the government response in managing the outbreak.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ijinfomgt.2020.102187.

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