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Exploring extreme events on social media: A comparison of user reposting/retweeting behaviors on Twitter and Weibo

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ABSTRACT

Although recent research suggests that Twitter and other forms of micro-blogging are becoming increasingly relied upon by both the public and response agencies dealing with crises and disasters, little is known about how these dynamics may play out in a non-Western context. The current study examines the use of the Chinese Weibo service during a 2013 smog emergency, and compares user generated content to that found in earlier data concerning a weather event in North America. The results indicate that by way of comparison, the Weibo sample contained proportionately similar degrees of informative and affective content, but that users were less likely to use humor and showed no increase in affective outpouring as the crisis developed. Results are discussed in terms of implications for those designing social media campaigns for informing and motivating those affected by large-scale weather-related crises.

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1. Introduction

Social media have evolved into widely used and legitimate sources of news and information, particularly for natural disasters, crises, and other extreme events (Pepitone, March 10, 2010). This evolution is happening globally, within and between cultures and across individual technological expertise. Previous extreme weather situations, such as the 2010 Haiti cholera outbreaks, the 2011 Japanese tsunami, and Hurricane Sandy of 2012, have evident that citizens in closest proximity to an event often act as eyewitnesses, reporting information on social media in a timely manner (e.g., Dredze, 2012; Lachlan, Spence, Lin & Del Greco, 2014; Sutter, 2010). As a group of interactive, collaborative, conversational, and community-based platforms, social media collapse diverse social contexts and media audiences into one, providing a comprehensive outlet for the dissemination of crisis and risk information (Spence, Lachlan, Lin, & del Greco, 2015). Despite the increasing volume of research regarding the utilization of social media during extreme events (Lachlan, Spence, Lin, Najarian, & Del Greco, 2016), the extent to which different social media functions (such as reposting or retweeting on microblogging services) are used for crisis communication and information accessibility is understudied (Lachlan, Spence, Lin, Najarian, & Del Greco, 2014). Further, most research has focused on Western cultures and their social media applications, while less is known about the differences in the information consumption and learning across social media platforms from different cultures. Such cross-cultural explorations of social media are needed due to rapid technological diffusion and increased opportunities for international travel and work.

As Twitter and other social networking sites are unavailable in China, applications such as Sina Weibo fill the void and take the lead in the Chinese microblogging market (Tai & Liu, May 6, 2015). To expand and solidify the understanding of social media functions within different culture domains, the current study examines mediated communication on Twitter and Weibo in the time leading up to the impact of two large-scale weather-related events. In particular, this study focuses on reposting/retweeting behaviors, and compares the content and frequency of these behaviors regarding the 2013 winter storm Nemo on Twitter and the 2013 Eastern China smog on Weibo. Specifically, examining retweeting/reposting (the act of relaying a message that has been written by another user of the platform) may reveal patterns or behaviors that could be helpful during an extreme event. Moreover, cross-cultural comparisons of crisis communication using social media are scarce. This study aims to investigate public interactions of risk awareness and concerns as well as to compare emergency information

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management within different cultures and platforms.

1.1. Twitter and Weibo

Twitter launched in March of 2006, having accumulated around 302 million monthly active users with 500 million tweets being posted per day as of 2016 (twitter.com). By initially providing users the opportunity to post, read, and respond to text-based messages limited to 140-characters in length, Twitter creates a multi-media platform with constantly updated timelines for wide-open content. These messages, called tweets, range from mundane life chores to critical breaking news. Twitter users connect with each other by following or being followed without reciprocal requirement.

However, Twitter and other non-China-based networking sites have been blocked in China since 2009, whereas some local social networking services, such as Weibo, emerged to lead the Chinese microblogging market ("Sina Weibo", n.d.). Weibo was launched in July 2010 and has occupied over 56.5% of microblogging market in China since 2011, which can be thought of as a hybrid of Twitter and Facebook. This social networking service currently has over 500 million users with more than 100 million posts being sent per day ("Sina Weibo", n.d.). Weibo also limits the lengths of each post to 140 characters; it also provides a follower-followee social network. Weibo users can organize their social networking, to update and follow the posts in unidirectional relationships as well.

A previous study indicates that in 2010, approximately 11% of all tweets from a random sample were retweets, and users tend to retweet messages containing hashtags and URLs (Suh, Hong, Pirolli, & Chi, 2010). By using the retweet, Twitter users can repost a message from another user and share it with one's own followers, whereas, for Weibo users, the function is called "repost." The retweets or reposts are shown to the public on a senders' profile page; depending on these repost and reply mechanisms, users choose to disseminate the information on Twitter and Weibo which could go beyond the original messages (Kwak, Lee, Park, & Moon, 2010). Given the increased portions of retweets and reposts in online daily updates, it is necessary to investigate the roles these particular report functions have upon specific online communication.

Holding great promise as a social medium for crisis communication, these two networking sites provide publicly available online information, reflecting immediate accessibility and harnessing collective intelligence (O'Reilly & Battelle, 2009; Wunsch-Vincent & Vickery, 2006). The public has gradually used Twitter or Weibo as a source throughout a crisis lifecycle to make sense of an event and to make well-informed decisions, especially for natural disasters which have the potential to cause varying degrees of destruction or harm to vulnerable populations (Coombs & Holladay, 2002; Qu, Huang, Zhang, & Zhang, 2011; Zhang, Zhou, & Nunamaker Jr, 2002). For instance, Spence et al., (2015) analyzed the content and the frequency of over 1500 tweets being sent during the prodromal stage of Hurricane Sandy in 2012 and found that Twitter served as a medium for information sharing and an outlet for affective expressions. The results revealed several insights into audience responses on Twitter that differed from previous self-report studies. People sought out tweets that more closely resembled interpersonal messages than did those stemming from a centralized, mass media entity (Spence et al., 2015). Qu et al. (2011) examined the use of Weibo in response to 2010 Yushu earthquake and reported a large portion of posts were opinion-related. However, limited research compares the use of these two microblogging platforms from different cultures in risk and crisis domains, thus, cross-cultural research is needed (Burke & Zhou, 2010). Two extreme weather-related events, the 2013 winter storm Nemo and the 2013 Eastern China smog, are examined in the current study.

1.2. 2013 Winter Storm Nemo

Winter storm Nemo primarily struck the northeastern United States and parts of Canada in early February 2013 ("February 2013 nor'easter", n.d.). The storm delivered rapidly accumulating snowfall combining with hurricane-force winds and destructive tides, which caused at least eighteen storm-related fatalities, over 600,000 customer power outages, and economic damages throughout New England (Ariosto et al., February 9, 2013). In the city of Boston, Nemo brought 24.9 inches of snowfall from February 8 to 10, 2013, ranking as one of the five worst snowstorms in Boston since 1935 (Klepper & Salsberg, February 10, 2013). On February 8, 2013, Boston reported a storm surge that peaked at 4.21 feet, marking it as the fourth-highest storm surge since 1921 (Masters, 2013). The blizzard caused a buzz on the social media during that time. Bostonians and local organizations spontaneously used *#Bosnow* on Twitter to track blizzard updates, send out emergency alerts, and offer relief assistance in real time (e.g., City of Boston. Gov, October 2013).

Previous studies have investigated how people used Twitter in the early stage of winter storm Nemo. For instance, Lachlan, Spence, Lin, Najarian, & et al. (2014) retrieved the tweets containing localized and national hashtags during this weather event, and suggest that Twitter might be used more for affective display than for information seeking, which is consistent with Twitter research on Hurricane Sandy (Spence et al., 2015). However, it is unclear whether retweets during Nemo reflect such findings. Thus, as an extended investigation of Lachlan, Spence, Lin, Najarian, & et al's. (2014) data, the first research question follows:

RQ1 What were the frequency and specific information users retweeted concerning Winter Strom Nemo on Twitter?

1.3. 2013 Eastern China smog

To compare the repost/retweet behaviors between Twitter and Weibo during weather-related disasters, the current study also examines how online users communicated during the 2013 Eastern China smog. This weather-related event was chosen because it occurred in the same year as Winter Storm Nemo, thus allowing for as close of a chronemic examination as possible. Given that the time and type of weather related crises are not predictable; these two events provide the best comparison available.

From December 2nd to 14th, 2013, with a combination of weather conditions and an increase in the burning of coal for homes and municipal heating systems, heavy smog blanketed Eastern China, affecting more than seven provinces and nine major cities. High levels of tiny and harmful PM 2.5 particulates were detected, with over 150 μg per cubic meter on average ("2013 Eastern China smog," n.d.). In Shanghai, air quality index (AQI) reported the highest level air pollution among all the cities on December 6th; PM 2.5 particulates also reached 602.5 μg per cubic meter on that day (Tang & Hoshiko, December 7, 2013). It reached the most hazardous level since the city began recording such data and soared to a record over 24 times higher than the World Health Origination's (WHO) safety standard (Tang & Hoshiko, December 7, 2013). The severe air pollution resulted in limited visibility, reduced outdoor activity, increased respiratory symptoms, causing major disruption in transportation and daily routines ("2013 Eastern China smog," n.d.).

This severe weather event caused discussions on Weibo. Researchers have investigated how people use microblogging for

online and off-line activisms (e.g., Xu, 2014). However, limited research has focused on certain functions of microblogging platforms, such as retweets or reposts, to investigate how users fulfill their needs during extreme events. Thus, the following research question is raised:

RQ2 What were the frequency and specific information users reposted concerning Eastern China Smog on Sina Weibo?

It is also critical to compare the repost and retweet behavior between users on Twitter and Weibo during these events to determine similarities and differences based on platform and culture. Thus, the final research question is offered:

RQ3 Are there differences in the frequency of types of account profiles from which people post on Twitter and Weibo?

2. Methods

2.1. BoSnow retweets

TweetArchivist (www.tweetarchivist.com) was used to collect tweets at 4 hour intervals during the noon and evening of February 8, 2013. The search terms #nemo and #bosnow were used, as #nemo was a widely used hashtag that was promoted by federal-level relief agencies such as the National Oceanic and Atmospheric Administration (NOAA), and #bosnow was used and promoted by the Boston Globe and other media outlets in southern New England (Lachlan, Spence, Lin, Najarian, & et al., 2014). Users' information and live links were also collected by TweetArchivist. A total of 799 tweets were collected. Of these tweets, 283 were retweets.

Content attributes and the time of the tweets were identified in the coding process. Two undergraduate coders were trained on the coding scheme over the course of one week. The coders were then recruited for coding process to make judgments concerning the content attributes of each tweet. Reliability above the minimum standard of 0.70 was confirmed for all variables in the dataset (see Krippendorff, 1980; Spence & Lachlan, 2005), with the reliability of 0.88 for the message type.

Both the type of content present in the tweet (information about the storm, expressions of affect, spam, humor, or insult) and the profile characteristics were identified. The operational definition for informative tweets was those whose primary intent was to provide information concerning the technical aspects of the storm or specific mitigation efforts. Expressions of affect were defined as tweets whose primary purpose was the expression of emotion (such as fear, anger, worry, or dread). If an advertisement or a link to a Web page advertising a consumer product was present, the tweet was categorized as spam. Humorous tweets contained a primary intention to entertain and included all tweets that could be identified as digitally manipulated photographs, celebrity commentary, and individual messages designed to induce amusement. Insults were tweets defined as those containing derogatory comments directed at individuals or organizations (See Lachlan, Spence, Lin, & Del Greco, 2014).

2.2. Eastern China smog reposts

Weibo Search (s.weibo.com) was used to collect posts during December 2nd to December 14th, 2013. The search term 雾霾 (Smog) and 上海雾霾 (Shanghai smog) were used, as Shanghai was the major city and most affected by the smog. Weibo Search produces exact replications of 1000 random posts at a given collection point, including links to users profiles and images, videos, and active URLs embedded in each post. A total of 23,222,244 posts were shown in the search results, of which 1000 posts were randomly selected for the current study. Of these posts, 205 were reposts.

Two coders were recruited for the coding process to make judgments concerning the time, user account identity, the number of reposts, and the content attributes for each post. For the content of each post, the number of the images, videos, active URLs, and @ other users were identified. Acceptable inter-colder reliability were reported, with the minimum reliability of 0.74 for message type.

Both the type and content present in the coding scheme used in the Twitter sample were used in the Weibo sample. However, an additional category titled reflection was added due to representation in the sample. Reflective reposts were those where the profile owner reposted specific posts debating the causes of the smog. These were not informative but rather focused on debates between users on the attribution of the weather-related event.

Methods and measures for data collection through social media in crisis situations are unstructured, untested, and there is little agreement on the standard conventions (Nelson, Spence, & Lachlan, 2009; Spence, Lachlan & Rainear, 2016). Due to differences across platforms and crisis types, an exact replication of the sampling procedures was not possible; however, given the affordances of the available tweet/post collection programs, and the length of each crisis event, the two sampling procedures have complementary features. However, the randomized selection of retweets/reposts have advantages that are represented in the literature (see Spence & Lachlan, 2010; Spence, Lachlan, & Rainear, 2016).

3. Results

The first research question investigates the frequency and content of retweets on Twitter during winter storm Nemo. A total of 283 retweets were identified at exact time points February 8th, 2013, this is 35.4% of all the tweets collected. This date was chosen as it represents the day on which the storm inflicted the greatest degree of impact on the region. Among these retweets, 23.3% were sent at noon, 31.1% retweets were sent at 4:00 p.m., 25.1% were sent at 8:00 p.m., and 20.5% were sent at midnight. For the content of these retweets, 41.0% of these retweets were categorized as information, 34.9% were categorized as humor, 23.0% were categorized as affect displays, 0.7% were categorized as spam, and 0.4% were categorized as insults.

Examining the time-series analysis of storm retweets, results indicated the retweet content with information and affect shifted between noon, afternoon, evening, and midnight (see Table 1). For the informative retweets, 41.4% were sent at noon, which dropped to 18.1% by 4:00 p.m. and 16.4% were sent at 8:00 p.m., then the number of informative retweets increased to 24.1% by midnight. Whereas for affective display, 6.1% of the retweets were sent at noon with 38.5% being sent at 4:00 p.m. and 8:00 p.m.; and 16.9% were sent at midnight. For the retweets with humor, 14.1% were sent at noon, with 42.4% of humorous retweets being sent at 4:00

Table 1
2013 BoSnow Nemo: Retweet content type by time.

Time	Retweet type				
	Information	Affect	Spam	Humor	Insult
12:00	41.4%	6.1%	0%	14.1%	0%
16:00	18.1%	38.5%	0%	42.4%	0%
20:00	16.4%	38.5%	100%	24.2%	100%
24:00	24.1%	16.9%	0%	19.3%	0%

p.m., followed by 24.2% at 8:00 p.m., and 19.3% by midnight. The retweets categorized as insult and spam were all sent in the evening (8:00 p.m.).

Research question two examined how people used reposts on Weibo during the Eastern China smog. Of the 1000 posts collected, 205 were reposts (20.5%), the repost rates range from 120,613 to 61. Over 71% (145) of all retweets occurred over the four day period when the smog was at its highest levels from December 5th – 8th which will be the focus of the subsequent analysis. The two most active days were December 7th where 33.7% of the messages were reposted and 21.5% were on December 6, 2013, during the time when smog reached the extremely hazardous levels in Shanghai. For the content attributes of all the reposts on Weibo during the weather-related event, 47.3% were categorized as information, 19.5% were categorized as affect displays, 14.6% were categorized as humor, 13.2% were categorized as reflection or attribution, and 5.4% were categorized as spam.

Examining the time-series analysis of smog reposts for December 5th – 8th, results indicated the repost content of information, and affect, humor, and reflection were consistent as the weather event developed. To make the comparisons across the two weather-related events similar, only the four days of the highest smog levels are reported. The percentage of informative reposts began to increase on December 5th with 54.6%, and continued on December 6th with 38.6%, and expanded to 49.4% on December 7th before reaching a peak of 70% on December 8th. Consistently, for the affective posts, an increase in reposts began on December 5th continuing through December 8, 2013 (see Table 2). On December 5th, 18.2% of all reposts were affective, with 20.5% sent on December 6, remaining nearly equal to 18.8% on the 7th and dropping to 10% on the 8th. A unique finding for affective reposts was that there was an additional spike in affective reposts numbers on the 9th, with 46.7% of all the reposts being affective.

For the reposts with humor, 4.5% of reposts on December 5th were humorous, increasing to 29.5% on December 6th and 13% on December 7th, and declining to 10% on December 8th. For the reposts with reflection or critiques, 18.2% of all reposts on December 5th were reflections, followed by 2.3% on December 6th, 17.4% on December 7th, and then reposts with reflections or critiques were absent December 8th. Finally, reposts classified as spam were low on December 5th (4.5%), rising to 9.1% on the 6th then dropping to 1.4% on the 7th and 1.0% on the 8th.

The third research question asked about differences in account type and profile between Twitter and Weibo. On Twitter, for user account identity, 87.3% of the accounts were standard user accounts with 4.6% of all retweets coming from for-profit organizations and 1.4% being retweeted from government agencies. In the Weibo sample for the user account identity, 44.9% were organizational Weibo accounts with blue verification identities attached to their usernames, including news media, business company, and local private sectors; 44.4% were individual accounts with orange verification identity attached to their usernames, such as public health practitioners, celebrities, lawyers, journalists, scholars, and business people. A total of 9.8% were individual accounts without any

identification verification, and 1.0% were popular individual accounts with start verifications.

4. Discussion

It is well documented that individuals use social media for information seeking and subsequent learning when faced with the challenges and threats posed by crises (Lachlan, Spence, & Lin, 2014; Lachlan et al., 2016). This study aims to present how the public use social media during extreme weather-related events as well as to compare the retweet and repost behaviors within different microblogging cultures. The 2013 winter storm Nemo and the Eastern China smog were examined as extreme weather-related events in this study. The first area of note is that the number of retweets/reposts appears to double during a crisis related event, compared with more routine events. The 35.4% of retweets with winter storm Nemo and 20.5% associated with the smog event is well above the 11% of retweets found in previous research. This indicates that during times of crisis, people potentially attempt to share information. However, Twitter users were more likely to repost/retweet than users of Weibo, but this may be a cultural difference which emerged in the data. These types of retweets increased the percentage of total retweets in the sample, but were not as largely represented in the Weibo sample.

The results suggest that most of the messages retweeted/reposted were informative both in winter storm Nemo and the Eastern China smog events. However, the findings indicate a balance between informative and affective retweets during the time series of the storm Nemo, whereas a consistency among informative, affective, and humorous reposts during the time series of the China smog. The similarities and the differences between these two repost behaviors are discussed as below.

First, most of the messages on Twitter retweets and Weibo reposts contained informative messages, which reflects the levels of uncertainties during these extreme weather events (Seeger, 2006). These informative messages included weather updates, general risk, as well as hazard preventions and protections. More specifically, informative retweets with the hashtag of #bosnow tended to provide more actionable information such as evacuation efforts, the whereabouts of food/shelter, the whereabouts of others, and how to how to care for the sick and elderly. Reposts with the keywords of *Shanghai smog* included more information about the use of smog masks, the suggestions for preventions, and protections for the children and elderly. These findings suggest that users in both cultures may tend to offer more messages with efficacy and actionable suggestions (Spence et al., 2015). For the informative retweet findings for the winter storm Nemo, results are also consistent with Lachlan, Spence, Lin, Najarian, & et al.'s (2014) analyses on the original tweets. Although not specifically measuring learning and uncertainty, people turn to social media to learn and reduce uncertainty; and the data suggests that much of the messages which were retweeted/reposted were informative in nature. Examining retweets/reposts explicitly provides different results than what emerged in previous studies (Lachlan, Spence, Lin, Najarian, & et al., 2014; Lachlan et al., 2016; Lachlan, Spence, Lin, & Del Greco, 2014; Spence et al., 2015); it suggests that to find informative information during an information glut on social media, users may want to focus on retweeted/reposted messages.

Second, different patterns between retweet behaviors and repost behaviors were found. For Nemo retweets, the results suggest that, at the beginning of the storm, individuals were retweeting informative information. This indicates that informative, usable information is more available at the onset of the event and then begins to dissipate; this finding is similar to what was reported following Tropical Strom Sandy (Spence et al., 2015).

Table 2
2013 Eastern China smog: Reposts content type by date.

Date	Repost type					
	Information	Affect	Spam	Humor	Insult	Reflection
December 5	54.6%	18.2%	4.5%	4.5%	0.0%	18.2%
December 6	38.6%	20.5%	9.1%	29.5%	0.0%	2.3%
December 7	49.4%	18.8%	1.4%	13.0%	0.0%	17.4%
December 8	70.0%	10.0%	10.0%	10.0%	0.0%	0.0%

However, affective retweets during the day also began to dissipate. In a study by Lachlan, Spence, Lin, Najarian, & et al. (2014) affective content became more prevalent as the weather event continued, thus rendering tangible, actionable information more difficult to locate in the morass of available information. The decrease in affective retweets in the current data may simply be related to the increase in affective tweets at the same time. That is, if all the tweets surrounding a hashtag appear to show displays related to fear, dread and anxiety, individuals may see little need in retweeting those displays. However, for the Eastern China smog reposts, the results suggest consistency in the relative proportions of informative and affective messages. This might be a result of the different time lengths for collecting the data between the samples; however, it is important to note that the differences in length of data collection were a result of the duration of the weather-related events. More research is needed on this issue.

Moreover, a large number of smog reposts contained emoticons, which indirectly indicated affective displays. In particular, not only individual accounts, but also official accounts, such as news media or celebrities, were widely embedded emoticons in the posts for connotation meanings. This is different from Nemo retweets, where most affects were displayed by verbal denotations.

Third, lower rates of humorous reposts are seen in the Weibo sample. This may be attributed to cultural differences indicating less of a wiliness to engage in humor during a crisis event. Another difference between the samples was that there was more organizational participation in reposting on Weibo. There was almost equal participation between organizational accounts and individual accounts on Weibo, whereas the majority of retweets in the Twitter sample were performed by individual (civilian) accounts. These differences indicate larger participation from organizations during weather-related events for the Weibo sample, a finding that may be explained by cultural and socio/political factors.

Taken together, the findings offer a first glimpse into the ways in which microblogging platforms, like Twitter and Weibo, may vary in terms of their use across different cultures in the context of an impending crisis or disaster. While a substantive amount of actionable information can be found in content generated by users on both platforms, the trailing off of actionable information detected during North American crises was not found in China. At the same time, during this specific incident in China, the glut of humorous tweets was not detected, presumably posing fewer difficulties in users obtaining information. First responders designing campaigns using Weibo to inform and motivate may be able to rely upon the medium well into the evolution of the crisis, knowing that users are going to the platform for informational needs. They may also have more confidence in the likelihood that their content would be reposted by individuals, as information from organizations and government sources was more likely to be reposted than that originally generated by individuals; this finding stands in stark contrast to earlier findings concerning western audiences.

4.1. Limitations

Several limitations were identified in this study. First, the time series for the storm Nemo and the China smog were collected differently, with one day for the storm retweets and two weeks for the smog reposts. Although this was a feature of the length of the crisis, it does create a limitation in the findings. Second, due to the technical limitations on Weibo Search, it is impossible to retrieve the entire posts and reposts. Thus, future research could use other Weibo API tools to gain a more comprehensive understanding on both reposts and original posts. Third, the small sample size of Weibo reposts was utilized in the study. Future research should collect more data for analysis to gain more generalizability and

validity power.

4.2. Conclusion

This study examined the content of communication and frequency of communication on Twitter and Weibo during extreme weather events. A comparison was made between Twitter retweets and Weibo reposts. Results indicate the similarities and the differences between these two networking platforms in light of reposting behavior patterns and post content attributes. The understanding the information processing of the public during these weather-related events begin to provide useful insights into crisis learning in disaster responses, recovery, and evaluations for future disaster management. As the public becomes more reliant on social media for information seeking and affect displays, it is necessary for risk and crisis researchers as well as public health practitioners to continue learning about this process, and learning about how and why people create and consume crisis-related information through social media.

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