Computers in Human Behavior 50 (2015) 392–398

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Communicating on Twitter during a disaster: An analysis of tweets during Typhoon Haiyan in the Philippines

Bruno Takahashi [a,*], Edson C. Tandoc Jr. [b,1], Christine Carmichael [c,2]

[a] Knight Center for Environmental Journalism, School of Journalism and Department of Communication, College of Communication Arts and Sciences, Michigan State University, United States
[b] Wee Kim Wee School of Communication and Information, Nanyang Technological University, Singapore
[c] Department of Forestry, College of Agriculture and Natural Resources, Michigan State University, United States

ARTICLE INFO

Article history:

Keywords:
Content analysis
Crisis
Natural disasters
Social media
Twitter

ABSTRACT

Social media in crisis situations, such as natural disasters, have been recognized by scholars and practitioners as key communication channels that can complement traditional channels. However, there is limited empirical examination from the user perspective of the functions that social media play and the factors that explain such uses. In this study we examine Twitter use during and after Typhoon Haiyan pummeled the Philippines. We tested a typology of Twitter use based on previous research, and explored external factors – time of use and geographic location – and internal factors – type of stakeholders (e.g. ordinary citizens, journalists, etc.) and social media engagement – to predict these uses. The results showed that different stakeholders used social media mostly for dissemination of second-hand information, in coordinating relief efforts, and in memorializing those affected. Recommendations for future research and applications in future crises are also presented.

1. Introduction

A natural disaster is an event that can create significant ecological disruption between humans and their environments, which requires extensive efforts to overcome and cope with (Spiegel, 2005). In an era of global climate change, natural disasters linked to extreme weather events are expected to become more frequent and intense, affecting millions of people around the world (de'Donato & Michelozzi, 2014; Meehl et al., 2000; Mirza, 2003; Sena, Corvalan, & Ebi, 2014). The massive tsunami that killed more than 200,000 people in South East Asia in 2004, Hurricane Katrina that wreaked havoc in New Orleans, the destructive 2010 earthquake in Haiti, and the recent Typhoon Haiyan that devastated the Philippines in 2013 exemplify the magnitude of these occurrences. These cases also illustrate the differences between developed and developing countries in terms of their preparedness and ability to respond to the impacts of such events, which can have a considerable effect on the number of fatalities and reconstruction efforts (Mirza, 2003).

Communication channels during times of crises and natural disasters play a vital role before, during, and after these events. Social media, in particular, have become important channels for communication, playing complementary roles to those played by traditional media. This is particularly salient considering that in 2013, the social media service Twitter unveiled a new service called Twitter Alerts, designed to prioritize information from credible organizations during crises when other communications channels are not accessible (Twitter, 2013). Similarly, in October 2014, Facebook introduced Safety Check, a service that allows users to communicate that they are safe and check the status of their acquaintances during a crisis (Facebook, 2014). These efforts, to some extent, exemplify the relevance given to social media during times of crises. The U.S. National Weather Service also announced that it would rely on Twitter as an environmental information service for weather alerts (Holthaus, 2014). Elsewhere, social media have played an important role in raising awareness and coordinating relief efforts, such as during the recent massive flooding in India (Chatterjee, 2014). Social media offer a form of communication not only within affected areas but also between affected areas and the rest of the world. They provide platforms for rapid detection of natural disasters (Earle et al., 2010), situational awareness (Vieweg, Hughes, Starbird, & Palen, 2010), as well as for relief coordination (Landwehr & Carley, 2014). They also provide avenues for individuals to make

* Corresponding author. Tel.: +1 517 432 2454.
E-mail addresses: btakahas@msu.edu (B. Takahashi), edson@ntu.edu.sg (E.C. Tandoc Jr.), carmich7@msu.edu (C. Carmichael).
[1] Tel.: +65 6790 6110.
[2] Tel.: +1 (517) 281 0295.

http://dx.doi.org/10.1016/j.chb.2015.04.020
0747-5632/

sense of the events around them and for the rest of the world to engage in collective coping.

The use of social media during natural disasters has started to receive considerable scholarly attention from various disciplines. But most of this focus is skewed toward institutional uses of social media during disasters, which is aligned with the idea of the audience as passive receivers of information. Social media, however, have demonstrated different uses, with individuals being highly engaged as active producers and disseminators of information. It is therefore necessary to further explore how ordinary people, faced with extraordinary situations, use social media, and how their patterns of use compare with those of other institutional actors, such as journalists and government officials. This study will focus the different uses of Twitter when Typhoon Haiyan, one of the strongest storms ever recorded on Earth, pummeled the Philippines in November 2013, and what factors influence particular usage patterns.

The Philippines is an archipelago composed of more than 7000 islands, and the communities affected by the devastation are interspersed in these islands, separated by bodies of water. The powerful storm knocked down power and phone lines, and the island geography made communication in the affected areas extremely difficult. Some 10% of Filipinos also live outside the country, and many overseas Filipinos had to rely on social media to monitor the situation in their home communities and keep in touch with their loved ones. In this context, other non-traditional information sources and communication platforms, such as Twitter, serve prominent roles. Therefore, there is a need to examine patterns of Twitter use by those affected during the disaster, to document both effective and ineffective information dissemination strategies. From a practical perspective, understanding such patterns can be useful in future responses to better suit the needs of communities in search of not only physical help, but also emotional assistance in extremely difficult and uncertain times. From a scholarly perspective, this study also contributes to the understanding of environmental risks communicated via social media during a natural disaster. This type of scholarship is aligned with Cox's (2007) normative tenant concerning environmental communication as a crisis discipline, which suggests that environmental communication should "seek to enhance the ability of society to respond appropriately to environmental signals" (p.15).

This study explores social media uses during a natural disaster as well as the various structural factors (i.e. time of use and geographic location) that explain differences in usage patterns among different users (e.g. citizens, journalists, government officials). This type of analysis is useful in the development of theoretical considerations that are missing in this area of research. This paper also builds on a growing body of research in various fields, including environmental communication (e.g. Binder, 2012), crisis and risk communication (e.g. Bruns & Burgess, 2013), information technologies (e.g. Starbird & Palen, 2010), and disaster management (e.g. Veil, Buehner, & Palenchar, 2011), among others, that focus on the role of social media in disaster and emergency contexts.

2. Literature review

Considering that there is still a lack of clarity about the role of traditional media in crisis and risk communication (Wahlberg & Sjoberg, 2000), it comes as no surprise that there is even more limited understanding about the role of social media in these contexts (Binder, 2012). Studies in this area mostly deal with the use of social media from an organizational perspective (Freberg & Palenchar, 2013; Lundgren & McMakin, 2013; Veil et al., 2011). Such studies have documented cases of effective and ineffective uses of social media in crisis, such as a university response during an earthquake (Dabner, 2012), or in global issues such as climate change (Feldpausch-Parker, Parker, & Peterson, 2012). This stream of research has led to the development of best practices for organizations from a public relations perspective, such as: communicate quickly, be credible, be accurate, be simple, be complete, and communicate broadly (Freberg, Saling, Vidoloff, & Eosco, 2013). Similarly, governmental organizations have realized the potential of social media in dealing with crises (Beneito-Montagut, Anson, Shaw, & Brewster, 2013). For example, the Organization for Economic Cooperation and Development (OECD) (Wendling, Radisch, & Jacobzone, 2013) and the U.S. Congress (Lindsay, 2011) have recently developed reports from their institutional perspectives outlining benefits and challenges of social media for crisis managers.

Studies of social media use by lay populations, however, remain scarce. We argue that there is an equally pressing need to understand social media use during natural disasters from the perspective of ordinary users and public communicators, consistent with how much the audience has changed. An important body of research in information and computational sciences has explored this area (e.g. Acar & Muraki, 2011; Beneito-Montagut et al., 2013; De Choudhury & Counts, 2012; Kongthon, Haruechaiyasak, Pailai, & Kongyoung, 2012; Liu, Palen, Sutton, Hughes, & Vieweg, 2008; Miyabe, Miura, & Aramaki, 2012; Potts, Seitzinger, Jones, & Harrison, 2011; Qu, Huang, Zhang, & Zhang, 2011; Starbird & Palen, 2010; Vieweg et al., 2010) while researchers are only starting to investigate the implications of social media in disaster relief situations (Landwehr & Carley, 2014).

In this paper, we argue for both a need for more audience-based research, as well as for more communication-based research on social media use in crisis situations. This research should encompass communication paradigms and methodologies, as well as the existing research developed in other disciplinary areas. We argue that this approach would be suitable to the development of theoretical considerations, which is an important omission in the literature. With this in mind, the focus of this current study is on the ways in which individuals (e.g. affected people, journalists, celebrities, etc.) and organizations (e.g. government, media, NGOs, etc.) used social media during a natural disaster. This study also examines a set of factors that can explain those uses, such as time of the tweets, the location and characteristics of the users, previous patterns of social media use, and the degree to which the crisis has directly or indirectly affected the users.

2.1. Social media information uses in disaster situations

Traditional media are still valued sources of information for individuals who use social media during emergency situations (Utz, Schultz, & Glocka, 2013). Binder (2012) reported an increasing trend in the use of hyperlinks to media stories during the two weeks following the Fukushima disaster. Hughes and Palen (2009, p. 248) studied Twitter use during mass convergence and emergency events and concluded that:

> Twitter messages sent during emergencies and mass convergence events reveal features of information dissemination that support information broadcasting and brokerage. This can be seen in the presence of fewer person-specific reply tweets and greater inclusion of URLs in the hurricane- and convention-tweets as compared to the general tweet pool.

This is similar to the functions of traditional media within social media use in human-related crises. For example: "news and information were the most commonly tweeted H1N1-related material" (Chew & Eysenbach, 2010, p. 10).

Similar to traditional media functions, users rely on social media channels to be informed first-hand and immediately about

the developments of a crisis or disaster. Social media users utilize these platforms to scan the environment not only for news but also for updates from other users, particularly those at affected areas. Thus, aside from reading updates about the crisis, consuming messages that communicate relief efforts is also a source of assurance for users already in fear (Smith, 2010). There is also evidence that social media allow users to get information about their community and as a way to communicate with family or friends during a crisis (Bird, Ling, & Haynes, 2012; Landwehr & Carley, 2014).

The type of tweet has been found to have an influence on how users consume information during natural disasters. Mendoza, Poblete, and Castillo (2010) examined tweets during an earthquake in Chile and reported that users tend to question tweets that correspond to rumors more often than tweets that spread news, which in turn affects the propagation of the tweets. These results are consistent with those reported by Acar and Muraki (2011, p. 392), who found that "unreliable retweets (RTs) on Twitter was the biggest problem the users have faced during the disaster." Bruns and Burgess (2013) also reported in the context of the Queensland's floods the importance of the authority of emergency service accounts in limiting the spread of misinformation via Twitter.

2.2. Theoretical developments

Recent crisis communication scholarship (e.g. Sellnow & Seeger, 2013) does not fully incorporate social media in theoretical propositions. Similarly, the extant literature on social media has not developed significant theoretical constructs for the examination of social media uses in crisis situations. Qu et al. (2011) first developed categories in the context of an earthquake in China. Kongthon et al. (2012) also developed a set of categories to determine uses in the context of floods in Thailand. There is an overlap between these sets of categories, which include situation update, relief efforts, requests for assistance, requests for information relief coordination, criticizing government response, and emotion-related uses (e.g. coping with the tragedy). Shaw, Burgess, Crawford, and Bruns (2013) also developed a typology of sense making practices in the context of Queensland's floods in Australia, including flood preparations, the current situation on the ground, and individuals' roles in the subsequent clean-up effort. Expressions of gratitude for the efforts of the Queensland Police Service media unit were particularly relevant. In an attempt to integrate the dispersed literature, Houston et al. (2014) conducted a systematic review of social media uses in disasters and started to develop a typology of social media uses from a communication perspective. They identified 15 different types of social media use, ranging from the dissemination of disaster preparedness information, to their use to express emotions and cope with the disaster. This taxonomy of social media uses is valuable as a starting point to provide theoretical and conceptual frameworks in this area of study. It now becomes imperative to test these ideas in order to refine them and build upon them. In this study we follow the work by Houston et al. (2014) by refining these categories of uses and providing a first empirical test of their occurrence in the context of a recent disaster, which we discuss in more detail in the methods section below. We are also refining Houston et al.'s (2014) categories by focusing on the social media platform Twitter. We expect to provide some empirical evidence for further theorizing about these typologies by testing the presence of these uses among a variety of users, and also testing how some factors affect these uses differently or similarly across these groups of users.

This discussion leads us to our first two research questions:

RQ1: *For what purposes did citizens directly and indirectly affected by Typhoon Haiyan use Twitter before, during, and in the immediate aftermath of the storm?*

RQ2: *What are the differences and similarities in Twitter use between user types (i.e. laypeople, journalists, celebrities, government officials, NGOs, etc.)?*

A geographic component is also important to consider when examining differences in social media use. Starbird and Palen (2010) examined retweets by people outside the area of emergency and found their use of media information to be significantly higher than that of local people. Individuals outside the affected area mostly attempted to provide a broad, abstract picture of the event, while those directly affected were more interested in specific local information. People in disaster areas tend to directly communicate with each other (reply-based tweet) while people in other areas prefer to spread the information from the disaster area by using retweets (Miyabe et al., 2012). Similarly, Vieweg et al. (2010) studied Twitter use during the Spring 2009 Red River floods in North America and Oklahoma grass fires based on a situational awareness framework. They examined geo-location, location referencing, and situational update information, and found difference in the references to geo-location between both disasters. Tweets in the wildfire disaster included more geo referencing because of the uncertainty about where the wildfires were spreading. Similarly the wildfire case was more unexpected, which can help explain the higher proportion of tweets including evacuation information. However, users outside affected areas in disaster contexts are expected to include lower levels of concern than those affected, due to a high level of social and geographical distance (Binder, 2012). This divergent evidence suggests a need to further explore differences in social media use based on geographical distance from the disaster area and the attributes of each disaster. Based on this discussion, we present the following research question:

RQ3: *What are the differences and similarities in Twitter use between users in the affected area and those outside this area right before, during, and immediately after Typhoon Haiyan?*

Binder (2012) also examined tweets after the Fukushima disaster in Japan and found that risk reports were negatively correlated with time. Risk messages declined as time passed. However, there is limited evidence that explains differences in media use before, during, and after a disaster. Other researchers suggest that adoption and continued use of social media after a disaster is considerable as individuals perceive social media as a way to help in the response and recovery efforts, and in rebuilding a sense of community (Hughes & Palen, 2009). Therefore, we also ask:

RQ4: *What are the differences and similarities in Twitter use right before, during, and immediately after Typhoon Haiyan?*

Finally, this study seeks to compare the effects of the aforementioned factors on social media use. Thus:

RQ5: *To what extent does the type of social media user, the time of use, and the geographic location of the user explain the type of Twitter use?*

3. Method

We analyzed content shared on Twitter about Typhoon Haiyan. We collected 10,147 tweets between November 8, 2013 when the typhoon made landfall in the Philippines and November 13, 2013, or five days after the typhoon. The data collection was done using the qualitative software *NVivo*. Tweets were searched and collected in real time at three separate time points each day based on the following hashtags: #PrayforthePhilippines, #Haiyan, #ReliefPH, and #YolandaPh, as well as the following subjects mentioned in

tweets: Philippines, Tacloban, Yolanda (see Table 1). From this data set, a simple random sample of 1000 tweets was selected. For analysis, we only sampled tweets written in English, since Filipinos are known to be proficient English speakers. This sampling strategy allowed comparison with tweets that originated from outside the Philippines. The first selection of 1000 tweets yielded approximately 85.6% of tweets in English, with 14.4% of the tweets in the local language Filipino. An additional random selection was conducted to reach 1000 tweets for analysis, which represented 10% of all tweets we have collected. Some 57% of the tweets were from ordinary citizens, 19.1% were from news organizations, 9.9% were from journalists, 5% were from celebrities, 4.7% were from NGOs, and 4.3% were from government sources.

3.1. Variables

NVivo allows downloading of tweets along with user-related information, including username, geographic location, hashtags, hyperlinks, number of tweets, and number of followers, among others. Some of these metadata were recoded for analysis. For example, geographic origin of tweet was recoded as coming from the Philippines, outside the Philippines, or unidentified. Number of followers, number of accounts being followed, and number of tweets were transformed to address issues of kurtosis and approximate normal distribution using logarithmic transformation.

The sampled tweets were coded following the theoretical considerations described above. First, the type of user was coded based on the following categories: NGOs, government organizations, news organization, journalists, lay people, celebrities, or other (Krippendorff's alpha = .72). Second, tweets were coded based on a typology of social media uses in disaster situations drafted based on the literature (see Table 2). Only the dominant use was coded based on the content of the tweet (Krippendorff's alpha = .78). Two coders were trained and intercoder reliability was tested using 83 tweets from the population, which were excluded from the final study sample.

4. Results

RQ1 focused on the content-based uses of those who tweeted during Typhoon Haiyan. The most common use was to report secondhand information (43.4%). This refers to tweeting about information sourced from someone else—such as a news report, information from government websites, or an interview with affected residents. The second most common purpose was memorializing (32.3%). This refers to tweets that expressed well-wishes, prayers, or sympathy to those affected by the typhoon. The third most common purpose was coordinating relief efforts (14.6%) which refers to tweets that were aimed at organizing relief and rescue operations, such as asking for donations and volunteers, or providing information about where people can drop off their donations or sign up for volunteer work (see Table 3).

There were very few tweets that referred to the other categories. For example, only 4.9% were about personal reporting, or when users tweeted about their personal circumstances. This is expected, considering that the strong winds that Haiyan brought knocked down power and phone lines, so Internet access was disrupted in many places as soon as Haiyan made landfall. Thus, tweeting about personal circumstances from within the affected areas during and in the immediate aftermath of the storm was impossible. Given these findings, we will focus on the three most common uses of Twitter based on our dataset in answering the next research questions.

RQ2 asked how different types of users used Twitter during Typhoon Haiyan. A chi-square analysis found a significant association between user type and Twitter use, χ^2 (10) = 274.46, $p < .001$. News organizations, journalists, and government sources tended to use Twitter for secondhand reporting, which is consistent with expectations of news organizations and journalists. In contrast, laypeople and celebrities tended to use Twitter to engage in memorializing. NGOs primarily used Twitter for relief coordination. These findings are consistent with what would be expected from these groups of users. But they also underscore important patterns in terms of what is lacking in social media use by certain

Table 1
Sampling of tweets.

Subject or hashtag	Number of tweets collected
Philippines	4579
#YolandaPH	2089
#Haiyan	1993
#PrayforthePhilippines	497
Tacloban	495
#ReliefPH	298
Yolanda	196
Total	10,147

Table 2
Uses of social media during a disaster.

Categories of social media use	Description
Reporting on the situation from a personal perspective	This use includes providing and receiving disaster preparedness information and disaster warnings from a personal perspective. This includes informing others about one's own condition and location
Reporting on the situation (secondhand reporting)	This use includes signaling and detecting disasters; documenting and learning what is happening in the disaster; and delivering news coverage of event
Requesting help	Tweets of users sending requests for immediate help or assistance during and after the event
Coordinating relief efforts	Includes raising and developing awareness of the event; donating and receiving donations; identifying and listing ways to help or volunteer; and providing disaster response information
Providing mental counseling	Providing and receiving disaster mental/behavioral health support
Criticizing the government	Tweets discussing sociopolitical causes and implications of and responsibility for events
Expressing well wishes and memorializing	Expressing emotions, concerns, well-wishes; memorializing victims; and providing information about disaster response, recovery, and rebuilding
Discussing causes	Includes discussions of scientific, religious, and other causes that explain the event
(Re)connect community members	Tweets discussing how individuals reconnected with community members after the event, as well as forging new community connections as a result of the event

Table 3
Social media uses.

Social media uses	Percentage
Reporting (secondhand)	43.4
Memorializing	32.3
Coordinating relief	14.6
Reporting (personal)	4.9
Discussing causes	1.5
Reconnecting	1.2
Criticizing government	1.2
Requesting help	0.6
Providing counseling	0.1

categories of users. For example, government officials and institutions could have employed social media to coordinate their rescue and relief operations. Celebrities, with their large following, could also have been influential in mobilizing people to donate (see Table 4).

RQ3 sought to compare Twitter use from within and outside the Philippines. A chi-square analysis revealed a significant pattern, χ^2 (2) = 48.31, $p < .001$. A lot of relief coordination originated within the Philippines, while Twitter users outside the country engaged in memorializing. These findings also make sense, as the proximity of Twitter users within the Philippines to the affected areas made them more knowledgeable about situations on the ground. Twitter users from outside the country, presumably including a lot of Filipinos working overseas, were constrained by geographical distance in terms of their ability to do something concretely, and as a result, a way to be part of the community concerned for the affected areas was to engage in memorializing on social media, such as on Twitter (see Table 5).

RQ4 asked about the relationship between time and Twitter use. A chi-square analysis also found a significant association, χ^2 (6) = 129.43, $p < .001$. Specifically, the number of tweets about relief coordination increased after the storm hit, indicating the response to the disaster (see Table 6). But it also indicates a reactive response, when information on evacuation centers, donation drop off points, and venues for volunteer sign-ups could have been disseminated early on, even prior to the storm. Tweets on secondhand reporting and memorialization dropped in the aftermath of the storm, which is attributed to the increase in tweets coordinating relief efforts.

RQ5 focused on predicting what accounts for particular uses of Twitter during the disaster. We shall focus on the three most common uses of Twitter during the storm based on our data. First, we focused on exploring variables that predict secondhand reporting on Twitter. A logistic regression analysis was conducted, including Twitter use, user type, time of use, and geographic location as predictor variables. The regression model was significant, χ^2 (5) = 145.84, $p < .001$, accounting for between 16% (Hosmer & Lemeshow) and 27% (Nagelkerke) of the variance.

Those who tweet a lot were more likely to engage in secondhand reporting, $B = .33$, $p < .01$. News organizations ($B = 1.58$, $p < .01$) and journalists ($B = 1.79$, $p < .01$) were also more likely to engage in secondhand reporting while celebrities were not ($B = -1.31$, $p < .01$). With the above variables controlled for, geographical proximity became a negative predictor, ($B = -1.04$, $p < .01$), which means that tweets originating from within the Philippines were more likely to engage in secondhand reporting than those from outside (Table 7).

Next, we looked at what predicts using Twitter for relief coordination. The regression model was also significant, χ^2 (6) = 93.38, $p < .001$, accounting for between 13% (Cox & Snell) and 22% (Nagelkerke) of the variance (see Table 8). Number of followers ($B = .35$, $p < .01$) was a positive predictor while number of tweets was a negative predictor ($B = -.50$, $p < .01$). Relief coordination also increased across time ($B = .26$, $p < .01$). Twitter users in the Philippines ($B = 1.09$, $p < .01$), particularly NGOs ($B = 1.54$, $p < .01$) were more likely to have used Twitter for relief coordination. Being a journalist, however, was a negative predictor ($B = -1.13$, $p < .01$).

Finally, we sought to understand what predicts using Twitter for memorialization. The regression model was also significant, χ^2 (4) = 132.49, $p < .001$. The model explained between 18% (Cox & Snell) and 27% (Nagelkerke) of the variance (see Table 9). This use decreased over time ($B = -.19$, $p < .01$). Laypersons ($B = 1.49$, $p < .01$) and celebrities ($B = 2.38$, $p < .01$) were more likely to have used Twitter for memorialization, while being a news organization was a negative predictor ($B = -1.90$, $p < .01$).

Table 4
Social media uses by user type.

	Secondhand reporting (%)	Coordinating relief (%)	Memorializing (%)
Individuals	32.8	12.4	54.8
Celebrities	13	21.7	65.2
Journalists	86.6	4.9	8.5
News organizations	84.6	13.5	1.9
Government	52.9	26.5	20.6
NGOs	30.6	52.8	16.7

Note. There is a significant association between user type and type of social media use, χ^2 (10) = 274.46, $p < .001$.

Table 5
Social media uses by geographic location.

	Secondhand reporting (%)	Coordinating relief (%)	Memorializing (%)
Philippines	41.9	34.9	23.3
Outside the Philippines	58.3	10.9	30.8

Note. There is a significant association between user type and type of social media use, χ^2 (2) = 48.31, $p < .001$.

Table 6
Social media use by time of use.

	Secondhand reporting (%)	Coordinating relief (%)	Memorializing (%)
Nov. 8	55.9	1.7	42.4
Nov. 9	50.7	4.1	45.2
Nov. 10	43.8	32.1	24.2
After Nov. 10	40.9	27.8	31.3

Note. There is a significant association between user type and type of social media use, χ^2 (6) = 129.43, $p < .001$.

Table 7
Predicting secondhand reporting use.

	B	*SE*	95% CI for odds ratio		
			Lower	Odds ratio	Upper
Constant	−.46	.49			
Number of tweets	.33	.12	1.10	1.39	1.75
Location	−1.04	.191	.242	.353	.513
News organization	1.58	.25	2.96	4.87	8.01
Journalist	1.79	.31	3.28	6.01	10.99
Celebrity	−1.31	.50	.10	.27	.72

Note. $R^2 = .16$ (Hosmer & Lemeshow), .20 (Cox & Snell), .27 (Nagelkerke). Model χ^2 (5) = 145.84, $p < .001$. The model was able to make correct predictions at 70.3%.

Table 8
Predicting coordinating requests use.

	B	*SE*	95% CI for odds ratio		
			Lower	Odds ratio	Upper
Constant	−5.04	.76			
Number of tweets	−.50	.16	.44	.60	.83
Number of followers	.352	.09	1.20	1.42	1.68
Time	.255	.05	1.17	1.29	1.42
Location	1.09	.23	1.89	2.98	4.71
NGOs	1.54	.44	1.97	4.68	11.13
Journalist	−1.13	.54	.11	.32	.94

Note. $R^2 = .15$ (Hosmer & Lemeshow), .13 (Cox & Snell), .22 (Nagelkerke). Model χ^2 (6) = 93.38, $p < .001$. The model was able to make correct predictions at 82.7%.

Table 9
Predicting memorializing use.

	B	*SE*	95% CI for odds ratio		
			Lower	Odds ratio	Upper
Constant	−.234	.46			
Time	−.19	.05	.75	.83	.91
News organizations	−1.90	.62	.04	.15	.50
Individuals	1.49	.24	2.78	4.45	7.14
Celebrities	2.38	.42	4.66	10.66	24.39

Note. R^2 = .18 (Hosmer & Lemeshow), .18 (Cox & Snell), .27 (Nagelkerke). Model χ^2 (4) = 132.49, p < .001. The model was able to make correct predictions at 76.9%.

5. Discussion

This study provided an empirical test of a typology of social media uses developed through previous research in this area (Houston et al., 2014). This study also tested initial conceptual considerations that try to explain why people engage in those uses. The results show that individuals and organizations rely on social media mostly to disseminate second-hand information, memorialize those affected, and coordinate relief efforts. These uses vary depending on the time of use and whether the user is geographically close to the affected area. In support of earlier studies (Binder, 2012; Utz et al., 2013), evidence suggests that social media users value traditional media sources during times of crisis, given the preponderance of tweets referencing and linking to secondhand news sources. This value may be derived from the trust users place in news sources over rumors, as was the case in Twitter use following an earthquake in Chile Mendoza et al. (2010). The frequent use of Twitter to communicate about relief efforts is also in line with previous research suggesting that users employ social media as a way to help in response and recovery efforts (Hughes & Palen, 2009).

We also examined the factors that affect specific social media uses. The results show that each of the three uses examined were predicted by a different set of factors. For example, Twitter users in the Philippines were more likely to use social media to coordinate relief efforts than those outside the country, complementing earlier findings that consuming messages that communicate relief efforts is a source of assurance for users already in fear (Smith, 2010).

Through this study, we found that different types of users used Twitter in a way consistent with their traditional roles. We compared uses by ordinary users, oftentimes ignored in studies of social media and crisis, with uses of actors such as journalists and government officials. News organizations and journalists engaged in secondhand reporting, celebrities and laypersons engaged in memorializing, while nongovernmental organizations (NGOs) engaged in relief coordination. Particular uses increased and waned in time as expected. For example, relief coordination increased in the aftermath of the typhoon. But the results of this study shed light not only on how different types of users used Twitter during Typhoon Haiyan in the Philippines, but also more importantly on how potential uses of Twitter during a disaster were absent. Instead of maximizing its nontraditional affordances, users used Twitter—a non-traditional media platform—for traditional purposes. For example, government agencies engaged in secondhand reporting, but not sufficiently in relief coordination. The use of Twitter for relief coordination came in the aftermath of the typhoon, but Twitter's speed and reach could have become an ideal platform for coordination for disaster planning and preparedness. For example, information about evacuation centers and relief preparation centers could have been disseminated prior to Haiyan's landfall via Twitter, and possibly aided those affected before they lost power and ability to access social media services. This follows one of the best practices for organizational use of social media in disaster situations outlined in previous research: communicate quickly (Freberg et al., 2013). We argue that it is also equally important to communicate proactively.

Journalists used Twitter for their traditional role of disseminating information. However, as discussed above, the needs of the public go beyond access to secondhand information during disasters of such magnitude as Typhoon Haiyan. The communitarian role of journalism, for example, expects journalists to help in community building (Black, 2013; Borden, 2014). Using Twitter for both relief coordination as well as memorializing on the part of news organizations during disasters could enact this. Journalists can join the community not only by providing factual information but also by joining in collective coping through memorializing and relief coordination.

Local residents also did not use Twitter to request help during the typhoon, unlike in other disasters as documented by previous research (Kongthon et al., 2012). A plausible reason for this finding is the limitation imposed by our decision to only analyze tweets written in English. This was done to facilitate comparison of tweets from within and outside the Philippines, as well as to simplify the coding process, which involved coders who did not speak the national language and the local dialects in the affected areas. But this was also guided by the acknowledgment that English is an official language in the Philippines, taught in schools, and used by the national print media. Less than 20% of the original sample of tweets selected was in Filipino. However, we argue that there is a stronger structural explanation for this finding. The magnitude of the storm knocked down power, phone, and Internet lines, making various forms of communication, including via social media, impossible. Future studies as well as disaster planning should anticipate this, so that social media communication can be factored into disaster preparedness and response plans.

This study is not devoid of limitations. The collection and analysis of social media-based data has been challenging for scholars in this area (Bruns, 2013; Bruns & Liang, 2012). This is also particularly difficult in the case of natural disasters, where real-time data collection is important. In this respect, we only examined a subset of tweets during this time period, which are those captured by the software *NVivo*. We also only analyzed English-language tweets, and thus cannot determine differences with non-English tweets (i.e. Tagalog). In addition, we identified a set of factors that predicted certain social media uses (i.e. time, geographic location, type of user), but more theorizing and exploration of additional factors should be considered, such as individual characteristics of users such as demographic information (e.g. gender, age, education level) and cognitive variables (e.g. scientific knowledge, language), affective variables (e.g. emotions); and other structural factors (e.g. access to Internet, type of technological capacity), and social factors (e.g. culture).

In this paper we have refined and tested previous categories of social media uses in disasters (Houston et al., 2014). There is, however, a need to further explore the factors that explain these uses and start to conceptualize theoretical models. There is also a need to explore additional functions that social media can play, such as the distribution of photographic evidence. Liu et al. (2008) explored the use of the photo sharing social media service Flicker in these contexts. The study, framed within the concept of citizen journalism, reveals the importance of this social media service in creating a larger collection of information that allows for better cross-referencing of different media sources, but not much research has followed this line of inquiry. These future studies could follow extant literature examining visual communication in social media in other crisis scenarios (besides natural disasters), such as a study of the 2011 UK riots by Vis, Faulkner, Parry, Manyukhina, and Evans (2013). Other research has examined the

issues surrounding the use of various hashtags by Twitter users when exchanging information about natural disasters. Potts et al. (2011) found that hashtag usage during disasters was somewhat mired by inconsistent formats, spellings, and word ordering. Relatedly, Mendoza et al. (2010) reported how false or misleading rumors can easily propagate in Tweeter during a disaster. However, these studies are the only available in this domain, and would thus benefit from further exploration.

References

Acar, A., & Muraki, Y. (2011). Twitter for crisis communication: Lessons learned from Japan's tsunami disaster. *International Journal of Web Based Communities, 7*(3), 392–402. http://dx.doi.org/10.1504/ijwbc.2011.041206.

Beneito-Montagut, R., Anson, S., Shaw, D., & Brewster, C. (2013). Governmental social media use for emergency communication. In *Paper presented at the proceedings of the 10th international conference on information systems for crisis response and management*, Baden-Baden, Germany.

Binder, A. R. (2012). Figuring out# Fukushima: An initial look at functions and content of US Twitter commentary about nuclear risk. *Environmental Communication: A Journal of Nature and Culture, 6*(2), 268–277.

Bird, D., Ling, M., & Haynes, K. (2012). Flooding Facebook-the use of social media during the Queensland and Victorian floods. *Australian Journal of Emergency Management, The, 27*(1), 27.

Black, J. (2013). *Mixed news: The public/civic/communitarian journalism debate*: Routledge.

Borden, S. L. (2014). Communitarian journalism and the common good: Lessons from the Catholic Worker. *Journalism, 15*(3), 273–288. http://dx.doi.org/10.1177/1464884913477283.

Bruns, A. (2013). Faster than the speed of print: Reconciling 'big data' social media analysis and academic scholarship. *First Monday, 18*(10).

Bruns, A., & Burgess, J. (2013). Crisis communication in natural disasters: The Queensland floods and Christchurch earthquakes. In K. Weller, A. Bruns, J. Burgess, M. Mahrt, & C. Puschmann (Eds.). *Twitter and society* (Vol. 89, pp. 373–384). New York: Peter Lang.

Bruns, A., & Liang, Y. E. (2012). Tools and methods for capturing Twitter data during natural disasters. *First Monday, 17*(4).

Chatterjee, R. (2014). Social media get the right stuff to India's flood victims, *NPR*. <http://www.npr.org/blogs/goatsandsoda/2014/09/19/349868432/social-media-gets-the-right-stuff-to-indias-flood-victims>.

Chew, C., & Eysenbach, G. (2010). Pandemics in the age of Twitter: Content analysis of Tweets during the 2009 H1N1 outbreak. *PLoS One, 5*(11), e14118.

Cox, R. (2007). Nature's "Crisis Disciplines": Does environmental communication have an ethical duty? *Environmental Communication, 1*(1), 5–20. http://dx.doi.org/10.1080/17524030701333948.

Dabner, N. (2012). 'Breaking Ground' in the use of social media: A case study of a university earthquake response to inform educational design with Facebook. *The Internet and Higher Education, 15*(1), 69–78.

De Choudhury, M., & Counts, S. (2012). The nature of emotional expression in social media: measurement, inference and utility. *2012 Human computer interaction consortium*.

de'Donato, F., & Michelozzi, P. (2014). *Climate change, extreme weather events and health effects. The Mediterranean Sea*. Springer, pp. 617–624.

Earle, P., Guy, M., Buckmaster, R., Ostrum, C., Horvath, S., & Vaughan, A. (2010). OMG earthquake! Can Twitter improve earthquake response? *Seismological Research Letters, 81*(2), 246–251.

Facebook (2014). *Safety check*. <https://http://www.facebook.com/about/safetycheck/> Retrieved 01.12.14.

Feldpausch-Parker, A. M., Parker, I. D., & Peterson, T. R. (2012). 350.org: A case study of an international web-based environmental campaign. In A. Carvalho & T. R. Peterson (Eds.), *Climate change politics: Communication and public engagement* (pp. 211–242). Amherst, NY: Cambria Press.

Freberg, K., & Palenchar, M. J. (2013). Convergence of digital negotiation and risk challenges: Strategic implications of social media for risk and crisis communications. In H. S. N. Al-Deen & J. A. Hendricks (Eds.), *Social media and strategic communications* (pp. 83–100). Palgrave Macmillan.

Freberg, K., Saling, K., Vidoloff, K. G., & Eosco, G. (2013). Using value modeling to evaluate social media messages: The case of Hurricane Irene. *Public Relations Review*.

Holthaus, E. (2014). National weather service finally entering a committed relationship with Twitter, *Slate*. <http://www.slate.com/blogs/future_tense/2014/09/24/national_weather_service_is_teaming_up_with_twitter.html>.

Houston, J. B., Hawthorne, J., Perreault, M. F., Park, E. H., Goldstein Hode, M., Halliwell, M. R., et al. (2014). Social media and disasters: A functional framework for social media use in disaster planning, response, and research. *Disasters*. http://dx.doi.org/10.1111/disa.12092. n/a–n/a.

Hughes, A. L., & Palen, L. (2009). Twitter adoption and use in mass convergence and emergency events. *International Journal of Emergency Management, 6*(3), 248–260.

Kongthon, A., Haruechaiyasak, C., Pailai, J., & Kongyoung, S. (2012). The role of Twitter during a natural disaster: Case study of 2011 Thai Flood. In *Paper presented at the technology management for emerging technologies (PICMET), 2012 proceedings of PICMET'12*.

Landwehr, P. M., & Carley, K. M. (2014). Social media in disaster relief. In W. W. Chu (Ed.). *Data mining and knowledge discovery for big data* (Vol. 1, pp. 225–257). Berlin Heidelberg: Springer.

Lindsay, B. R. (2011). *Social media and disasters: Current uses, future options, and policy considerations* (Vol. 41987): Congressional Research Service.

Liu, S. B., Palen, L., Sutton, J., Hughes, A. L., & Vieweg, S. (2008). In search of the bigger picture: The emergent role of on-line photo sharing in times of disaster. In *Paper presented at the proceedings of the information systems for crisis response and management conference (ISCRAM)*.

Lundgren, R. E., & McMakin, A. H. (2013). *Risk communication: A handbook for communicating environmental, safety, and health risks*. Wiley.com.

Meehl, G. A., Karl, T., Easterling, D. R., Changnon, S., Pielke, R., Changnon, D., et al. (2000). An introduction to trends in extreme weather and climate events: Observations, socioeconomic impacts, terrestrial ecological impacts, and model projections*. *Bulletin of the American Meteorological Society, 81*(3), 413–416. http://dx.doi.org/10.1175/1520-0477(2000) 081<0413:aittie>2.3.co;2.

Mendoza, M., Poblete, B., & Castillo, C. (2010). Twitter under crisis: Can we trust what we RT? In *Paper presented at the proceedings of the first workshop on social media analytics*.

Mirza, M. M. Q. (2003). Climate change and extreme weather events: Can developing countries adapt? *Climate Policy, 3*(3), 233–248. http://dx.doi.org/10.3763/cpol.2003.0330.

Miyabe, M., Miura, A., & Aramaki, E. (2012). Use trend analysis of twitter after the great east japan earthquake. In *Paper presented at the proceedings of the ACM 2012 conference on computer supported cooperative work companion, Seattle, Washington, USA*.

Potts, L., Seitzinger, J., Jones, D., & Harrison, A. (2011). Tweeting disaster: Hashtag constructions and collisions. In *Paper presented at the proceedings of the 29th ACM international conference on design of communication*.

Qu, Y., Huang, C., Zhang, P., & Zhang, J. (2011). Microblogging after a major disaster in China: a case study of the 2010 Yushu earthquake. In *Paper presented at the proceedings of the ACM 2011 conference on Computer supported cooperative work*.

Sellnow, T. L., & Seeger, M. W. (2013). *Theorizing crisis communication* (Vol. 4). John Wiley & Sons.

Sena, A., Corvalan, C., & Ebi, K. (2014). Climate change, extreme weather and climate events, and health impacts. *Global Environmental Change*, 605–613.

Shaw, F., Burgess, J., Crawford, K., & Bruns, A. (2013). Sharing news, making sense, saying thanks: Patterns of talk on Twitter during the Queensland floods. *Australian Journal of Communication, 40*(1), 23.

Smith, B. G. (2010). Socially distributing public relations: Twitter, Haiti, and interactivity in social media. *Public Relations Review, 36*(4), 329–335. http://dx.doi.org/10.1016/j.pubrev.2010.08.005.

Spiegel, P. B. (2005). Differences in world responses to natural disasters and complex emergencies. *Jama, 293*(15), 1915–1918.

Starbird, K., & Palen, L. (2010). Pass it on?: Retweeting in mass emergency. In *Paper presented at the proceedings of the 7th international ISCRAM conference-Seattle*.

Twitter (2013). Twitter alerts: Critical information when you need it most. <https://blog.twitter.com/2013/twitter-alerts-critical-information-when-you-need-it-most> Retrieved 10.04.13.

Utz, S., Schultz, F., & Glocka, S. (2013). Crisis communication online: How medium, crisis type and emotions affected public reactions in the Fukushima Daiichi nuclear disaster. *Public Relations Review, 39*(1), 40–46. http://dx.doi.org/10.1016/j.pubrev.2012.09.010.

Veil, S. R., Buehner, T., & Palenchar, M. J. (2011). A work-in-process literature review: Incorporating social media in risk and crisis communication. *Journal of Contingencies and Crisis Management, 19*(2), 110–122. http://dx.doi.org/10.1111/j.1468-5973.2011.00639.x.

Vieweg, S., Hughes, A. L., Starbird, K., & Palen, L. (2010). Microblogging during two natural hazards events: What twitter may contribute to situational awareness. In *Paper presented at the proceedings of the SIGCHI conference on human factors in computing systems*.

Vis, F., Faulkner, S., Parry, K., Manyukhina, Y., & Evans, L. (2013). Twitpic-ing the riots: Analysing images shared on Twitter during the 2011 UK riots. In K. Weller, A. Bruns, J. Burgess, M. Mahrt, & C. Puschmann (Eds.), *Twitter and society* (pp. 385–398). New York: Peter Lang.

Wahlberg, A. A. F., & Sjoberg, L. (2000). Risk perception and the media. *Journal of Risk Research, 3*(1), 31–50. http://dx.doi.org/10.1080/136698700376699.

Wendling, C., Radisch, J., & Jacobzone, S. (2013). *The use of social media in risk and crisis communication*. OECD Publishing.