

Online communication behavior at the onset of a catastrophe: an exploratory study of the 2008 Wenchuan earthquake in China

Xiaoli Lu¹ 

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Abstract This paper describes internet users' information communication behaviors at the very onset of the catastrophic 2008 Sichuan earthquake in China. Firstly, we examine how crisis communication environment changes in cyber times both in and out of China, and we identify the challenges for crisis communication managers in the network society. Secondly, Chinese netizens' behaviors in the 2008 Wenchuan earthquake are documented based on a survey conducted immediately after the shock. We find that internet was one of the channels to acquire information during the Wenchuan earthquake, and netizens used it as a supplement to confirm information comparint to other traditional channels. Professional portals played important role in information dissemination among internet users. Governmental official agency websites were trusted by most internet users, and multiple channels were used to confirm earthquake information. Instant messengers was the primary channel for information reposting by netizens.

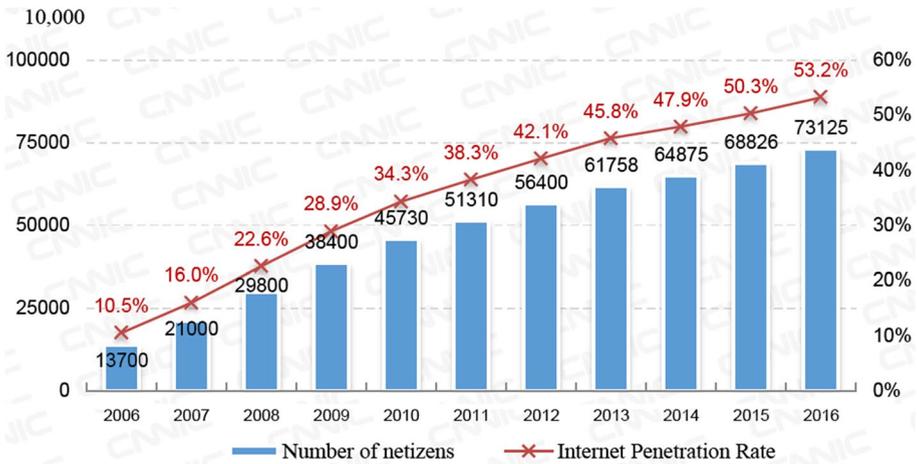
Keywords Communication behavior · Wenchuan earthquake · Crisis communication · Online

1 Introduction

Crisis communication has been widely studied, in which media plays a dual role in crisis management (Phillips 1986; Burkhart 1991; Seydlitz et al. 1994; Horlick-Jones 1995; Tierney et al. 2001; Haddow and Haddow 2008). Positively, media communication brought crisis events to public attention in crisis management's four phases (Liebenau 2003; Richardson and Byers 2007; Reuter and Kaufhold 2017). Media broadcast alerts, warns, and stimulates non-governmental organizations to participate in the response. They can also help government acquire needed information. Moreover, they motivate political processes,

✉ Xiaoli Lu
luxiaoli@tsinghua.edu.cn

¹ Center for Crisis Management Research, School of Public Policy and Management, Tsinghua University, Beijing, China



Source: **CNNIC** Statistical Survey on Internet Development in China

2016.12

Fig. 1 Trend of Chinese internet users' size and internet penetration rate (2006–2016). Adopted from CNNIC (2017): 39

such as pushing decision makers to examine the deficiencies and failures that lead to the crises and disasters.

In contrast, media could play counterproductive roles in crisis management processes. Media may exaggerate some deficiencies during crisis response which can cause unnecessary political blame games (Rosenthal 1998; Brändström et al. 2008). Additionally, inaccurate information dissemination can trigger public panic or rumors (Scanlon 1977; Lasorsa 2003).

New media, especially internet based, has been a helpful communication tool in crisis. In 2001, cell phones recorded the process of aircraft crashing into the twin towers on September 11 (Dutton and Nainoa 2003). In 2008, more than seventy thousand young and educated Egyptians joined a Facebook group to protest the regime of President Mubarak on the April 6 Youth Movement (Shapiro 2008). In the same year, an email list was used by European Sociologists as a tool of protesting Israel's Gaza invasion.¹ In 2009, the Twitter and Facebook were used to mobilize North Dakota citizens to protect local rivers against a flood breach (Condon 2009; Davey 2009). Microblogging, like Twitter and Sina Weibo in China, broadcasted real-time information to increase situation awareness capacities at the onset of an unfolded crisis (Vieweg et al. 2010). Volunteers adopted of geospatial information to assist emergency rescue in earthquake response (Li and Goodchild 2012).

In China, internet shows a rapid developing trend. According to statistics from China Internet Network Information Centre (CNNIC) (2008), China's internet users reached 253 million, and surpassed America with the largest online population (see Fig. 1). The internet penetration rate reached 22.6% at the end of 2008 which is slightly higher than the global average of 21.9% (CNNIC 2009). Although there are gaps between rural and urban areas,

¹ Personal observation of the European Sociologist email lists.

between eastern and western parts, these gaps are narrowing steadily.² This rapid development of internet in China provides the prerequisite of using internet as an increasingly important channel of crisis communication.

Internet users' crisis communication behavior has increasingly impacted crisis response, which poses emerging challenges to crisis managers. Crisis managers need to understand internet users' behavior in order to communicate in an appropriate manner, for instance, netizens' media channel selection, ways of confirming disaster information and information sharing in the context of a catastrophe.

The 2008 Wenchuan earthquake provides a unique opportunity to examine how netizens use internet as a tool in catastrophe crisis communication. Even though it is almost a decade since the occurrence of the Wenchuan earthquake, it is still worthwhile to discuss netizens' behaviors for the following reasons.

Firstly, this paper documents internet users' communication behavior at the onset of a major disaster in China when the social media has not been popular yet. Netizens' information processing behavior has been well studied in disaster warnings or experimental context (DeYoung et al. 2016). Warning studies are mostly in the context of an impending disaster, while this research is more about crisis communication behavior at the onset of a catastrophe.

Secondly, even though social media has been booming in the recent years all over the world, experts warned not to ignore traditional media channels in crisis communication, which still impacted public response in crisis (Liu and Fraustino 2014; Liu et al. 2015). The exploration of netizens' communication behavior at the pre-social media era will help to identify the enduring feature of netizens' communication behavior when comparing to the current situation.

Thirdly, Wenchuan earthquake is a unique case in terms of its extreme large-scale impact to the society, which cannot be comparable to other catastrophes in the internet era.

In this paper, we will examine how crisis communication environment has evolved in the recent decades, and its challenges brought to crisis communication managers. Secondly, Chinese netizens' behaviors in 2008 Sichuan earthquake will be described and analyzed based on a survey conducted immediately after the shock.

2 Internet as a channel in crisis communication: old wine in new bottles?

New media consumption is increasingly becoming an essential part of people's daily life. People check emails, chat with instant messengers (like Windows Messenger and ICQ, QQ for the Chinese), log on social network websites (like Facebook and Myspace, Renren and Kaixin001 for the Chinese), watch pictures online (like Google Picasa) and videos (like Youtube, Youku and Tudou for the Chinese), search unknown through searching engine (like Google, Baidu for the Chinese), do shopping and book tickets (like Amazon and eBay, Taobao and Dangdang in China), read news and write their own blog stories.

There have been large numbers of research on internet users' daily behavior (Horrikan and Rainie 2002; Katz and Rice 2002; Wikgren 2003; Case et al. 2004; Kraut et al. 2006; Briggs and Burke 2010). These studies confirm the integration of the internet into daily

² There were 84.6 million netizens in rural areas at the end of 2008, and it had around 60.8% annual increase while the increase in city areas was about 35.6%. The number of netizens in western China grows faster than that in the middle part [40.6%] and eastern part [39.3%].

life; the internet has become a prime source of information and interpersonal communication. Among the netizens by the end of 2008 in China, 54.3% (about 162,000,000 people) are bloggers, and 35.2% updated their blogs in the latest 6 months; 30.7% logged on bulletin board system (BBS) or online forums, and 19.3% registered social network websites (CNNIC 2009). In 2008, internet users concentrated on online news in 2008, and the popularizing rate of online news application climbed to the third place, which was preceded only by online music and instant messengers (CNNIC 2009).

2.1 Crisis communication based on new medias

With the development of internet in the daily life, new media becomes an integral part of crisis communication besides traditional communication channels, like brochures and pamphlets, town hall meeting, print media, radio, television and telephone these years (Haddow and Haddow 2008). Cell phone and internet demonstrated its importance in responding to the September 11 attacks, which became the watershed of internet's role in crisis communication (Bucher 2002; Noll 2003; Rainie et al. 2003; Dutta-Bergman 2004). The Indian Ocean tsunami of December 26, 2004, named as "the first internet-mediated natural disaster" by Samarajiva (2005: 731), show the strength of new communication technologies for prompting communication of hazard detection, monitoring information and effective dissemination of alert and warning messages. In Hurricane Katrina, internet users sought to internet for interaction with their neighborhoods and reducing uncertainty (Procopio and Procopio 2007).

Internet serves different roles in crisis communication lifecycle. In disaster mitigation, internet could facilitate dialogue among academy, experts and community leader around the world³ (Fischer 1998). In crisis warning, internet becomes a useful complement for specific targeted group, when other communication sources are not accessible⁴ (Procopio and Procopio 2007). In crisis preparedness, internet can also serve as a motivation tool when a crisis is approaching. For example, in the 2009 Fargo flood, Facebook and Twitter groups are set up to attract members as volunteers in building sandbag dike (Condon 2009). In the wake of a crisis, netizens often provide firsthand materials online (Laituri and Kodrich 2008). BBS and video websites become a platform for netizens to post clues of an ongoing crisis. In crisis response, internet provides a supplemental channel for the discussion of an existing crisis and criticism platform for failures or deficiencies of crisis managers' response (Gonzalez-Herrero and Smith 2008); netizens highlight some poorer or marginalized communities which are often neglected by media and government (Rodrigue and Rovai 1994; Rovai 1994; Dash et al. 1997). Internet can speed up donations (Laituri and Kodrich 2008), and assist information gathering of missing people in disasters, which has been evidenced in the 911 attacks (Palen and Liu 2007) and China's Wenchuan earthquake. Volunteering crisis mapping emerged to assist matching information on victims demands and rescue teams' supplies in multiple disaster responses like the 2010 Haiti earthquake,

³ Personal communication with Ms. Ping Xu, a Ph.D. student at Louisiana State University's Stephenson Disaster Management Institute, who participated in 2008 Sichuan volunteer assistance supported by Wenchuan earthquake taskforce. This volunteer academic organization communicated with foreign experts all over the world about practical problems faced on-site through internet and provided policy advice to local response headquarter.

⁴ For example, social network websites are very popular in the youth, so warning information is accessible quickly for them for free. For see video from Officer Michael Levy from the Ocean City, MD police department. <http://www.youtube.com/watch?v=jDQzpWq4r2c>.

the 2015 Nepal earthquake (Palen and Anderson 2016), and the 2017 Jiuzhaigou earthquake in China.⁵ Microblog has been used to an supplement tool for disaster impact assessment, even though it is still under doubt by crisis managers in practice (Qu et al. 2011; Palen and Anderson 2016).

2.2 Remaining questions on netizens' behavior in crisis communication

2.2.1 Channel selection between traditional and new medias

According to the Canadian Centre for Emergency Preparedness, internet overtook newspapers as the main source of emergency information in Canada (Haddow and Haddow 2008). In the 911 attacks, although the internet was not a primary resource for news or outreach for most Americans after the terror attacks, it was a helpful supplement to TV and telephone. Moreover, internet provided a virtual public space for anguished and prayerful gatherings (Pew Internet & American Life Project Group 2001). Existing findings show that people prefer to use traditional media source in an urgent crisis (Park and Avery 2016). Here we ask *to what extent Chinese netizens relied on internet in crisis communication when comparing with other traditional channels.*

2.2.2 Online communication behavior changes in times of crisis when comparing with that in routine situations?

Crises provide external jolts to individual and organizational behavior in both reality and virtual worlds. Palen and her associates identified emergent online behaviors in crises based on various cases, for instance, internet users not only seek response related information, but also trying to post some information as citizen journalists (Palen and Liu 2007). They also classified online convergent behaviors, including helping, being anxious, returning, supporting, mourning, exploiting, and being curious (Hughes et al. 2008). However, *to what extent the online behaviors of internet users change after the environmental jolt caused by a catastrophic earthquake in China* is also unknown.

2.2.3 Preferred information source: governmental source, business ones, or others?

Information sources are quite diversified in online crisis communication. The first are from governments which include information published on governmental websites or governmental operated internet channels. The second are from news agencies that release their news on their websites to increase their competitiveness, and allow interaction between reporters and audience. Some websites report news from their competitors if they think it newsworthy based on specially designed information sharing agreements (Scanlon 2007). The third are from netizens who utilize peer-to-peer websites to release their own ideas and evidence about a crisis, and forward news that they deem important from other sources. Experimental research shows that netizens who receive initial information in the form a tweet (form) tend to seek further information from twitter than a webpage, while those receiving initial information from a local newspaper (instead of national media as the information source) tends to seek information from local government website (Liu et al. 2015).

⁵ The organization named Zhuoming has provided this service, and its WeChat account is *postdizhen*.

It is still not clear *netizens' preferences about online information source in times of crisis in real catastrophic settings.*

2.2.4 Information sharing

Citizens' role changed significantly in crisis communication. Traditionally, citizens are only information receivers, but now they are part of the information providers (May 2006). In other words, the society has entered the era of citizen journalism or citizen media. Communication model changes from "one to many" to "many to many" (Gonzalez-Herrero and Smith 2008). In the social media era, social media users' information sharing behavior has been widely studied (Eismann et al. 2016). Liu et al. (2015)'s experimental study examines the impact of disaster type and information source to people's intention to seek and share information. Internet users most likely retweet information just read when initial information is sent by Twitter, and tend to call people they know when initial information is sent as a Facebook post. Studies in the USA find that Twitter users are more likely to share information than blog users and non-social media users (Schultz et al. 2011). Here we ask which groups of netizens are more likely to repost received information and what are their favorite channels.

2.2.5 Trustiness and online rumor diffusion

Internet can also play counterproductive role in crisis communication. Internet may disseminate potentially sensitive information widely, such as natural gas pipeline routes, to those most likely to use it for destroying, particularly terrorists (Carey 2003); and secrets that are exposed by WikiLeaks which cause the "September 11" in foreign affairs for the US government. Internet may be a tool for quickly fostering and spreading of rumor or false information as one of the channels of risk social amplification which erodes disaster response efforts (Kasperson et al. 1988, 2003; Renn et al. 1992; Quarantelli 1997). The social media, bulletin board system, online forum and other instant messenger tools are uncontrolled and uncoordinated in sharing crises information among individual internet users, which are more likely to escalate the dissemination of rumors (Weick 1988; Susskind and Field 1996). Internet serves as a platform that provides unlimited space for information and its contents (Bucher 2002), which can also bring information overload to the internet users to pick up information that is trustworthy. Trustworthiness becomes visible problems in crisis communication (Bucher 2002), however, several questions related to netizens' trustiness toward online news channel remain unclear, such as *to what extent do netizens trust online news in crisis? What is their favorite channel to verify uncertain information? If inaccurate information is received by the netizens, to what extent these netizens could receive clarification from the government?*

3 Data

In order to answer these remaining questions, the 2008 Sichuan earthquake provides a unique opportunity to explore online crisis communication behavior. Two hours after the shock, the author started the survey design. The questionnaire was revised according to feedback received from colleagues in the Leiden China Discussion Group within 2 days.

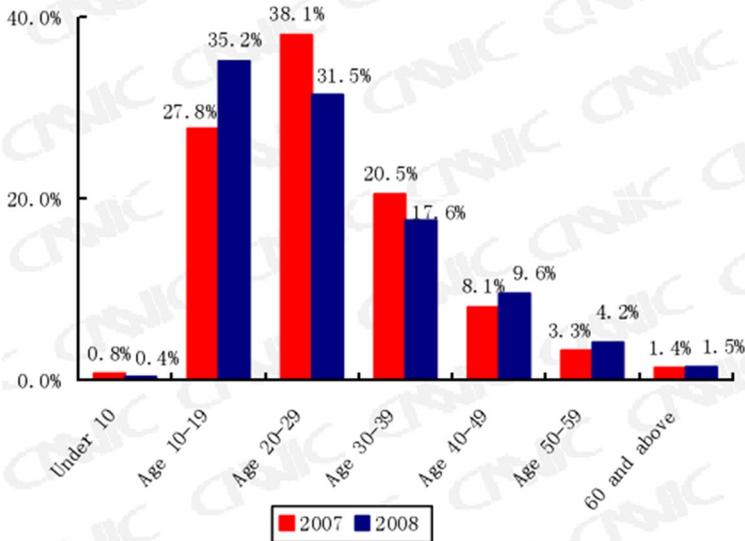


Fig. 2 Distribution of internet users based on survey conducted by China Internet Network Information Centre regarding the general population, 2009. Adopted from (CNNIC 2009)

The data were collected from May 15 until May 30, 2008, 18 days after the shock. The data come from two sources, one is a snow ball approach from friends and their networks via email; the other is from internet users in Sohu BBS, Tianya BBS, Hainan University BBS, Lu's personal blog, Lu's internet social network group and users from QQ groups. According to CNNIC (2009), around 56.8% internet users used emails in 2008, which excludes non-email users in the former data collection channel. In order to balance the geographic difference, we sent additional emails to respondents in provinces less represented, inviting them to circulate questionnaires within their networks in the last 10 days before the deadline.

In total, 456 valid questionnaires were collected. Among which, 405 were from mainland China when earthquake stroke, and 49 were from the overseas Chinese. 54 respondents from Beijing ranked the first place in the geography sense. Sex ratio is 54.6:45.6 (male vs. female). Age-group 25–29 covers 55.1% of female respondents and 58.1% of males, following age-group 20–24 occupies 31.4% of females and 22.8% of males. Comparing with the netizens population in China (see Figs. 2, 3, 31.5% in age-group 20–29), the samples represent mostly youth netizens.

Besides the survey data, the data complement with observations and other online sources about internet users' communication behavior during the Wenchuan earthquake response.

4 Results and analysis

4.1 Internet as a channel of information acquiring in a crisis

More than 96.7% samples used internet as a channel to seek information, while about 40.1% samples first learnt about the earthquake information from internet. Notified by their

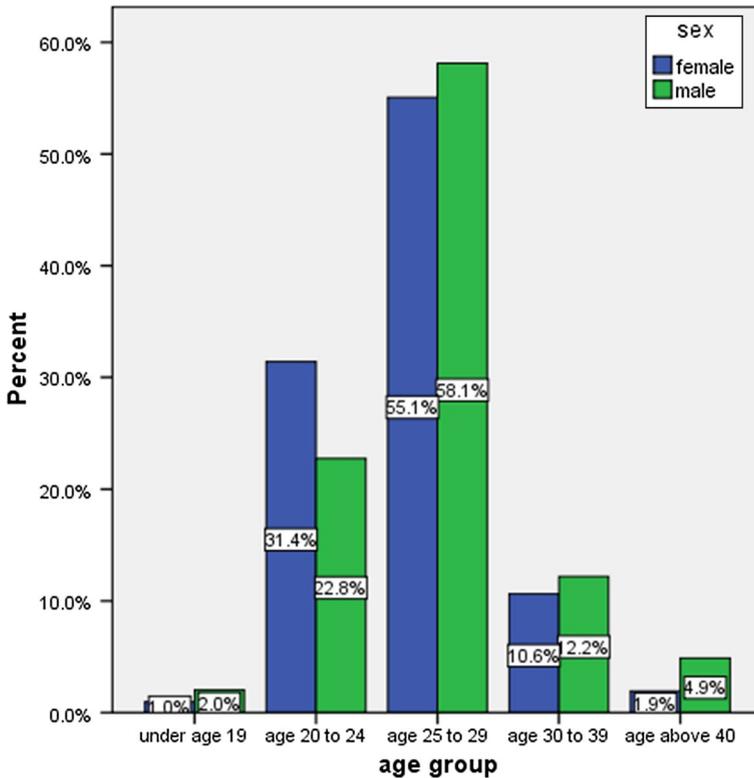


Fig. 3 Distribution of samples based on age-group

friends and experienced it follows with 32.6 and 19.2%. When comparing a major emergency in the USA, such as the 911 attacks, more than two-thirds of internet users [69%] used the Web to seek news and information related to the attacks and their aftermath (Pew Internet & American Life Project Group 2001).

Netizen journalists tend to be quicker than any other news channels to post disaster occurrence information, while online information from official channels gained more attention. In the Wenchuan earthquake, the first piece of earthquake information appeared in baidu.com's post bar, a giant search engine company in China, only 7 min after the earthquake, while the first official information from Xinhua News agency was 18 min after the shock and was clicked more than 1000 times in a minute. The first video was posted online about 2 h after the shock and shot by a student of Chengdu University of Technology (Zhang et al. 2008).

When it comes to the channels of confirming general earthquake threats that faced in the 2008 Sichuan earthquake, relatively lower percentage of netizens [53.8%] tried to use internet as a source of information, and channels for confirming the threats tend to be pluralism (see Table 1). In normal times, 64.6% of the internet users population tend to searching for information from internet when they have problems according to the survey of CNNIC (2009). Therefore, there is no big difference in terms of using internet for netizens in crisis and normal situations in terms of information searching.

Table 1 Channels of confirming the potential earthquake threats (multiple response)

	Responses		
	N	Percentage	Percent of cases
Internet	243	32.40	53.80
Friends, colleagues or relatives	131	17.50	29.00
TV	201	26.80	44.50
Radio or newspaper	115	15.40	25.40
Others	59	7.90	13.10
Total	749	100.00	165.70

4.2 Favorite online information sources

In normal times, 24.1% netizens tend to use two typical official news websites as favored news channels⁶; 49.3% internet users rely on four well-known professional websites, like Sohu news, Sina news, 163 news and QQ news which publish news from different sources under the preset agreement instead of composing news by themselves (Zhu et al. 2009)⁷; 2.4% netizens concentrate on information from instant messengers, like Tencent QQ⁸ or windows messengers. Moreover, 23.9% samples resorted to other trusted websites, some others tend to use BBS, search engine news, Fenghuang news (a Hongkong-based news portal) or some other foreign news sources (see Table 2).

During this earthquake, netizens used multiple channels to seek information. (1) 30.9% read news from two major official websites (Xinhua and China news), which are also the major news agencies. According to Peng (2008), until 22:00 on May 19, 2008, four main official news websites, including Xinhuanet.com, people.com.cn, cctv.com and China.com.cn, published 123,000 original news items (including photos, text, audio and video format), and Sina, Sohu, 163 and qq.com reprinted 133,000 piece of news. These news items were clicked 11.6 million times and posted about 10.63 million comments. (2) 132.9% samples read news from four major popular business portal websites (Sohu news, Sina news, 163 news and QQ news), which means most netizens gained information from more than one of the four most popular websites. QQ news was used by about 44.6% of netizens, and one reason is that QQ.com sent a pop-up window about earthquake news to their users via its instant messenger service 5 min after the shock,^{9, 10} (Zhu et al. 2009), and 24*7 report had began since then. 15 minutes after the shock a special bulletin about this earthquake was published on the website QQ.com, which was browsed about 60 million times daily on

⁶ Xinhua agency and China news agency are two main official news sources in China, who have extensive coverage capacities regarding news in and out of China. Xihuanet ranks the third among the world news website.

⁷ All these websites updated more than 20,000 pieces of news daily and were clicked more than 2 billion times daily.

⁸ Tcent QQ has 105.3 million peak concurrent users according to a statistical result in 2010. For details, read <http://www.tencent.com/en-us/at/abouttencent.shtml> (last accessed on September 9, 2017).

⁹ QQ is a popular free instant messaging computer application program in Mainland China, upon February 9, 2009; the peak simultaneous online users exceed 50 million, and registered users increase to 85.6 million till the end of 2008.

¹⁰ The first news about Sichuan earthquake from China Central Television was broadcasted at 14:50, while the first from China National Radio is at 15:04.

Table 2 A comparison of favorite news channels between normal and crisis time

	Favorite news channels in normal times			Favorite news channels in the Wenchuan earthquake (multiple response)		
	Frequency	Percentage	Cumulative percentage	Frequency	Percentage	Cumulative percentage
Official news						
Xinhua	82	18.0	24.1	97	11.4	22.2
China news	28	6.1		38	4.5	8.7
Professional portal						
Sohu news	54	11.8	49.3	127	15.0	29.1
Sina news	82	18.0		161	19.0	36.8
163 news	38	8.3		98	11.6	22.4
QQ news	51	11.2		195	23.0	44.6
Instant messenger						
Others	110	23.9	2.4	63	7.4	14.4
Total	456	100.0	100.0	848	100	194.1

Table 3 Channel distribution of information verification (multiple responses)

Channels for verifying news	Responses		
	<i>N</i>	Valid percentage	Valid percentage of cases
Governmental earthquake bureau	77	19.1	32.6
Other governmental websites	29	7.2	12.3
Xinhua or China news	69	17.1	29.2
Sina, Sohu or 163	77	19.1	32.6
QQ	41	10.2	17.4
Google, Baidu or other search engines	47	11.7	19.9
BBS or online forums	34	8.4	14.4
Others	29	7.2	12.3
Total	403	100.0	170.8

average up to May 29, 2008. (3) 14.4% samples preferred to read news via instant messenger which was shared by friends. (4) 15.8% samples preferred other resources (such as BBS, people news, search engine news, Fenghuang news and some other foreign news sources) (see Table 2). Therefore, professional portal websites' dominate role in online information diffusion remained unchanged in the earthquake response.

4.3 Trustworthiness and confirmation of online information

53.4% samples paid attention to news resources in their readings, and 55.0% respondents tried to verify the online earthquake information. 93.4% respondents kept on trusting the websites used in normal times during this catastrophe.

Among netizens who verified earthquake information, most used formal news websites to verify received earthquake information. 32.6% respondents verified information via governmental earthquake bureau websites, 12.3% relied on other governmental websites, 29.2% resorted to the official news agency websites, like Xinhua net and China news; 32.6% relied on professional portal websites. There are a large portion of respondents verified their received information via various informal channels, 17.4% went to QQ, 19.9% used searching engines, 14.4% relied on BBS and online forums, and 12.3% relied on other channels (see Table 3).

4.4 Online information sharing behavior

Most respondents had no online information sharing behavior after receiving the news; only about 32.7% respondents reposted or forwarded information to online channels. In the 911 attacks, a third of internet users [33%] in the USA have read or posted materials in chat rooms, bulletin boards or other online forums and most report that those virtual commons were civil, rational places (Pew Internet & American Life Project Group 2001). The favorite channel of reposting information was instant messenger (IM) [86.2%] during the Wenchuan earthquake. IM is an easy accessible way to convey information with users' friends which was popular in normal times. Until the end of 2008, IM was used by 75.3% netizens, among which mainly were university students [81.4%]

Table 4 Channel distribution of information reposting (multiple responses)

Channels of information reposting	Responses		
	<i>N</i>	Valid percentage	Valid percentage of cases
Instant messenger	131	68.2	86.2
Personal websites or blogs	29	15.1	19.1
BBS or online forums	24	12.5	15.8
Other	8	4.2	5.3
Total	192	100.0	126.3

and office workers [60.4%] (CNNIC 2009). Instant messengers, like QQ group [22.37 million users] and MSN group, have been a way of information sharing among users with similar interests, or classmates, alumni, colleagues and townie and have formed special culture for information sharing in both normal time and crisis situation (Zhu et al. 2009).

BBS and online forums were also active in reposting earthquake information (see Table 4). Online forum had its popularizing rate 38.3 among its Chinese internet users, and about 98.22 million people use them (CNNIC 2009). Daily posted information in one of the most popular online forum Tianya BBS increased 66%, among which the posted information of May 19 is 238 times of the average amount in the normal times (Zhu et al. 2009).

Some information posted on these online forums assisted responses in disasters. For example, after the shock, the military was trying to identify an appropriate place for helicopters landing, but the bad weather conditions hampered providing clear geo-information by the satellite. A girl from that region posted a message on an online forum to acknowledge that she knows an appropriate place fitting for helicopter landing, and this message was spread among QQ group and BBS on May 14. The authority contacted her immediately after acknowledging this information, resulting in a successful landing (HXDSB reporter 2008). In another case, a soldier in the frontline of earthquake rescue could not find his pregnant wife who was in another disaster strike area and posted a message on Sina online forum. This message was reprinted thousands of times by other netizens, and the soldier finally found his wife (Chen 2008).

Other internet users were active in making comments toward the online news; according to Zhu et al. (2009), these comments of earthquake news exceeded 10.63 million until May 19, 2008, in just 3 days after the earthquake. Some other hot issues have also been widely discussed on these online forums, like Premier Wen's visit to the earthquake stricken areas, national mourning day, collapsed school building, donations of No. 1 real estate company Vanke.

The contents of reposted information include (1) urgent demands from the disaster stricken areas, like AB type of blood was in need in Sichuan Province; (2) symbols and rituals of blessing and expressing sympathies, like attaching the China heart symbol to instant messenger profiles; (3) helping to look for missing people in the disaster areas through reposting missing people information received from others; (4) exposure of potential corruption, like the potential tent bidding corruption by the Red Cross and

Table 5 Sources of reposting news (multiple responses)

	Responses		
	<i>N</i>	Valid percentage	Valid percentage of cases
Governmental websites	63	31.7	41.7
Business	45	22.6	29.8
Personal websites or blogs	25	12.6	16.6
BBS or online forums	41	20.6	27.2
Others	25	12.6	16.6
Total	199	100.0	131.8

school collapse in the disaster areas. All these actions have persisted in other major disasters.

The sources of shared information were mainly official websites and professional portal websites, but informal channels also served as supplement sources. 41.7% reposted news come from governmental websites, 29.8% from professional portal websites, 27.2% from BBS or online forums, 16.6% from personal websites or blogs, and 16.6% from other sources (see Table 5). According to Peng (2008), until May 19, Blogger in Sina, 163, Sohu and QQ publish 2.33 million diaries, which were clicked 2.36 billion times and posted 613.2 billion comments; netizens posted 1.49 million passages which were clicked 230 million times and commented 7.6 million times.

4.5 Rumors

When there lacked of official information about what had happened and what would be the next after the shock, netizens turned to the internet for further information. Three pieces of incorrect information filled in the blank immediately after the earthquake, which was distributed either on the official news websites or on professional portals,

“a magnitude of 3.9 earthquake centered in Tongzhou, on the outskirts of Beijing city”. [translated by the author] by Xinhua news agency at 14:46 on May 12, 2008; at 18:35 the same day, Xinhua News Agency confirmed that it is not an earthquake, just the earthquake wave from the Sichuan shock.

“A Magnitude 5.7 earthquake stroke between Shanghai and Jiaying” by eastday.com at 15:01. At 16:19, xinmin.cn confirmed this was a humor.

“There would be a magnitude 6 aftershock in western Beijing between 10pm and 12pm in the evening” [translated by the author from Chinese to English] by either china news agency or people.com.cn at 15:22. At 15:41, QQ.com sent a pop-up window to its customers. At 16:41, People.com.cn confirmed that this is a rumor after reached China Earthquake Bureau.

As seen from Table 6, most samples did not receive these three pieces of information and only from 10 to 35% have already got the information. For those recipients, most trusted the received information (82.3% internet users in the Tongzhou earthquake information, 60% in the Zhejiang earthquake information and 47.1% in the aftershock in Beijing information). Regarding to the clarification information to uncover inaccurate information,

Table 6 Rumor information communication behavior

	Tongzhou earthquake rumor		Zhejiang earthquake rumor		Aftershock in Beijing		
	Frequency	Valid percentage	Frequency	Valid percentage	Frequency	Valid percentage	
Whether got the news	No	306	67.1	407	89.3	355	77.8
	Yes	150	32.9	49	10.7	101	22.1
	Total	456	100	456	100	456	100
Whether trust the news	No	26	17.7	20	40	54	52.9
	Yes	121	82.3	30	60	48	47.1
	Total	147	100	50	100	102	100
Whether got the rumor clarification news	No	94	64.8	30	61.2	29	28.7
	Yes	51	35.2	19	38.8	72	71.3
	Total	145	100	49	100	101	100

Table 7 Distribution of future trust toward favorite websites

		Frequency	Valid percentage	Cumulative valid percentage
Official news websites	Xinhua	79	17.3	24.1
	China news	31	6.8	
Professional business portal websites	Sohu news	34	7.5	31.4
	Sina news	57	12.5	
	163 news	20	4.4	
	QQ news	32	7.0	
Instant messenger		8	1.8	1.8
Others		195	42.8	42.8
Total		456	100.0	100.0

only low percentage of netizens (35.2% in the Tongzhou rumor and 38.8% in the Shanghai rumor) received the clarification about what had happened, while more internet users received information (about 71.3% in the aftershock in Beijing rumor) about what will be the next.

4.6 General attitude toward governmental information

As seen from Table 7, after experiencing online communication in the 2008 Wenchuan earthquake, around 62.3% samples still trusted the websites that they have used, and 37.2% would depend on the situation. 24.1% would trust official news websites, which is the same percentage with that in normal times. There was slight change on the specific portal news website. Fewer internet users still trusted professional portal websites, which is reduced from 49.3% in normal times to 31.4% after the Sichuan earthquake. Most users turn into trusting other channels, and according to the open questions followed, some did not trust news websites at all, and some shifted toward oversea Chinese news websites. In a general sense, more than 90% internet users were satisfied with the governmental information dissemination.

5 Conclusion

This study documents online communication behaviors of internet users at the onset of a catastrophic earthquake in China. We find that internet has become one of the important channels of crisis communication among internet users in 2008 in China. Most netizens tended to use internet as one of the channels to acquire information, and some even learnt of the initial earthquake news from the internet. When confirming the threats faced by netizens, internet serves as a supplement role.

Different types of websites satisfied different demands in crisis communication. Professional business portal websites play important roles in diffusing timely information to the public. Governmental websites are still ill-prepared for the large amount of information demand from the mass public in the Wenchuan earthquake; for instance, the China Earthquake Bureau and some local earthquake bureau branch websites, like Beijing, Sichuan,

and Hunan, cannot be browsed because of the breakdown of their servers caused by large visit demands, which blocked the official information diffusion. Business sectors show great flexibilities in diffusing timely information to the public. For example, Tencent QQ pop-up windows have already provided tentative branding new channels for their wide audience for timely crisis information.

Internet users relied on governmental and official news agency websites to verify received information and tended to use multiple channels. Netizens used various channels to share information, and instant messenger was the prime channel during the earthquake response. For the inaccurate information diffused by the official news agency or portal websites, quite large number of internet users tended to trust them, but only relatively small percentage of them can receive the subsequent clarification.

This article captured very unique onset occasion of the catastrophic Wenchuan earthquake and documented netizens' crisis communication behavior in the pre-social media era. However, there are still some limits in this article, which desire further investigation. This research relied on snow ball sampling technique, which mostly covers the age-group from 20 to 30. The samples cannot represent the whole netizen population in China. This research does not study the content of online communication, which may impact netizens' behavior. Further research could study which type information tends to be trusted or shared by internet users in crisis.

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References

- Brändström A, Kuipers S, Daléus P (2008) The politics of blame management in Scandinavia after the Tsunami disaster. In: Boin A, 't Hart P, McConnel A (eds) *Governing after crises*. Cambridge University Press, Cambridge
- Briggs A, Burke P (2010) *A social history of the media: from Gutenberg to the internet*. Polity Press, Cambridge
- Bucher H-J (2002) Crisis communication and the internet: risk and trust in a global media. *First Monday* 7(4):1–10
- Burkhart F (1991) Journalists as bureaucrats: perceptions of "social responsibility" media roles in local emergency planning. *Int J Mass Emerg Disasters* 9(1):75–88
- Carey J (2003) The functions and uses of media during the September 11 crisis and its aftermath. In: Noll AM (ed) *Crisis communication: lessons from September 11*. Rowman & Littlefield Publishers, New York, pp 1–16
- Case DO, Johnson JD, Andrews JE, Allard SL, Kelly KM (2004) From two-step flow to the internet: the changing array of sources for genetics information seeking. *J Am Soc Inf Sci Technol* 55(8):660–669
- Chen Y (2008) Jiuzai junren fatie qiuren zhaogu huaiyun qizi xu. *Xin Kuai Bao*
- CNNIC (2008) *Statistical report for the development of China Internet Network*, vol 22. Beijing, China Internet Network Information Centre
- CNNIC (2009) *Statistical report for the development of China Internet Network*, vol 23. Beijing, China Internet Network Information Centre

- CNNIC (2017) Statistical report on internet development in China, vol 39. Beijing, China Internet Network Information Centre
- Condon P (2009) Fargo uses social networks to fight floodwaters: Facebook group seeking volunteers attracted more than 4,550 members. <http://www.msnbc.msn.com/id/29901184/print/1/displaymode/1098/>. Retrieved 3 Apr 2009
- Dash N, Peacock W, Morrow BH (1997) And the poor get poorer: a neglected black community. In: Peacock W (ed) Hurricane Andrew: ethnicity, gender and the sociology of disasters. Routledge, New York, pp 206–225
- Davey M (2009) Fargo works to hold back rapidly rising river. New York Times, New York
- DeYoung SE, Wachtendorf T, Farmer AK, Penta SC (2016) NOAA radios and neighbourhood networks: demographic factors for channel preference for hurricane evacuation information. *J Conting Crisis Manag* 24(4):275–285
- Dutta-Bergman MJ (2004) Interpersonal communication after 9/11 via telephone and internet: a theory of channel complementarity. *New Media Soc* 6(5):659–673
- Dutton WH, Nainoa F (2003) The social dynamics of wireless on September 11: reconfiguring access. In: Noll AM (ed) Crisis communication: lessons from September 11. Rowman & Littlefield Publishers, New York
- Eismann K, Posegga O, Fischbach K (2016) Collective behaviour, social media, and disasters: a systematic literature review. In: Proceedings of the 24th European conference on information systems, Istanbul, Turkey, AIS Electronic Library (AISeL)
- Fischer HW (1998) Response to disaster: fact versus fiction & its perpetuation: the sociology of disaster. University Press of America, Lanham
- Gonzalez-Herrero A, Smith S (2008) Crisis communications management on the Web: how internet-based technologies are changing the way public relations professionals handle business crises. *J Conting Crisis Manag* 16:143–153
- Haddow K, Haddow G (2008) Disaster communications in a changing media world. Burlington, Butterworth-Heinemann
- Horlick-Jones T (1995) Modern disasters as outrage and betrayal. *Int J Mass Emerg Disasters* 13(3):305–316
- Horrigan J, Rainie L (2002) The broadband difference: how online Americans' behavior changes with high speed internet connections at home. Pew Internet & American Life Project, Washington, DC
- Hughes AL, Palen L, Sutton J, Liu SB, Vieweg S (2008) "Site-seeing" in disaster: an examination of on-line social convergence. In: Proceedings of the 5th international ISCRAM conference, Washington, DC
- HXDSB Reporter (2008) QQ qunshang zhuanfa kongjiang didian nvhai zhu zhishengji kongjiang wenchuan. Huaxi dushi Bao
- Kasperson RE, Renn O, Slovic P, Brown HS, Emel J, Goble R, Kasperson JX, Ratick S (1988) The social amplification of risk: a conceptual framework. *Risk Anal* 8(2):177–187
- Kasperson JX, Kasperson RE, Pidgeon N, Slovic P (2003) The social amplification of risk: assessing fifteen years of research and theory. In: Pidgeon N, Kasperson R, Slovic P (eds) The social amplification of risk. Cambridge University Press, Cambridge, pp 13–46
- Katz JE, Rice RE (2002) Social consequences of internet use: access, involvement, and interaction. MIT Press, Cambridge
- Kraut RE, Brynin M, Kiesler S (2006) Computers, phones, and the internet: domesticating information technology. Oxford University Press, Oxford
- Laituri M, Kodrich K (2008) On line disaster response community: people as sensors of high magnitude disasters using internet GIS. *Sensors* 8(5):3037–3055
- Lasorsa D (2003) News media perpetuate few rumors about 9/11 crisis. *Newsp Res J* 24(1):10
- Li L, Goodchild MF (2012) The role of social networks in emergency management: a research agenda. In: Jenness M (ed) Managing crisis and disasters with emerging technologies: advancements: advancements. IGI Global, Hershey, pp 245–254
- Liebenau J (2003) Communication during the World Trade Centre disaster: causes of failure, lessons, and recommendations. In: Noll AM (ed) Crisis communication: lessons from September 11. Rowman & Littlefield Publisher, New York, pp 45–54
- Liu BF, Fraustino JD (2014) Beyond image repair: suggestions for crisis communication theory development. *Public Relat Rev* 40(3):543–546
- Liu BF, Fraustino JD, Jin Y (2015) How disaster information form, source, type, and prior disaster exposure affect public outcomes: jumping on the social media bandwagon? *J Appl Commun Res* 43(1):44–65
- May AL (2006) First informers in the disaster zone: the lessons of Katrina. The Asepen Institute, Communications and Society Program, Washington DC, p 80
- Noll AM (2003) Crisis communications: lessons from September 11. Rowman & Littlefield Publishers Inc, Lanham

- Palen L, Liu SB (2007) Citizen communications in crisis: anticipating a future of ICT-supported public participation. In: Proceedings of the SIGCHI conference on human factors in computing systems. ACM, San Jose, California
- Palen L, Anderson KM (2016) Crisis informatics—new data for extraordinary times. *Science* 353(6296):224–225
- Park S, Avery EJ (2016) Effects of media channel, crisis type and demographics on audience intent to follow instructing information during crisis. *J Conting Crisis Manag*. <https://doi.org/10.1111/1468-5973.12137>
- Peng B (2008) Guowuyuan xinwen bangongshi wangluoju fusizhang pengbo zhici. <http://tech.sina.com.cn/i/2008-05-20/14222206107.shtml>. Retrieved 24 Apr 2009
- Pew Internet & American Life Project Group (2001) The common of the tragedy: how the internet was used by millions after the terror attacks to grieve, console, share news. Pew Internet & American Life Project, Washington
- Phillips B (1986) The media in disaster threat situations: some possible relationships between mass media reporting and volunteerism. *Int J Mass Emerg Disasters* 4(3):7–27
- Procopio CH, Procopio ST (2007) Do you know what it means to miss New Orleans? internet communication, geographic community, and social capital in crisis. *J Appl Commun Res* 35(1):67–87
- 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: Proceedings of the ACM 2011 conference on computer supported cooperative work. ACM, Hangzhou, pp 25–34
- Quarantelli EL (1997) Ten criteria for evaluating the management of community disasters. *Disasters* 21(1):39–56
- Rainie L, Schneider S, Foot K (2003) One year later: September 11 and the internet. Diane Pub Co, Darby
- Renn O, Burns WJ, Kasperon JX, Kasperon RE, Slovic P (1992) The social amplification of risk: theoretical foundations and empirical applications. *J Soc Issues* 48(4):137–160
- Reuter C, Kaufhold M-A (2017) Fifteen years of social media in emergencies: a retrospective review and future directions for crisis informatics. *J Conting Crisis Manag*. <https://doi.org/10.1111/1468-5973.12196>
- Richardson BK, Byers L (2007) Communications studies and emergency management: common ground, contributions, and future research opportunities for two emerging disciplines. In: McEntire DA (ed) *Disciplines, disasters and emergency management: the convergence and divergence of concepts, issues and trends from the research literature*. Charles C. Thomas Publisher, Springfield
- Rodrigue CM, Rovai E (1994) The “Northridge” earthquake: differential geographies of damage, media attention and recovery. *Natl Soc Sci Perspect J* 7:98–111
- Rosenthal U (1998) Future disasters, future definitions. In: Quarantelli E (ed) *what is a disaster? perspectives on the question*. Routledge, London, pp 146–160
- Rovai E (1994) The social geography of disaster discovery: differential community response to the north coast earthquakes. *As Pac Coast Geogr* 56:49–74
- Samarajiva R (2005) Mobilizing information and communications technologies for effective disaster warning: lessons from the 2004 tsunami. *New Media Soc* 7(6):731–747
- Scanlon TJ (1977) Post-disaster rumor chains: a case study. *Mass Emerg* 2(2):121–126
- Scanlon J (2007) Research about the Mass Media and Disaster: Never (Well Hardly Ever) the twain shall meet disciplines. In: McEntire DA (ed) *Disasters and emergency management: the convergence of concepts issues and trends from the research literature*. CC Thomas, Springfield
- Schultz F, Utz S, Göritz A (2011) Is the medium the message? Perceptions of and reactions to crisis communication via twitter, blogs and traditional media. *Public Relat Rev* 37(1):20–27
- Seydlitz R, Spencer JW, Lundskow G (1994) Media presentations of a hazard event and the public’s response: an empirical examination. *Int J Mass Emerg Disasters* 12(3):279–303
- Shapiro SM (2008) Revolution, Facebook-style. *New York Times*, New York
- Susskind L, Field P (1996) *Dealing with an angry public: the mutual gains approach to resolving disputes*. Simon and Schuster, New York
- Tierney KJ, Lindell MK, Perry RW (2001) Mass media organizations and disaster. In: Tierney KJ, Lindell MK, Perry RW (eds) *Facing the unexpected: disaster preparedness and response in the United States*. Joseph Henry Press, Washington, DC, pp 136–143
- Vieweg S, Hughes AL, Starbird K, Palen L (2010) Microblogging during two natural hazards events: what twitter may contribute to situational awareness. In: Proceedings of the 28th international conference on human factors in computing systems. ACM, Atlanta, Georgia
- Weick KE (1988) Enacted sensemaking in crisis situation. *J Manag Stud* 25(4):305–317
- Wikgren M (2003) Everyday health information exchange and citation behaviour in internet discussion groups. *New Rev Inf Behav Res* 4(1):225–239
- Zhang Z, Liu J, Zhu H (2008) Di Zhen Zhong, Jia Ru Mei You Wang Luo. *Xin Xi Shi Bao*. Guang Zhou: 1
- Zhu H, Shan X, Hu J (2009) 2008 Zhongguo Hulianwang Yuqing Fenxi Baogao. Beijing Renmin Wang