



How Does the Government Crowd Out the Public? An Analysis of Networked Crisis Communication Patterns on Weibo during the Earthquakes of 2010–2019

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Abstract

Under unprecedented conditions of increasing precarity in this century of disasters, changes in social media-based networked crisis communications are driving innovation in risk governance, public understanding of risk, and public online participation. We develop the concept of Networked Crisis Communications Pattern (NCCP) formed by online participation of and connections between different types of users in Weibo-based networked crisis communication. By analyzing 133,440 Weibo posts of six significant earthquakes between 2010 and 2019 through calculation of proportion and social network analysis, we present a new phenomenon: the Chinese government has “crowded out the crowd” by increasing users, posts, and positioning as distributors of crisis information. Although “crowding out” may constitute a missed opportunity for public online participation, this study draws a cooperative and collective relationship between the government and the public in Weibo-based networked crisis communication.

Keywords

Social Media-Based Networked Crisis Communication; Weibo; Crisis Informatics; Social Network Analysis; Crowding Out



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Как правительство вытесняет общественность? Анализ сетевых паттернов кризисной коммуникации на платформе Weibo во время землетрясений 2010–2019 годов

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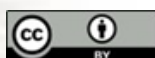
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Аннотация

В эпоху растущей нестабильности, связанной с природными катастрофами, трансформация кризисных коммуникаций на основе социальных медиа открывает новые возможности для управления рисками, повышения общественной осведомленности и вовлечения граждан в онлайн-дискуссию. В рамках исследования представлена концепция сетевых паттернов кризисного взаимодействия (NCCP), основанная на участии пользователей и их взаимосвязях в коммуникационных процессах на платформе Weibo. Анализ 133 440 постов, опубликованных во время шести значимых землетрясений с 2010 по 2019 год, с применением социальных сетевых методик и пропорционального анализа, выявил интересную тенденцию: китайское правительство вытесняет проявления активности общественности, занимая доминирующую роль в распространении информации о кризисах. Несмотря на возможные упущения в использовании потенциала гражданской активности, исследование указывает на формирование кооперативных и коллективных моделей взаимодействия между государственными структурами и пользователями в условиях кризиса.

Ключевые слова

кризисная коммуникация на основе социальных медиа; Weibo; кризисная информатика; анализ социальных сетей; вытеснение



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Introduction

As a significant part of crises in human society, the sheer number of natural hazards has led to the twenty-first century being dubbed “a century of disasters” (Achenbach, 2011). Crisis communication now has been turned the spotlight of research upon it. Remarkably, the evolution of networked crisis communication, facilitated by social media, has reshaped modern crisis communication.

Researchers from various disciplines devoted considerable attention to crisis communication, which has inspired an interdisciplinary research field – crisis informatics – concerned with the social, technical, and informational aspects of emergency response (Nerlich & Doring, 2007). Borrowing insights from crisis informatics and crisis communication, we have particular interest in how the crisis communication is expanded and promoted in Chinese online network. We argue that how the government effectively coordinates other social actors and timely responses to crises is extremely important to reduce the impact of crises on human society. This is mainly because social media-based networked crisis communication emphasizes the public criticism of formal agencies’ response, disruption of crisis management models, and a struggle for control (Büscher et al, 2017). China has a particular situation regarding the long-standing censorship of social media, which may raise frictions between the government and the public and thus impede the way forward. With over 500 million users, the integration of Weibo (a domestically developed social media in China) has promoted the formation of Weibo-based networked crisis communication, which has refigured the ingrained view and changing formats of government-to-public information dissemination that prevailed in the “traditional media” era, from one- to-many into closer two-way connections (Keim & Noji, 2011). The public, in this study, includes multi-types of organizations, celebrities, and citizens. The public is the main part of participants in crisis communication and crisis response, while the Chinese government led in crisis response and took the lead in formulating response systems, policy making, and implementation mechanisms, because the government had exclusive power and expertise to co-ordinate and control the strategy and resources to respond to crises (Shi, 2012).

Motivated by the coexistence of the government and the public in networked crisis communication, we argue that Weibo has inspired and facilitated the formation of a networked crisis communication pattern (NCCP) since the public was empowered online by actively participating in crisis communication on Weibo (Xie et al., 2017). The government-public interactions through Weibo have changed over time in social media-based networked crisis communication, which is marked by the temporary consolidation of particular patterns. We define a pattern in a specific crisis formed by the online participation of the government and the public, the forms of connection, and the intensity of connections between them in Weibo-based networked crisis communication.



Through the empirical analysis of six severe earthquakes in China during 2010–2019 with a diachronic focus, we describe a new phenomenon of “crowding out the crowd”: since the 2010 Yibin earthquake, the Chinese government has crowded out the public by pushing a mass of users into NCCPs, posting vast quantities of posts, and functioning as influential distributors of crisis information. The opposite trend has been seen in public online participation, resulting in a phenomenon of hunkering down. However, members of the public have become disseminators of governmental crisis information, indicating a cooperative and collective relationship between the government and the public in NCCPs. While the current findings are unable to draw direct connections between the two phenomena described above, they provide an empirical contribution to the complex and dynamic emerging field of researching NCCPs in China. This study contributes to understanding the changes and innovations brought by NCCPs and how the government and the public response to “a century of disasters”.

The period following 2019, particularly during the COVID-19 pandemic, has introduced significant changes in how crises are communicated in China. The government has adopted a more proactive approach in managing public discourse on social media platforms like Weibo, often delivering real-time updates to mitigate misinformation and control the narrative. This shift may have further entrenched the ‘crowding out’ phenomenon, where the space for public participation in crisis communication is increasingly restricted. Moreover, public engagement has also changed, as individuals are more likely to rely on official sources for accurate health information during a global pandemic. While the study period ends in 2019, it is clear that the pandemic has further intensified the dynamics of government–public interaction observed in previous crises.

Literature Review

According to Alexander (2014), the widespread adoption of social media by the public heralds a new age in which the government, as the primary crisis manager, has to adapt its working practices to the challenge and potential of this development. In China, a country with paternalistic governance on social media platforms, the government has to adjust its online participation in NCCPs. However, this change may not only be one-sided: the public may also change their online participation. Over the decade under investigation, NCCPs in China changed significantly. One change in my quantitative data set stands out: the proportion of governmental users in NCCPs increased significantly, from 0.6% in 2010 to 29.23% in 2019. At the same time, the proportion of public users has decreased, from 91.68% in 2010 to 48.54% in 2019.

How can we explain this? To find some answers, we turn to networked authoritarian governance concerning social media-based networked crisis communication and existing studies of community, where a phenomenon of ‘hunkering down’ has



been observed. We also articulate a set of hypotheses about community interaction patterns.

Crisis informatics and the integration of social media

With the establishment of crisis informatics, researchers have focused on social media as a platform for use in crisis communication and on the impact such use brings to the nature of crisis communication, particularly the nature and extent of public online participation. Palen and Liu (2007, p. 727) claim the role played by members of the public in crises [...] is becoming more visible, active, and in possession of greater reach than ever seen before. Increased public participation has not only indicated the number of people involved in crisis response but has also shown the changed dynamics of this response. Following its development, crisis informatics also places particular emphasis on people using ICT in crisis response in creative ways, primarily to cope with uncertainty (Palen & Anderson, 2016). The exploration of changes in NCCPs concurs with the core tenet of crisis informatics, allowing professional emergency responders to work closely with communities in an environment of shared technology and organizational infrastructure (Latonero & Shklovski, 2011).

The widespread adoption of social media by the public heralds a new age in which the government, as the crisis manager, has to adapt its working practices to the challenge and potential of this development. The integration of social media into natural disasters can be traced back to the 2004 Indian Ocean tsunami when citizens spontaneously used photo storage sites to exchange information and learn more about crises (Liu et al., 2008). This event was followed by the 2007 Southern California wildfires. It was especially important for a geographically dispersed community and allowed the leveraging, and even creation, of community resources of crisis response (Shklovski et al., 2008). In the 2010 Haiti earthquake, millions joined Facebook discussion groups to share information, donate money, and offer comfort and support, thereby generating a new forum for collective intelligence, social convergence, and community activism (Keim & Noji, 2011). In 2012 Hurricane Sandy, Twitter was used by both emergency services and the public to discuss and exchange information during all phases (Sadri et al., 2018).

Scholars have explored how social media users exchange crisis information, the types of information involved, and the effects of social media on government behaviors, decision-making, strategies, and crisis responses (Hughes & Palen, 2009). Some research indicates that social media provides additional resources for the public to access crisis information (St. Denis et al., 2014). The public has increasingly turned to social media for accessing crisis information and may believe it to be more trustworthy than information published by the mainstream media (Houston et al., 2015).

Crisis informatics offers an interdisciplinary framework that explores how information systems, particularly social media, are leveraged in emergency and disaster scenarios (Palen & Liu, 2007). Social media platforms, such as Weibo, have



become pivotal in reshaping crisis communication by enabling citizens to share real-time information, challenge official narratives, and actively participate in crisis response. These platforms facilitate horizontal communication, which contrasts with traditional top-down approaches where governments controlled crisis narratives. Crisis informatics also highlights the growing influence of digital tools in empowering ordinary citizens to contribute to the collective understanding of crises and providing alternative sources of information. However, in contexts like China, where the state tightly controls information, the potential of social media to decentralize crisis communication is limited by the government's regulatory influence.

Hunkering down in NCCP

Social media provides the opportunity for the government and the public to connect, which has prompted the rapid creation of complex relationships between the two parties. How do the complex relationships between the government and the public affect online participation and thus the formation of NCCPs? To better understand this, we draw on insights from studies of real-world communities.

With valuable perspectives on diversity in a community in the western context, Putnam (2007) argues that ethnic diversity in a community leads to declining solidarity and reduced trust. People who live in ethnically diverse communities are inclined to turn inwards, generating a “hunkering down” phenomenon. When a group encounters different groups, they will retreat to their own space and decline/withdraw from connection with others. This phenomenon reduces action, communication, and connections amongst community members, declining the collective contributions to the community. However, such communication is what NCCPs are exactly needed since Putnam (2000, p. 19) claims that communication can support the creation of social networks based on connections among the public, generating reciprocity and trust. Communication between the government and the public can prove helpful at a political level (Putnam, 2007, p. 137), facilitating more effective government. By drawing on this, communication is critical for the connection between the government and the public.

However, Sturgis et al. (2011) suggest that a weak relationship between diversity, solidarity, inequality, and power imbalances as more substantial reasons for “hunkering down”. Borrowing insights from this controversial argument, we need to consider the different dimensions encompassing multiple factors that may trigger “hunkering down” in our discussion. Public participation is a critical element in the theoretical framework of crisis communication, particularly in democratic societies, where it is seen as a means for communities to co-create solutions and share responsibilities with formal crisis managers (Palen et al., 2010). However, in authoritarian contexts, such as China, public participation is often limited by the state's desire to control the narrative and prevent challenges to its authority. While platforms like Weibo initially provided a space for public engage-



ment and discourse, this participation has been increasingly curtailed by the government's 'crowding out' of the public. The state's overwhelming presence on Weibo, coupled with the use of automated tools and mass postings, has reduced the public's ability to independently disseminate and consume crisis-related information. This phenomenon illustrates how the Chinese government has strategically managed public participation in a way that supports its control over the crisis communication space, rather than allowing for a truly participatory, decentralized approach.

Paternalistic governance in the networked communication

The concept of networked authoritarian governance refers to how authoritarian regimes, such as China, adapt to the digital age by integrating social media platforms into their governance strategies (MacKinnon, 2011). Rather than outright censorship, these regimes often employ a more nuanced approach, involving selective engagement with the public through controlled digital spaces. In the context of networked crisis communication, the Chinese government has used Weibo not only to disseminate official information but also to actively shape public discourse. By doing so, the government simultaneously maintains control while appearing approachable and responsive to public concerns. This strategy is part of what has been termed 'networked authoritarianism', where the state allows limited engagement to prevent dissent while retaining ultimate control over the narrative. This adaptation helps consolidate the government's authority, particularly during crises, when control over information flow is critical to maintaining public trust and order.

For a long time, the Chinese government has made considerable efforts to control social media use paternalistically through a combination of legislation, policies, and actions that have conveyed and fortified an image of powerful and tough leadership (Liu & Zhou, 2011). Dworkin (1972) defines paternalism as the interference of a state or an individual with another person, against their will, and defended or motivated by a claim that the person interfered with will be better off or protected from harm. Notably, one of the most widespread criticisms holds that paternalistic governance implies disregard for one's will and/or expresses a sense of superiority in governance (Shiffrin, 2000). When the Chinese government applies paternalistic governance, it often creates centralized structures, and behaves like a "father figure"; and the purpose is always stated as being "for your good", using direct and strict authority to realize the aim of the government (Peng et al., 2001). Such paternalistic governance reflects the literal meaning of the word, whereby the government enacts leadership in a paternal style, in which authority is combined with elements of concern, consideration, and moral leadership.

In such a social media environment under paternalistic governance, it is imperative for the government to expand its online presence in Weibo-based networked crisis communication. The dominance of political power over society can be clearly seen through the central government's strict control of disseminating



information on social media (Cheng et al., 2017). The government has the power and responsibility to adjust and balance social resources to achieve social stability (Moore & Recker, 2015). Particularly in China, the government has a sufficiently dominant political position to censor public online participation; the power of online space is thus not balanced, which significantly influences NCCPs. We argue that it reduces public online participation and results in a lack of communication between the Chinese government and the public, which has exacerbated tensions in the state- society relationships in China.

Research indicates that the Chinese government has recently changed its long- held crisis communication style, moving from strict regulation toward being an active online participant, namely an approachable government (Zeng et al., 2017). It is exemplified in its use of Weibo to build connections with the public. The total number of governmental users on Weibo increased from 312 in 2010 to 138,253 in 2019, including different administrative departments such as the China Earthquake Networks Center (Sina, 2019). The statistics mean that the government was fresher in 2010 but has adapted Weibo in its work in 2019; thus, the government can connect with the public and thereby enhance its positive image. A high response rate from the public is a sign of good governance, because a timely and responsible response signals to the public that the government is capable of solving problems (Min & Shen, 2021).

From the perspective of the public, it would be better if the government became more responsible and active than maintaining an image of “hard” leadership. In crises, the public often lacks the capacity to deal with crises professionally, thus demanding the government gives deep “care” to affected people and areas to function its role as a primer crisis manager. The inherent responsibility of government, and expectations of and attention from the public, require high levels of caring to be inspired by the government as the crisis manager, which explains and legitimizes their status as caring leaders in control of the situation (Hobbins, 2017).

Although significant, the paternalistic governance of social media has not been the only strategy of the regime to control public engagement; this has also included a show of authority via greater government participation on social networks, joining the online-communication sphere as a novel way to establish and maintain a favourable voice for the regime (Wang, 2018). For the public, the self-expression on social media allows the spread of misinformation, rumours, and criticism of the government on Weibo. Not only could the phenomenon raise concerns and risks to the public’s physical and mental health, but it could also seriously threaten governance and social order stability (Lazer et al., 2018). Since the massive user base has made it impossible for the Chinese state to censor all users’ statements or regulate every message on Weibo, in addition to passing laws and regulations, the government has become approachable and active online to help uphold its authority. The regime has worked to establish its own online discourse to influ-



ence public opinion, join existing debates to show concern about certain social and political issues, and communicate with the public to resolve issues and promote compliance with national policies (Huang & Yip, 2012; Wang, 2018).

Hypotheses

Given the above discussion, we use the term “crowding out” to describe this possible phenomenon for further investigation. The term “crowding out” refers to the government’s effects taking up a disproportionate level of funding and crowding out the private sectors (Blanchard, 1991). We suggest that “crowding out” reflects a similar effect in NCCPs that the expanded share of governmental online participation may suppress public online participation.

We propose a research question as follows:

RQ. In the period 2010-2019, how did Weibo-based networked crisis communication patterns change?

To further discern what changes have been generated in NCCPs over the past decade, we examined three main components that constitute a NCCP:

(1) The change in involved users of the government and the public. Weibo users can be seen as online sensors of crisis who inject rumors because they regularly provide information (Xu et al., 2017). Therefore, we propose Hypothesis 1:

H1: The government has crowded out the public in NCCPs by increasing involved governmental users.

(2) The change in posts by the government and the public. In crises, the delay in releasing government information will lead to rumors (Rosenthal et al., 1991).

Actively governmental posts will provide a significant opportunity for others to access governmental crisis information, thereby limiting rumors. The second hypothesis is:

H2: The government has crowded out the public in NCCPs by increasing Weibo posts from governmental users.

(3) The change in who were the distributors of crisis information. Reposting and replying are the functionalities that clearly show the direction of connections between distributors and consumers of crisis information because they produce directions of visible links to determine the distributors of crisis information, who are the users distributed crisis information to others on a significant scale; thus, there is greater consumption of their information. Hypothesis 3 is:

H3: The government has crowded out the public in NCCPs by playing influential distributors of crisis information.

Methodology

This study explores the changes in NCCPs on Weibo between 2010 – 2019 based on an original and unique database comprising 133,440 Weibo posts from six earthquakes.



Selection of Cases

The six earthquakes were chosen as cases for two reasons. First, the first NCCP appeared in the 2010 Yushu earthquake, and the 2019 Yibin earthquake formed the latest NCCP in the studied period. Thus, earthquakes became a focus for data collection to maintain consistency in crisis types.

Second, we select earthquakes of a magnitude 6.0 or above because, according to the Richter scale, earthquakes with a magnitude 6.0 or above are “strong” and severe earthquakes can attract surged public online participation. Due to the lack of available data and the rarity of completely comparable events, we did not set identical magnitude as a criterion for case selection. Still, we used the categories established by the international classification system applied to earthquakes. All six earthquakes with a diachronic focus can be tracked against chronological developments in using Weibo in NCCPs.

Table 1. Basic information about the six earthquakes

Earthquakes	Year	Location (City, Province)	Administrative Region	Magnitude
Yushu Earthquake	2010	Yushu, Qinghai	Autonomous Prefecture	7.1
Ya’an Earthquake	2013	Ya’an, Sichuan	Prefecture-level city	7.0
Ludian Earthquake	2014	Ludian, Yunnan	County	6.5
Pishan Earthquake	2015	Pishan, Xinjiang	County	6.5
Jiuzhaigou Earthquake	2017	Jiuzhaigou, Sichuan	County	7.0
Yibin Earthquake	2019	Yibin, Sichuan	Prefecture-level city	6.0

The data is comparable for six specific crises with similar magnitude.

Data and sample

The data were obtained by Python, and we applied the API of Weibo. A keyword search formula “geographical name + earthquake” (e.g., Yushu earthquake) was used to filter irrelevant messages. Weibo posts from 30 days after the earthquake were collected because, on Weibo, the public attention to crises usually gathers momentum in three to four weeks following (Civiw, 2019). The dataset contained 133,440 posts, including user types and the originality (i.e., a post is original/reposted).

Key variables

Types of users: The number of users involved reflected the scale of a NCCP. This variable was initially measured by the proportion of four user types, according to the authentication mechanism of the Weibo platform:



- verified governmental users (e.g., different levels of governmental departments, state media).
- verified organizational users (e.g., NGOs, enterprises, colleges, etc.)
- verified individual users (e.g., celebrities, stars, politicians, etc.)
- unverified users (ordinary individuals).

The post of our user types: This variable was measured by the proportion of posts and the mean number of posts per user of different user types. Statistics for this variable took account of multiple posts by the same user, thereby capturing each user type's posting frequency. After counting the post number of the four types of users, we determined the distributors of crisis information by measuring the following multiple aspects of the central nodes of NCCPs. User type, size, and direction of connection of central nodes: In a NCCP, we defined a node as a user, and a tie was a connection between two user nodes. The more ties, the more central the nodes are. A central node indicates the importance of nodes in the network (Newman, 2010). The tie between two nodes was generated if a node was engaged by reposting or replying to a post. The more connections a node has, the more central the node is. This variable was measured in two steps:

(1) The degree centrality of central nodes. The size of central nodes for each user type was calculated based on out-degree which is the sum of connections that originate at a vertex and point outward to other vertices (Hansen et al., 2011). The more significant the proportion of connections going out from the node (out-degree), the more central the node is, that is, a central node. Degree centrality is the sum of connections of a node, indicating the importance of nodes in the network (Newman, 2010). The more connections a node has, the higher the centrality of the node, or the more prominent the node degree, the more central the node is. When a connection has a direction, the concept of vectors is introduced: the in-degree (the number of ties coming into a node) and the out-degree (the number of ties going out from a node). The proportion of connections going out from different central nodes was calculated to make the out-degree of central nodes in six NCCPs comparable.

(2) The direction of connections. The connection of reposts between two nodes is unidirectional. The connection of replies is bidirectional because the "reply" passes information back to the node that provided information. We counted the proportion of reposts and replies of central nodes and the information dissemination-reception ratio (the ratio between the proportion of reposts and replies of each type of user) to examine the direction of connections of central nodes in disseminating information. When the ratio is greater than 1, the proportion of repost is higher than that of replies, the central node distributes crisis information unidirectionally.

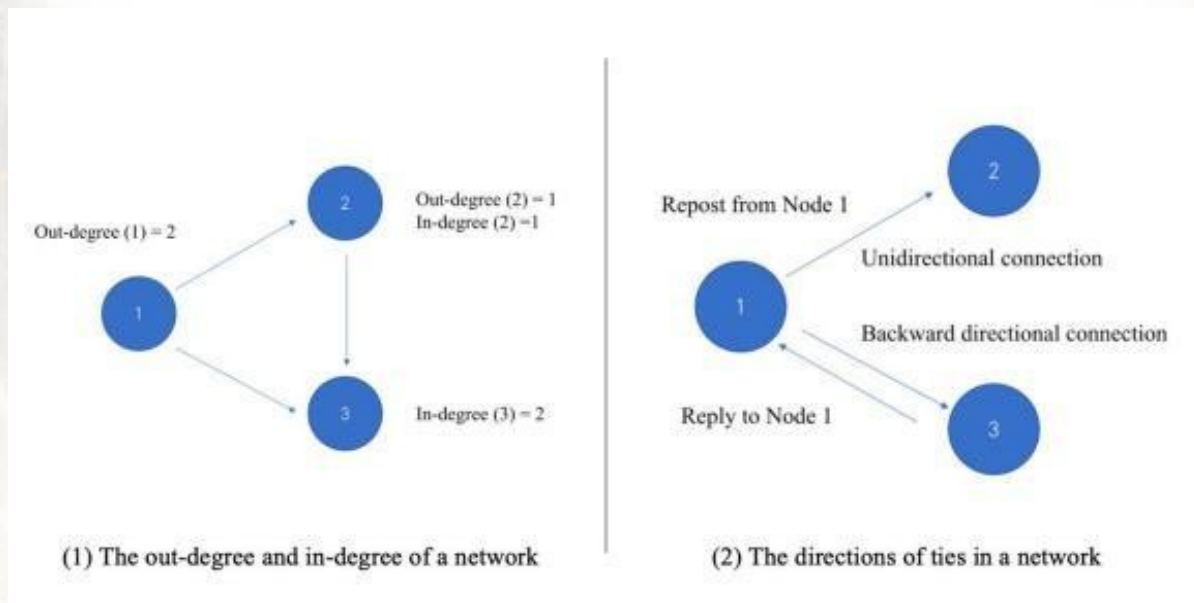
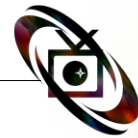


Figure 1. Degree of and Directions of ties in a network

Analytical strategy

The analysis is in three-step. First, we calculated the proportion of different user types to test Hypothesis 1. Second, we calculated the proportion of posts and the mean number of posts per user of four user types to test Hypothesis 2. Proportion calculation was carried out because it allows us to observe the changes in the quantitative trend of variables. Third, we used social network analysis (SNA) to test Hypothesis 3. SNA is particularly suited to explore the networked patterns because SNA permits whole-system analysis of the inter-organizational network of the public (Steketee et al., 2015). SNA provides deep insights into key nodes and the dynamics of change driven by users, posts, and connections. Hypothesis 3 was tested in three steps:

(1) We visualized the structure of six NCCPs and highlighted central nodes' positions. To visualize the patterns, we created six directional aggregate network graphics in Gephi based on the out-degree of nodes; edges inherited color from central nodes.

(2) We displayed the change in user types and the out-degree of central nodes. The out-degree of the top nine central nodes in the six patterns was calculated separately based on the out-degree of each user type to illustrate the change in influential user types.

(3) We examined the direction of connection of central nodes. We calculated the proportion of repost and reply of central nodes and the information dissemination-reception ratios to reveal the direction of connection of central nodes. A higher ratio indicates that the central nodes operate mainly as unidirectional information distributors rather than bidirectional.



Results

The change in involved users between 2010 –2019

The data we analyzed in the table below demonstrates that the government has crowded out the public by increasing the governmental users in NCCPs.

Table 2. The proportion of involved users

Earthquake	The Proportion of Involved Users (%)			
	Verified governmental users	Verified organizational users	Verified individuals	Unverified users
E1 2010 Yushu 5,979	0.60	6.14	1.58	91.68
E2 2013 Ya'an 37,420	3.32	21.08	1.66	73.94
E3 41,333	8.75	22.29	4.19	64.76
E4 2015 Pishan 2,087	27.46	23.33	0.15	49.06
E5 2017 Jiuzhaigou 29, 126	15.87	7.00	5.11	72.02
E6 2019 Yibin 17,495	29.23	17.24	5.00	48.54

From 2010 to 2019, the proportion of governmental users has increased from 0.60% at E1 to 29.23% at E6; the figure in 2019 is 47.71 times higher than at E1 in 2010. It means the government has surged more users in NCCPs to present its active response in crises, which can be seen as away of networked authoritarian governance. It shows the “crowding out” of the government in participating in NCCPs.

In contrast, the proportion of unverified users has almost halved over the period from 91.68% in 2010 to 48.54% in 2019, a drop of 43.14%. The proportion of verified organizational users was 1.8 times larger than in 2019 than in 2010: 6.14% of involved users were verified organizational users at E1, reaching 17.24% at E6. The proportion of verified individual users has increased from 1.58% in 2010 to 5% in 2019. The upward trends in involved verified organizational and individual users are far less than governmental users. The other three user types have increased slightly or decreased significantly over the relevant period. It means the public may have noticed the surged governmental users and began to be cautious about its online participation, showing a “hunkering down” of the public in participating in NCCPs. Therefore, Hypothesis 1 is supported.

The change in posts between 2010- 2019

Table 3. shows the change in the proportion of posts of different user types and the mean number of posts per user.

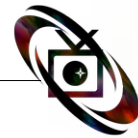


Table 3. Percentage of posts and mean number of posts per user

Earthquakes	Number of posts	Verified governmental users		Verified organizational users		Verified individual users		Unverified users	
		Posts (%)	Mean	Posts (%)	Mean	Posts (%)	Mean	Posts (%)	Mean
E1 2010 Yushu	5,979	4.00	6.63	5.00	0.82	1.60	1.02	89.40	0.97
E2 2013 Ya 'an	37,420	13.70	4.98	14.20	0.81	1.60	1.16	70.50	1.15
E3 2014 Ludian	41,333	25.10	3.80	14.10	0.83	3.90	1.23	56.90	1.16
E4 2015 Pishan	2,087	25.50	1.45	24.40	1.63	0.20	2.50	52.90	1.59
E5 2017 Jiuzhaigou	29,126	23.00	2.39	11.30	2.66	4.80	1.54	60.90	1.39
E6 2019 Yibin	17,495	40.50	1.71	14.20	1.01	4.40	1.09	40.90	1.04

In line with the growth in involved users (H1), the proportion of posts by governmental users has increased from 4% of posts in 2010 to 40.50% in 2019. The mean number of posts per government user declined, from 6.63 posts per user in 2010 to 1.71 in 2019. More governmental users posted more over time, with an exceptional in Jiuzhaigou Earthquake in 2017. Jiuzhaigou is renowned for its incredible landscape and tourism value. It is also a UNESCO World Heritage Site and a World Biosphere Reserve. The public may pay great attention to this earthquake – even governmental users have had posted many posts. In general, the government has functioned as the influential and active users to play its role as a primary crisis manager, and more importantly, expand its power in NCCPs by posting increasingly, showing a “crowding out” of the government in posting.

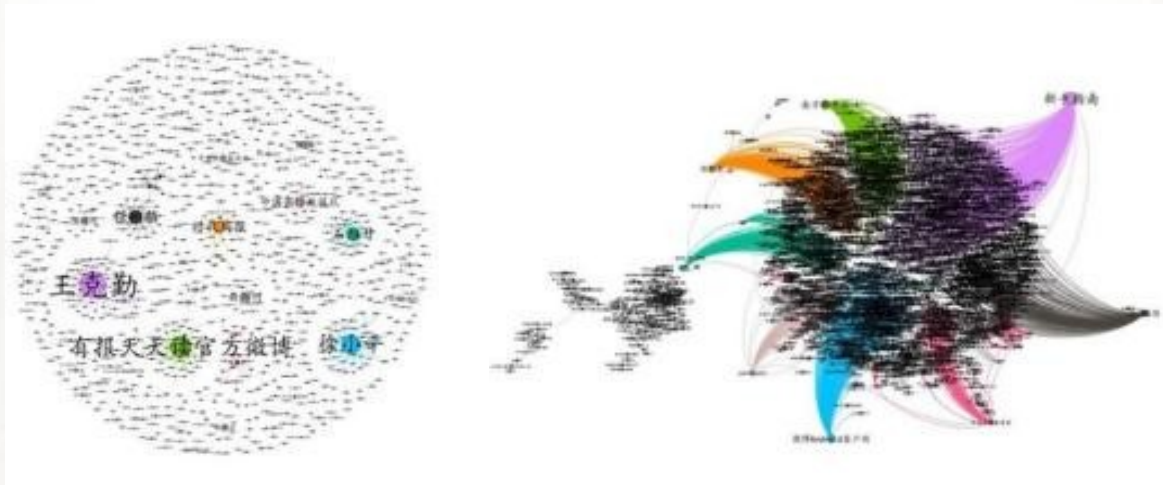
A striking decline can be seen in the proportion of posts by unverified users, from 89.40% at E1 to 40.90% at E6; thus, the proportion of posts has almost halved, which mirrors the decrease in involved unverified users. The mean number of posts per unverified user remained steady, at nearly one post per user from 2010 to 2019. Notably, although the proportion of posts by governmental users and unverified users were similar in 2019, the proportion of governmental users (29.23%) was significantly lower than unverified users (48.54%). It indicates the mean number of posts per user was higher for governmental users than unverified users in 2019. In terms of involved users, the proportion of posts from verified organizational users rose from 5% in 2010 to 14.20% in 2019. The proportion of posts from verified individual users went from 1.60% in 2010 to 4.40% in 2019. The mean number of posts per user for both verified organizational and individual users has changed little, with almost one post per user per earthquake. It means that the public has



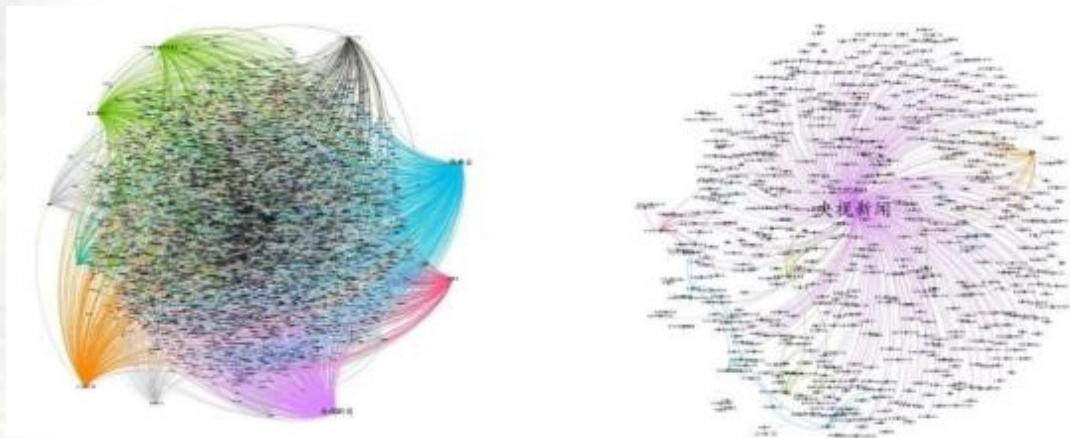
reduced its online participation, some may move away from NCCPs, and some may keep silent, showing a “hunkering down” of the public in posting. The increased post share by governmental users indicates the greater government participation to provide official crisis information. The other three types of users have reduced or barely increased the post proportion. Hypothesis 2 is supported.

The change in the distributors of crisis information in NCCPs between 2010 – 2019

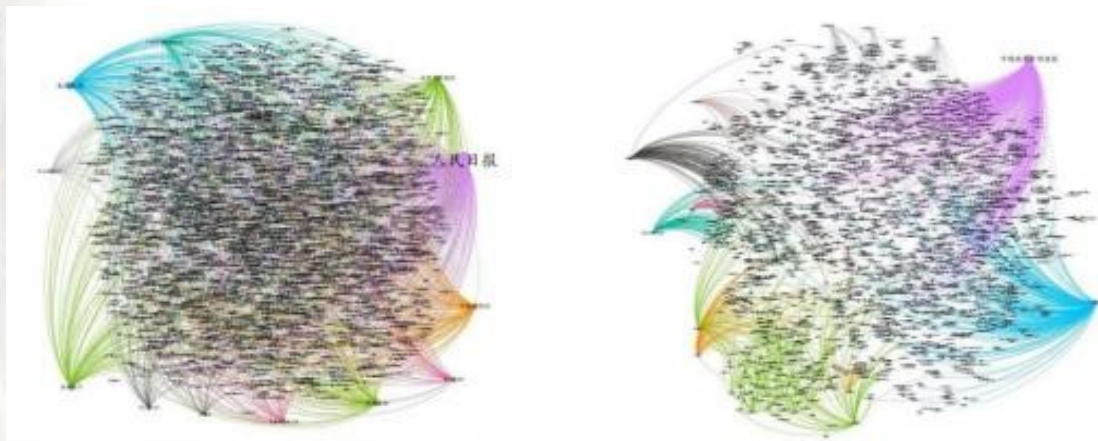
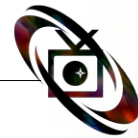
The combination of Figure 2, Table 4, and Table 5 show the change in the distributors of crisis information. Figure 2 presents the visualization of NCCPs. The structure of a NCCP has changed from a wide-open communication space with several small-sized central nodes in 2010 into a state whereby it has several significantly-sized central nodes since 2013. In 2019, the structure of a NCCP had ultimately become a more centralized and oligarchic information linkage pattern.



3a. NCCP of E1 3b. NCCP of E2



3c. NCCP of E3 3d. NCCP of E4



3e. NCCP of E5 3f. NCCP of E6

Figure 2. The change in Chinese Networked Crisis Communication Patterns between 2010-2019

Table IV shows the nine most prominent central nodes of each earthquake and their out-degree of central nodes of different user types in NCCPs to show the change in the connected scale of each user type, and demonstrates the direction of connections of distributors of crisis information according to the information dissemination-reception ratio of the nine central nodes.

Table 4. User type and the out-degree of the nine central nodes, the information dissemination-reception ratio of central nodes

Earthquake	The Out-degree of the Nine Central Nodes (%)		
	User Types		
	Verified Governmental users	Verified Organizational users	Verified individual users
E1 2010 Yushu	-	11.39	17.36
E2 2013 Ya'an	0.95	14.20	1.97
E3 2014 Ludian	17.19	17.93	12.04
E4 2015 Pishan	59.20	5.64	10.49
E5 2017 Jiuzhaigou	21.03	3.77	14.57
E6 2019 Yibin	38.03	8.00	2.67

The out-degree of governmental users as central nodes has increased more significantly than others. From 2010 to 2019, the proportion of the out-degree of governmental users has expanded from 0 to 38.30%. It shows that governmental users strengthened their ability to connect with other nodes, and their interconnection level increased much faster than the others. The proportion of the out-degree of verified organizational users has fallen from 11.39% in 2010 to 8% in 2019. The proportion of the out-degree of verified individual users has decreased from 17.36% to 2.67%. Such shrinking ability of both verified organizational and individual users in terms of connecting nodes in NCCPs indicates a growing tendency to access crisis information from governmental users. Notably, no unverified users



acted as central nodes. In other words, verified users, particularly governmental users, were more likely to serve as the central nodes in NCCPs. The change in the proportion of the out-degree of the central nodes of the three user types shows that governmental users became more highly communicative and central than others in NCCPs.

Table 5 shows the direction of connections of distributors of crisis information according to the information dissemination-reception ratio of the nine central nodes.

Table 5. The information dissemination-reception ratio of central nodes

Earthquake	User Types		
	Verified governmental users	Verified Organizational users	Verified individual users
E1 2010 Yushu	-	2.67	1.53
E2 2013 Ya'an	9.13	6.43	5.28
E3 2014 Ludian	2.37	2.14	1.24
E4 2015 Pishan	1.46	2.28	3.83
E5 2017 Jiuzhaigou	8.68	5.22	1.22
E6 2019 Yibin	1.26	4.86	3.57

Note: Ratio = proportion of reposts / proportion of replies

All information dissemination-reception ratios between the proportion of reposts and replies from other nodes to a central node exceeded 1, indicating central nodes have more reposts than replies; thus, the central node distributes information unidirectionally. The dissemination-reception ratio of governmental users rose from 0 in 2010 to 9.13 in 2013 but reached 1.26 in 2019, showing a sharp increase and then a decline. Since 2013, the posts reposted by governmental users were higher than the replies they received, demonstrating governmental users have distributed crisis information unidirectionally in NCCPs. Thus, as central nodes, governmental users have a higher capacity for unidirectional distributing crisis information rather than bidirectional in 2019 than that in 2010.

Therefore, Hypothesis 3 is supported.

Discussion and conclusion

This study examines the changes in networked crisis communication patterns (NCCP) by analyzing Weibo posts from six earthquakes of magnitude 6.0 and above in China between 2010 and 2019. We provide insights regarding (a) teasing out changes in NCCPs according to data from the six earthquakes in China over a decade, instead of a single crisis; (b) investigating online participation of



the government and the public in NCCPs in China with a setting of paternalistic governance.

In a ‘century of disasters’, which is also a century of proliferating technological connection, responses and understanding of the relevance of crisis to human society have led governments and others to pay greater attention to social media as a vector for crisis information. In the traditional media era, the Chinese government exercised oligarchic lead in risk governance and took the lead in formulating the response system, policy making, and implementation mechanisms because the government had exclusive power and expertise to co-ordinate and control the strategy and resources to respond to crises (Shi, 2012). At this stage, the earlier role of the government was exclusive because Weibo was not yet widely available in networked crisis communication.

In a period of transition, when Weibo was first integrated into crisis communication in 2010, the government, like other users, lacked experience and did not know how to participate. Following the 2010 Yushu earthquake, the government issued only a handful of posts on Weibo, and since the 2014 Ludian earthquake, the government has stepped into and actively participated in NCCPs. In 2019, government users were the fastest-growing and active user group. Based on empirical results, we present a new phenomenon: “crowding out”, whereby the government has crowded out the public by increasingly involved governmental users, posts, and acting as distributors of crisis information. A greater volume of governmental crisis information can significantly increase the probability of the officially endorsed sources reaching the public. The growing governmental online participation would be a positive move to construct the government image by playing an active crisis manager in the digital age, thus expanding its power and voice in NCCPs.

Considering the long-term existing censorship and regulation, “crowding out” is a less aggressive approach of the Chinese government to avoid “face-to-face” conflict with the public. The phenomenon of ‘crowding out’ can also be interpreted as an invisible attempt or, rather, we would say, as an invisible deterrent, in which the government participates in NCCPs to compel the public to be cautious in their online participation. This approach of appearing to soften but tightening its grip can help the government amplify its power and voice in NCCPs – thus ascertaining control of public online participation.

Decreased public online participation further supports the generation of “hunkering down” in NCCPs. While the present findings are inconclusive regarding direct connections between “crowding out” and “hunkering down”, two possibilities emerge in which the former can be partly responsible for generating the latter. We consider potential passive and proactive mechanisms to explain the advent of “hunkering down” in China.

Regarding passive mechanisms, the influx of governmental users may prompt others to turn inwards and reduce their online participation. The extent to which



the participants are heterogeneous in a NCCP is significant. In China, the government has the right and responsibility to adjust and balance social resources to achieve social stability, and it has the power to censor public online participation. The power of online space is thus not balanced. The public may passively hunker down in response to the massive governmental online participation in NCCPs. This constitutes a deliberately attenuated opportunity for public online participation.

Turning to proactive mechanisms, overwhelming volumes of crisis-related information from state sources may prompt other users to hunker down. It is crucial for the regime to release crisis information in real-time (Hand & Ching, 2011). If netizens genuinely trust government-issued crisis information, they may rely upon it to the point that they no longer post alternative content, voluntarily hunkering down in NCCPs.

However, motivated by both passive and proactive mechanisms, a question is provoked: how does the 'hunkering down' affect NCCPs in China? On the one hand, hunkering down may reduce connections between the government and the public and restrict cooperative and collective action to the detriment of NCCPs. On the other hand, during crises, the Chinese public was constantly influenced by online rumours and misinformation (Luo & Jiang, 2012). In this context, "hunkering down" cannot be entirely negative because reduced participation can generate less information, thus limiting the stream of rumours and misinformation within NCCPs. Although the hunkering down of the public will reduce the connections between the government and the public, and it also reduces the risks posed by rumours and misinformation.

We argue that, firstly, the relationship between the government and the public has been refigured, from the one-to-many dissemination of information in the traditional media era to the closer connection in Web 2.0. When the government crowded them out, some members of the public tended to acquiesce rather than push back, and even leaving from NCCPs maybe regarded as a safe strategy by the public, because no (less) participation is no (less) possibility of punishment. Such public reaction maybe a surprising response. While the 'crowding out' phenomenon can be observed in NCCPs, some members of the public have turned into disseminators of state-issued crisis information. Reducing online participation is a self-protection measure for the public to avoid conflict with networked authoritarian governance. Although both the Chinese government and the public have managed to adapt to network-centric risk governance – constituting self-directed networks and connections on social media – netizens must remain cautious about their participation.

Second, the public has increased the awareness and willingness to promote the government as crisis information distributors by disseminating governmental posts on a large scale. The public can respond to crises cooperatively and collec-



tively with the government (even though public online participation was decreasing) and particularly become better collective crisis response resources.

Third, the public was quietly crowded out in NCCPs rather than raising a significant protest and contest on Weibo or off-line that Büscher et al. (2017) observed in Western NCCPs. Some Chinese netizens who sought to criticize the regime openly have been shut down and become onlookers for fear of the threat of retaliation and punishment by the state. The decreased public online participation cannot directly illustrate a passive attitude of people regarding the “crowding out”. We argue that the constant public supply of crisis information cannot always be taken as an advantage for NCCPs because chaotic information and rumors can be generated by massive information flow.

Some limitations of the study and suggestions for further research must be addressed. This study focused on examining ties, nodes, and patterns, rather than systematically measuring the multi-dimensional change in a NCCP. Future research should expand this view of the changes to achieve a more comprehensive view of the changes in NCCPs on Weibo in China. Furthermore, the current findings of this study have not reflected the connections between ‘crowding out’ and ‘hunkering down’. Future research should also look at this research direction to understand the dynamics of online participation of the government and the public in NCCPs better. While this study covers the period between 2010 and 2019, it is important to acknowledge the significant developments in crisis communication during the COVID-19 pandemic. The pandemic has underscored the role of social media as a crucial tool for disseminating timely crisis information, and the Chinese government has further intensified its online presence. This increased dominance may have exacerbated the ‘crowding out’ phenomenon observed in earlier crises, as the government took on a more centralized role in managing public discourse on platforms like Weibo. Future research should explore how the pandemic has influenced the evolving nature of government-public interactions in crisis situations.

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