

Research on Influencing Factors of Public Opinion Information Dissemination Effectiveness on Social Media: A Case Study of the “8.12 Tianjin Explosion” Incident on Sina Weibo (Postprint)

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Date: 2017-11-08T00:00:00+00:00

Abstract

[Objective] To investigate the patterns of public opinion information dissemination on social media and the factors influencing communication effectiveness, thereby providing a reference for government management practices and policy-making. **[Method]** Hypotheses regarding information dissemination factors were proposed based on the 5W communication model and agenda-setting theory, and validated using correlation analysis. **[Results]** The study reveals that opinion leaders exert the greatest influence on communication effectiveness among all communication groups, publisher attributes on Weibo are positively correlated with communication effectiveness, while information dissemination volume is negatively correlated with communication effectiveness. **[Limitations]** Due to constraints in time and technology, the empirical analysis was limited to the dissemination pattern of a single topic within a specific timeframe. **[Conclusion]** This research holds significant importance for managers in government agencies, news media, and large enterprises to comprehend the influencing mechanisms of public opinion dissemination and to explore the factors affecting public opinion information.

Full Text

Preamble

ChinaXiv Cooperative Journal, Issue 277, 2016, No. 12

Research on Influencing Factors of Public Opinion Information Dissemination Effects on Social Media: A Case Study of the “8.12 Tianjin Explosion” on Sina Weibo

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Abstract

[Objective] This study investigates the patterns of public opinion information dissemination on social media and the factors influencing communication effectiveness, providing a reference basis for government management practices and related decision-making. **[Methods]** Combining the 5W communication model and agenda-setting theory, hypotheses regarding information dissemination factors were proposed and validated through correlation analysis. **[Results]** The study found that opinion leaders exert the greatest influence on communication outcomes, that attributes of microblog posters correlate positively with dissemination effects, and that the volume of information dissemination correlates negatively with communication effectiveness. **[Limitations]** Due to time and technical constraints, only a single topic within a single timeframe was selected for empirical analysis. **[Conclusions]** This research holds significant importance for managers in government agencies, news media, and large enterprises to understand public opinion dissemination dynamics and explore influencing factors.

Keywords: Information dissemination; Social media; Influencing factors; Hypothesis verification

Classification Number: G350

The 37th “Statistical Report on Internet Development in China” released by the China Internet Network Information Center (CNNIC) shows that in the comprehensive social media domain, Weibo reaches 33.5% of internet users. Weibo primarily satisfies users’ needs for interest-based information and serves as an important platform for acquiring and sharing “news hotspots,” “interest content,” “professional knowledge,” and “public opinion guidance” [1]. Precisely because of its massive user base, Weibo has become the main force in online public opinion dissemination. The public opinion generated on this platform and its communication mechanisms influence the entire landscape of online opinion propagation. On Weibo, users (ordinary users, opinion leaders, media organizations, government entities, etc.) create information and then disseminate and amplify it, triggering public opinion incidents. Many sensitive topics involving people’ s livelihoods, official conduct, wealth gaps, social justice, public safety, and celebrity scandals can spark nationwide debate once exposed online [2]. Weibo public opinion incidents such as illegal vaccines, assaulted nurses, and hospital vandalism can cause significant social harm if not promptly guided and controlled. Therefore, this paper selects Sina Weibo—the mainstream platform for public opinion—to study the influencing factors of online public opinion information dissemination effectiveness, providing reference for government management practices and public opinion control.

2. Literature Review

The outbreak of online public opinion has posed unprecedented challenges to governments, making research on its influencing factors a hot topic among scholars. Related research can be mainly divided into user analysis and user relationship studies within information dissemination influencing factors.

Weibo users themselves are nodes for public opinion information dissemination, and their different characteristics in posting, receiving, forwarding, and commenting all affect communication effectiveness. For instance, Yang Chengming revealed behavioral characteristics and existing problems of Weibo users from multiple factors including gender, region, and influence [3]; Peng Xixian et al. conducted statistical analysis of Weibo users and found that posting time, length, follower count, and comment volume exhibit statistical properties, with correlations among private messages, cities, and comment numbers [4]; Zhao Rongying et al., studying factors influencing Weibo information dissemination, discovered that follower count has a significant positive impact on repost volume, while activity level and events have some but non-significant effects [5]. Agichtein et al. studied user behavior feedback mechanisms to improve web search ranking [6]; Benevenuto et al. found that user behavioral characteristics sufficiently demonstrate the energy and positivity of user interactions [7]; Ye et al., by measuring posting volume on Twitter, documented dissemination patterns during public opinion outbreaks on social networking sites and assessed user behavior stability and correlations, providing new perspectives for online social network research [8].

User relationships constitute the primary pathway for Weibo information dissemination, directly affecting the scope of information spread [9]. Song Enmei et al. constructed “mutual attention” and “co-attention” networks from user follow relationships under the “fashion” tag on Sina Weibo, revealing authoritative figures in that domain and differences in network properties and member relationships between the two network types [10]; Ping Liang et al. analyzed the network topology of “following” and “followed” relationships among Weibo users using network structure indicators such as degree centrality, betweenness centrality, and closeness centrality [11]; Kang Wei studied the overall structure of public opinion dissemination networks for emergencies, the position of nodes within networks, and their interrelationships, as well as how network structure affects information dissemination paths, speed, and scope [12]. Additionally, many researchers have collected and analyzed data on social network user relationships, finding that social networks have small average path lengths and diameters, high clustering coefficients, and small-world network characteristics, with tightly connected nodes that facilitate information dissemination [13-14]; Hui-Ye et al., by measuring structural properties of online social networks and relationship strength, concluded that analyzing social networks from a strong-tie perspective is important [15]; Java et al. applied social network analysis to user behavior, discovering potential motivational communities and studying user behavior purposes and tool usage reasons to help social networking sites

retain more users [16].

Current research primarily focuses on user social relationships and follow relationships, striving to demonstrate how network structural factors influence information dissemination. However, research on influencing factors of online public opinion information dissemination effectiveness remains weak and requires deeper data mining from more perspectives and using more methods. Therefore, this paper takes the “8.12 Tianjin Explosion” incident on Sina Weibo as a case study to investigate influencing factors of public opinion information dissemination effectiveness.

3.1. Theoretical Foundation

(1) Research Theoretical Basis

Literature surveys reveal numerous communication theories in the field of communication studies. In early research on communication effects, Lasswell proposed the “5W” model in his 1948 paper “The Structure and Function of Communication in Society” : Who → says What → in Which channel → to Whom → with What effect [17]. This model reveals communication elements and emphasizes the chain of effect production. In the 1970s, McCombs et al. proposed agenda-setting theory, which has remained an important theoretical model for measuring media communication effects [18]. Its core hypothesis is that the media agenda influences the public agenda. Agenda-setting theory also involves five research areas: basic effects, attribute agenda-setting, psychology of agenda-setting effects, sources of media agenda, and consequences of agenda-setting effects, with particular emphasis on exploring how media should disseminate information to improve issue communication effectiveness [19]. This paper uses Lasswell’ s 5W model and agenda-setting theory as its research foundation to explore influencing factors in the process and effectiveness of social media public opinion information dissemination.

(2) Indicator Selection

This paper selects follower count and following count as indicators for Weibo poster attributes, posting volume as an indicator for information dissemination quantity, posting time as an indicator for temporal influence research, and repost/comment volume (daily repost/comment volume, total repost/comment volume, daily total repost/comment volume, and cumulative daily repost/comment volume) as indicators for communication effectiveness. Specific measurements are shown in Table 1 .

3.2. Research Hypotheses

(1) Hypotheses on the Influence of Weibo Posters on Communication Effectiveness

In 5W model research on the first element “Who,” scholars analyze not only the factors triggering communicators’ behaviors but also study communicators, opinion leaders, basic communication groups, role structures, and other factors [17].

Specifically on Sina Weibo, the first element “Who” is represented by different types of Weibo posters, which themselves contain multiple evaluation indicators such as follower count, following count, repost count, and comment count [20]. Meanwhile, research indicates that the relationship between follower count and Weibo influence can be described based on AISAS theory and AR(1) models [21]; further studies point out that follower count largely represents audience recognition of communicators and is therefore considered by many scholars as an important factor affecting Weibo communication effectiveness [22-23]. This paper thus selects factors such as poster volume and poster attributes to evaluate influential posters and their characteristics in public opinion events. Existing research also shows that Weibo public opinion communication effectiveness is primarily expressed through repost and comment counts [24]. Therefore, these two indicators are selected as the basis for communication effectiveness statistics. Based on this, the following hypotheses are proposed:

H1: Communication effectiveness is influenced by different types of Weibo posters, with opinion leaders having the most significant impact.

H2: The attribute characteristics of Weibo posters promote communication effectiveness.

(2) Hypotheses on the Influence of Information Dissemination Volume on Communication Effectiveness

The amount of information received by audiences has always been an important factor explored in agenda-setting theory. Similar explorations exist in current public opinion research. For instance, Lan Yuexin et al., taking online information volume as the research object, constructed a model of how online rumors influence online public opinion, analyzing factors in public opinion dissemination during public crisis events [25]; Wang Xiaoguang analyzed Weibo content and posting volume, summarizing general patterns of user behavior and relationships [26]; other scholars found that communication effectiveness significance is not solely related to the amount of media exposure [27]. Therefore, this paper proposes the following hypothesis regarding whether dissemination volume positively influences communication effectiveness:

H3: Information dissemination volume promotes communication effectiveness.

(3) Hypotheses on the Influence of Temporal Factors on Communication Effectiveness

In agenda-setting theory, temporal factors have always been important elements in studying communication effectiveness, becoming even more significant in the new media era. Some scholars measured social website data over time to analyze user relationships [28]; Terpstra et al. tracked public opinion incidents throughout their lifecycle, analyzing information dissemination moments before and after crisis outbreaks and judging information dissemination directions [29]; Bosch et al. studied dynamic data on people’s interest topics on blog sites based on temporal factors, proposing new methods for managing interest topics [30].

Thus, this paper proposes the following hypothesis based on temporal influenc-

ing factors:

H4: Communication effectiveness is significantly influenced by Weibo posting time.

4. Data Source and Basic Description

4.1. Data Source

Sina Weibo includes functions such as posting, reposting, following, commenting, searching, and private messaging, characterized by grassroots users, fragmented content, and diverse interactions. Based on these features and quantifiability, this paper selects Sina Weibo as the research platform and the 2015 “8.12 Tianjin Explosion” as the case study for exploring influencing factors of public opinion information dissemination effectiveness.

Data collection was conducted using Sina’s open API platform. A snowball crawling strategy was employed to obtain information about users, their reposters, commenters, etc., followed by crawling secondary user information. Data from August 12, 2015 to August 26, 2015 were collected, with Weibo data grabbed 24 hours a day. The data included: Weibo content, repost count, comment count, poster ID, reposter ID, commenter ID, Weibo ID, etc. Collected data were stored in a MySQL database.

4.2. Data Description

(1) Basic Data Overview

A total of 62,475 Weibo posts were crawled, with daily follower counts, following counts, posting volumes, and repost/comment volumes for the “8.12 Tianjin Explosion” incident compiled. Basic data conditions are shown in Table 2 .

(2) Data Screening

Using Ucinet on the crawled data, the top 14 bloggers with highest centrality were selected, accounting for 36,836 Weibo posts. Table 3 shows the centrality and total repost/comment information for these Top 14 nodes, which also form the basis for subsequent exploration of how poster type, poster attributes, and posting volume affect communication effectiveness.

Since opinion leaders are considered “individuals” rather than other forms of social organizations [31], this paper divides the Top 14 Weibo accounts into three groups: government Weibo, media Weibo, and opinion leaders defined as individuals. Government Weibo accounts include: @ApproachingChinaFirefighting and @NanjingZeroDistance; media Weibo accounts include: @SinaMusic, @SanlianLifeweek, @SinaRealEstate, @SinaFinance, and @HeadlineBlog; opinion leader accounts include: @HealingPsychology, @FanZhongxin, @AntiAnimalAbuse, @YeTan, @FanWei, @LouisKoo, and @ShiXiaojieWeibo.

5.1. Influence of Weibo Poster Type on Communication Effectiveness

Using daily repost/comment volumes of the Top 14 Weibo accounts during the public opinion cycle as the data foundation, Pearson correlation analysis was applied to identify main poster types reflecting communication influence. Results are shown in Table 4 .

The correlation analysis reveals that among opinion leader Weibo groups, @HealingPsychology, @FanZhongxin, @LouisKoo, @YeTan, @FanWei, and @ShiXiaojieWeibo have inter-influencing relationships with other bloggers, showing significant positive correlations. Among media Weibo accounts, @SinaMusic, @SanlianLifeweek, @SinaRealEstate, and @HeadlineBlog demonstrate the ability to influence other Weibo accounts with significantly positive correlation trends. Among government Weibo accounts, only @NanjingZeroDistance shows certain influence with significant positive correlations with other accounts. These results indicate that among the influential Top 14 Sina Weibo accounts, opinion leaders are most numerous (six accounts with $r > 0.5$), demonstrating not only quantitative advantage in influence but also moderate-to-high significant positive correlations. In the highly significant positive correlation relationships ($r > 0.8$), opinion leaders @HealingPsychology, @FanZhongxin, and @ShiXiaojieWeibo show influence, while only @SinaMusic does so among media accounts. In summary, opinion leader Weibo accounts demonstrate significantly greater overall influence than media and government Weibo accounts. Therefore, hypothesis H1 is validated.

5.2. Influence of Weibo User Structural Attributes on Communication Effectiveness

Using daily repost/comment volume during the public opinion period as the dependent variable, this study verified the influence of daily follower count and following count—two poster attribute indicators—on communication effectiveness. Correlation analysis between Top 14 poster attributes and their total repost/comment volumes yielded results shown in Table 5 .

Table 5 shows that follower count has significant or highly significant positive correlations with daily repost/comment volume, indicating that on the Weibo platform, higher follower counts for government, media, and opinion leader accounts can promote their total repost/comment volumes. Following count also shows significant or highly significant positive correlations with total daily repost/comment volume, suggesting that on Weibo, if opinion leaders have more followings and broader attention scopes, the likelihood of promoting information dissemination increases. Therefore, poster attribute characteristics directly affect public opinion event communication effectiveness. Weibo accounts with many followers and followings store high communication energy and can more effectively reach audiences. Thus, hypothesis H2 is validated.

5.3. Influence of Weibo Posting Volume on Communication Effectiveness

As events unfold, Weibo posting volume and repost/comment volume gradually accumulate. To examine whether posting volume affects communication effectiveness, correlation analysis was conducted between the Top 14 accounts' total posting volume and total repost/comment volume, with results shown in Table 6 .

The results show Pearson' s coefficient between total posting volume and total repost/comment volume = -0.380 , $p=0.001<0.01$, reflecting a significant negative correlation between posting volume and user reposting/commenting behavior. This indicates that accounts posting less information have greater total repost/comment volumes, while those posting more information have smaller total repost/comment volumes. Therefore, hypothesis H3 is not supported.

To explore the reasons, statistical analysis was conducted on the Top 14 accounts' total posting volume versus total repost/comment volume during the public opinion period. Posting volume was measured in individual posts, while repost/comment volume was measured in units of 100, with results shown in Figure 1 [Figure 1: see original paper].

Figure 1 shows that when the public opinion event erupted, the relationship between the Top 14 accounts' total posting volume and total repost/comment volume exhibited a weak curvilinear fluctuation, with the trend also indicating a negative correlation between posting volume and communication effectiveness. To further reveal why H3 was not supported, the author collected information from highly influential posters who posted three or fewer Weibo messages but generated massive dissemination volumes, with partial information shown in Table 7 .

These highly influential Weibo posts share common characteristics: (1) They all use text-image descriptions and video formats; (2) Content primarily expresses condemnation, mourning, and support, tending to use storytelling approaches; (3) Regarding opinion leader attributes, information posted by entertainment stars, grassroots celebrities, and scholars more easily triggers responses.

Therefore, Weibo posting volume is not a decisive factor promoting communication effectiveness; rather, content and format may influence audience reception to a greater extent. This is also because information dissemination is influenced not only by volume but also by audience psychological needs and other factors [32]. Consequently, posting volume does not determine communication effectiveness.

5.4. Influence of Weibo Posting Time on Communication Effectiveness

The author collected the first posting time after the “8.12 Tianjin Explosion” and daily repost/comment volumes, with partial information shown in Table 8 . Based on this information, cumulative daily repost/comment volumes during the public opinion cycle were calculated, and correlation analysis was conducted between posting time and both daily repost/comment volume and cumulative daily volume, with results shown in Table 9 .

The results show Pearson’s correlation coefficient between first posting time and cumulative daily repost/comment volume = 0.943, $p=0.000<0.05$, which is significant; while the correlation between posting time and daily repost/comment volume = -0.366, $p=0.001<0.01$, also significant. This indicates that posting time significantly influences communication effectiveness, exerting significant negative impact on daily repost/comment volume but highly significant positive impact on cumulative daily volume. This demonstrates that as events develop, Weibo communication fervor declines and daily dissemination volume gradually decreases; meanwhile, media set agendas through temporal control, stimulating knowledge in users’ memories and mobilizing their enthusiasm through information dissemination [19], causing total communication volume to increase over time, which aligns with actual developments. Therefore, hypothesis H4 is partially validated.

6. Conclusion and Future Work

Based on the Sina Weibo platform and using the 2015 “8.12 Tianjin Explosion” public opinion incident as a case study, this paper employed statistical analysis to investigate influencing factors of Weibo public opinion dissemination from communication studies and public opinion information management perspectives, reaching the following conclusions:

- (1) Based on the 5W communication model, hypotheses H1 and H2 were proposed regarding posters and poster attributes; based on agenda-setting theory, hypotheses H3 and H4 were proposed regarding information dissemination volume, content, and temporal factors.
- (2) On the Sina Weibo platform, opinion leaders constitute the most influential group, with mass media and government Weibo accounts showing inferior scale and effectiveness in communication. This reflects the popular and casual nature of the Weibo platform. Poster attributes such as follower count and following count significantly affect communication effectiveness, indicating that posters’ popularity and breadth of interests directly influence user activity levels. Weibo posting volume does not promote communication effectiveness, and this paper explored the reasons. Temporal factors themselves constitute an important measure of communication effectiveness. Through correlation analysis between first posting

time and daily/cumulative communication volumes, this study found that temporal factors have dual impacts on communication effectiveness.

- (3) In examining the relationship between posting volume and communication effectiveness, this study also found that posting volume and audience dissemination trends exhibit fluctuating patterns. During event dissemination, accounts posting less achieved greater dissemination volumes, typically using images and videos with emotionally charged text. This indicates that emotional expressions spread more widely and rapidly than factual reporting and in-depth rational analysis. Therefore, government agencies and mass media should strengthen agenda-setting at appropriate times to correctly guide public opinion and reasonably dispel negative emotions.

This paper explores influencing factors and communication effectiveness of the “8.12 Tianjin Explosion” incident on Sina Weibo, aiming to provide theoretical support for public opinion management and pattern exploration. However, limitations remain. Due to time and technical constraints, only a single topic within one timeframe was selected for empirical research. Future research should incorporate factors such as trending topics, high-frequency words, and user psychological motivations to conduct single-case studies or comparative multi-case analyses across different public opinion scenarios. Therefore, exploring interactions among various elements of public opinion incidents and identifying effective influencing factors to provide more scientific guidance for future public opinion forecasting remains the direction for future research efforts.

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Author Contributions: Liao Haihan: proposed research design and approach, collected and analyzed data, drafted and revised the manuscript. Wang Yuefen: participated in research design, revised the final manuscript.

Conflict of Interest Statement: All authors declare no conflict of interest.

Supporting Data:

Supporting data is available in the online version of the journal at <http://www.infotech.ac.cn>.

[1] Liao Haihan, Wang Yuefen. weibo_{infor}.xlsx. Weibo data collection information table for the “8.12 Tianjin Explosion” incident.

[2] Liao Haihan, Wang Yuefen. micro blog data crawling.txt. Data crawling code for the “8.12 Tianjin Explosion” incident.

Received: 2016-06-12

Revised: 2016-09-02

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv –Machine translation. Verify with original.