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# Social Media Network Structure: Framework, Motif and Optimization: Based on the Analysis of Social media Accounts during the COVID-19 Pandemic

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## KEYWORDS

*Social Media;*  
*Network Structure;*  
*Epidemic Information;*  
*Motif;*  
*Public Opinion*

## ABSTRACT

All kinds of social media accounts in China have formed a network with multiple subjects, large scale, complex structure, and diverse functions, becoming the main supplier of information for society. What are its core nodes and main communication channels, and how can overall communication efficiency be improved? These questions guide the analysis of China's current social media communication. Using the highly recognizable information of the COVID-19 pandemic, this study tracks and analyzes communication effects and paths, and examines structural characteristics from the perspective of complexity theory. The findings show that in China's complex social media network, traditional mainstream media and accounts hosted by party and government organizations are the most important communication nodes, whose linkage provides a framework function. During the static management of Xi'an and Shanghai, the communication structure exhibited three-point and four-point models, centered on local and central mainstream media accounts. Therefore, this study proposes improving the efficiency and quality of communication by optimizing the network structure, repositioning the roles of mainstream media and government accounts, and adjusting their responsibilities and powers, so as to enhance the network's functions in information dissemination, public opinion guidance, social mobilization, and information purification.

## INTRODUCTION

Social media has become the most important channel for people to obtain information. "Keeping abreast of information and current affairs" has become the biggest motivation for global users to use social media.<sup>[1]</sup> On the whole, a variety of different types of social media accounts in China are connected to each other, have formed a network with multiple subjects, large scale, complex structure, and huge function, which has be-

come the most important information supplier in our society.

Analyzing the general characteristics, network structure, core nodes and main channels of information dissemination of this network is fundamental and important for improving the communication efficiency of the entire social media, promoting the management of social media, and enabling it to play a better role in the dissemination of mainstream information, guiding public opin-

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ion, mobilizing the society, purifying information, and improving the accuracy of information arrival. This paper takes the social media network formed in China as a whole, uses complex network analysis, social network analysis, statistical inference and other methods to analyze the overall structure and internal relations of this network, and on this basis, discusses how to achieve the above purposes and functions through the re-positioning of responsibilities, the re-empowerment and the optimization of structure.

## LITERATURE AND PROBLEMS

Research on social media, in general, has focused on topics in the areas of social networks, social platforms, communication effects, social networking sites, opinion leaders, social media marketing, sentiment analysis, and artificial intelligence. The social network formed by social media links is a core issue in social media research. The analysis of the co-occurrence matrix of existing literature shows that the research on social networks is most closely related to online public opinion, social websites, social platforms, and social media.<sup>[2]</sup> Compared with studies on traditional media and portal websites, the network relationship formed by social media connections is a key link to analyze a series of issues in social media communication.

The focus on social networks in existing studies is mainly from the perspective of social media “users” to analyze the social networks formed by interconnected concerns, and the studies focus on the analysis of Facebook, Twitter and Weibo users. From a more macroscopic point of view, research on the overall structure, communication characteristics and efficiency of the total social network formed by it is still lacking. However, researchers have obviously noticed the value of the structural characteristics of social networks, important nodes in social networks, node locations and other issues in social networks, and have carried out research on them accordingly.

Xiang Debao et al. studied the network formed by 169 British “China hands” on Twitter in terms of overall structure, node influence and influence mechanism, and found that these British “China hands” constituted a relatively close social network, and the network showed an obvious core-edge structure. The number of media reporters in the core node position is the largest.<sup>[3]</sup> This is similar to the idea of this study. In addition, noting the differences between different nodes within the network and improving the role of important nodes within the network are similar to the purpose of this study. In Tang Tao's study, a specific user classification method based on heterogeneous information network embedding is used to identify high-value users corresponding to the target task, with the aim of identifying those nodes in the social network that can maximize the influence on

other nodes more efficiently, and improving the efficiency of identifying high-influence users in social media.

Compared with the above analysis of the “user” network, a more macroscopic view is the cross-platform dissemination of information in different social media “platforms”. For example, Wang Yu et al. used statistical inference and regression analysis methods to study the diffusion characteristics and related factors of information from other platforms in Sina Weibo, in the hope of helping to efficiently guide or control the evolution of public opinion.<sup>[4]</sup> Yang Lei et al. constructed an opinion dissemination model based on cross-platform social networks, found that cross-platform social networks can increase the attention of opinion information and expand the scope of influence, and that both the external platform environment and the external friend environment affect the dissemination of opinion in cross-platform social networks, and that controlling the dissemination thresholds and the exit thresholds of the platforms can effectively manage the dissemination and diffusion of opinion in cross-platform social networks.<sup>[5]</sup> These studies, focusing on the dissemination of information among different platforms, have taken a step deeper into the research perspective, but it is still sloppy to take all kinds of social media platforms as a whole and compare them with the reality of the free dissemination of social media among individual accounts.

In fact, the connection of all social media accounts in China has generally formed a complex network structure. Does this complex network structure have the characteristics of a “complex network”? It is an effective way of thinking that can help us analyze the network in depth. Complex networks are large-scale networks with complex topology and dynamic behavior. The study of complex networks takes various kinds of complex systems as objects and tries to summarize the spatial and temporal regularity of their structures.<sup>[6]</sup> Some researchers in the field of information science, using the theory of complex networks, have already carried out the research on the internal network structure of social networks and the characteristics of information dissemination. For example, Ai Xiaoxiang aims to improve the classification method of Twitter accounts and transforms the Twitter social network classification problem into a complex network analysis problem, thus realizing a better social network account classification effect. From the perspective of complex networks, Huo Zhaoguang et al. summarize the factors affecting the dissemination of social public opinion from four aspects: network structural characteristics, node attribute characteristics, information content characteristics, and other factors. It is found that the factors of “network structural characteristics” such as network topology, basic nature of the network, and characteristics of network relationships are the basis of the objective environment that affects the dissemination of social opinion. The “node attribute characteristics” such as the communication subject and the communication object are the sub-

jective artificial conditions of social opinion dissemination.<sup>[7]</sup>

In the study of complex networks, it is an important content and effective method to explore and understand the behavior and function of complex system to decompose complex system into several levels of subsystems and study the structure characteristics and organization mode of corresponding levels. In the study of local structural forms, motif plays a very important role, which is “isomorphic subgraphs that appear repeatedly in a network, and their frequency of occurrence in a real network is much higher than that in a random network with the same number of nodes and lines.”<sup>[8]</sup> The distribution of different scale motifs is of great significance to describe the organization of the network. In the existing studies, Qiao Yuwei, Zhong Zhijin, et al. had introduced the analytical method of motif as a parsing perspective when studying the emotional polarity and contagion pattern in the public opinion of emergencies. After comparison, a five-node motif was chosen to describe the information diffusion mode of the whole “Kunshan anti-killing case” event.<sup>[9]</sup> In the network formed by social media accounts in China, whether there are motifs, whether they have the structural characteristics of a complex network? It becomes a perspective to analyze the network.

Based on the above literature and the research purpose of this paper, this research raises the following three interrelated and progressive research questions:

**RQ1:** Which types of accounts comprise the high-influence nodes in the network formed by various types of social media accounts in China? Which social media accounts constitute the main information dissemination channels?

**RQ2:** Is there a motif structure of complex networks within the networks formed by social media in China?

**RQ3:** If there is a motif structure, which social media accounts make up its nodes? What is the relationship with the above high-influence nodes?

By analyzing the above questions and quantitatively analyzing and characterizing the information dissemination in China's social media network, it is expected that some research can be expanded in the following three aspects: firstly, from the perspective of the effect of information dissemination, we can differentiate the nodes according to the attributes of the accounts in China's social media network, analyze the main dissemination channels within the network, and portray the macroscopic “framework” characteristics of the network. Secondly, the concept of motif is applied in the study of social media communication network. By extracting the microstructure of information transmission process, the roles of different users on network nodes and the characteristics of cooperation are described. Thirdly, based on the statistical inference of the amount of information transmission, the motif index is combined with other indicators such as node type and communication influ-

ence of social media to further analyze the different importance of different nodes in the information transmission network. Finally, based on the characteristics of “frame” and modality in the network, the information dissemination mode in the social media network is revealed, and then suggestions are made to optimize the network structure of social media information dissemination in China.

## MACRO PERSPECTIVE: FRAMEWORK AND MAIN CHANNELS OF COMMUNICATION

Social media networks have been continuously spreading all kinds of information, how can we clearly and accurately describe the main nodes and channels in its spread for analysis? After several data capturing comparisons in the early stage, we chose a scheme that combines the tracking statistical analysis of specific information with the overall dissemination analysis of information in a specific environment, and chose the novel coronavirus epidemic information as the object of tracking analysis.

There are three reasons why we take the COVID-19 pandemic information as the research object: First, the epidemic information has a high degree of recognition and is not easy to be confused with other information, which ensures that we can obtain a better degree of differentiation when tracking the dissemination channels of the information. Second, the epidemic is related to the life and health of every member of society, all kinds of social media have sufficient power to spread the epidemic information, and the information has a wide coverage of social media. Third, China's epidemic prevention and control is a comprehensive social mobilization, which also determines that all types of social media are inevitably involved in the dissemination of information on the epidemic, to achieve the maximum possible dissemination of information on the epidemic.

### Research Design and Data Acquisition

First, it is the design of the first research question. That is to complete the statistical inference of the main communication nodes and channels in China's social media network, so that we can clarify the basic “framework” of the social media network. To this end, we firstly select the four most active and major social media, namely Weibo, WeChat, Tiktok, and Bilibili, as our research objects. In the preliminary data search, we found that the Wechat public account “Healthy China”, sponsored by the National Health Commission, is the main information dissemination channel for existing public health emergencies in China, and is also the main and most authoritative first media for information about the novel coronavirus epidemic in the country. Most of the most important and most disseminated information on the COVID-19 epidemic at the national

level transmitted by various social media sources are from the wechat public account. For this reason, we took this account as the target and analyzed all the information on the novel coronavirus epidemic it published from the emergence of the outbreak in December 2019 to November 1, 2021, and captured a total of 2,240 pieces of information. Preliminary statistics show that there are 43 messages with a reading volume of more than 100,000, with an average reading volume of 20,844 and an average reprint volume of 121. And then, taking the "amount of retransmission" as an indicator, the 2,240 messages are sorted, and the top 5 messages with the highest transfer load are searched for a second time, and then the forwarding accounts of each message are counted, and a random sample of these messages is selected to be analyzed. Then the forwarding accounts of each message were counted and 50 accounts were randomly selected, so that a total of 250 accounts of secondary dissemination were obtained. Then the subjects of these accounts are counted by type. At the same time, among these 2,240 messages, an article with a high degree of information recognition is selected, and the time of forwarding response by all its secondary dissemination accounts is counted. This realizes the analysis of the dissemination effect and dissemination initiative of the secondary dissemination of information. A similar approach is taken for Weibo, Tiktok, and Bilibili.

Since the total number of interactions (including the total number of retweets, comments, and likes) of the epidemic-related content released by the official microblog of "Healthy China" was low, the analysis of the dissemination of the epidemic information on the microblogging platform and the channels was focused on the microblogging hotlist data. Firstly, we analyzed the content data from the microblog hot search list by the keywords "epidemic", "lockdown", "quarantine", "anti-epidemic", "novel coronavirus pneumonia" and "COVID-19". A total of 100 hot topics were screened based on indexes such as list duration and topic popularity. After excluding topics such as entertainment news and people's livelihood news, a total of 74 hot topics of anti-epidemic news were retained, and then sorted according to the reading volume.

From the content dimension, From the content dimension, through the directional search of the topics related to "novel coronavirus pneumonia" published on the Tiktok platform, the distribution channels and networks of the content with the best dissemination effect were analyzed. The targeted search included topics related to the epidemic itself, such as # epidemic, # COVID-19, # novel coronavirus, and topics related to epidemic prevention and control, such as # epidemic prevention and control, # epidemic response, # lockdown, # nucleic acid testing, # COVID-19 vaccine. The eight main topics were searched separately within the Tiktok platform, and the total amount of interactions (i.e., the total amount of data in the three dimensions of

comprehensive forwarding, comments, and likes) for each related content under each topic was ranked from highest to lowest, and the top 50 data with the highest total amount of interactions under each topic were collected. Through the analysis of these 400 pieces of popular data, we preliminarily mapped the content related to the neocoronavirus pneumonia outbreak on the Tiktok platform by analyzing these 400 popular data, we initially mapped the mainstream dissemination channels of the content related to the COVID-19 on the Tiktok platform.

## Research Analysis and Findings

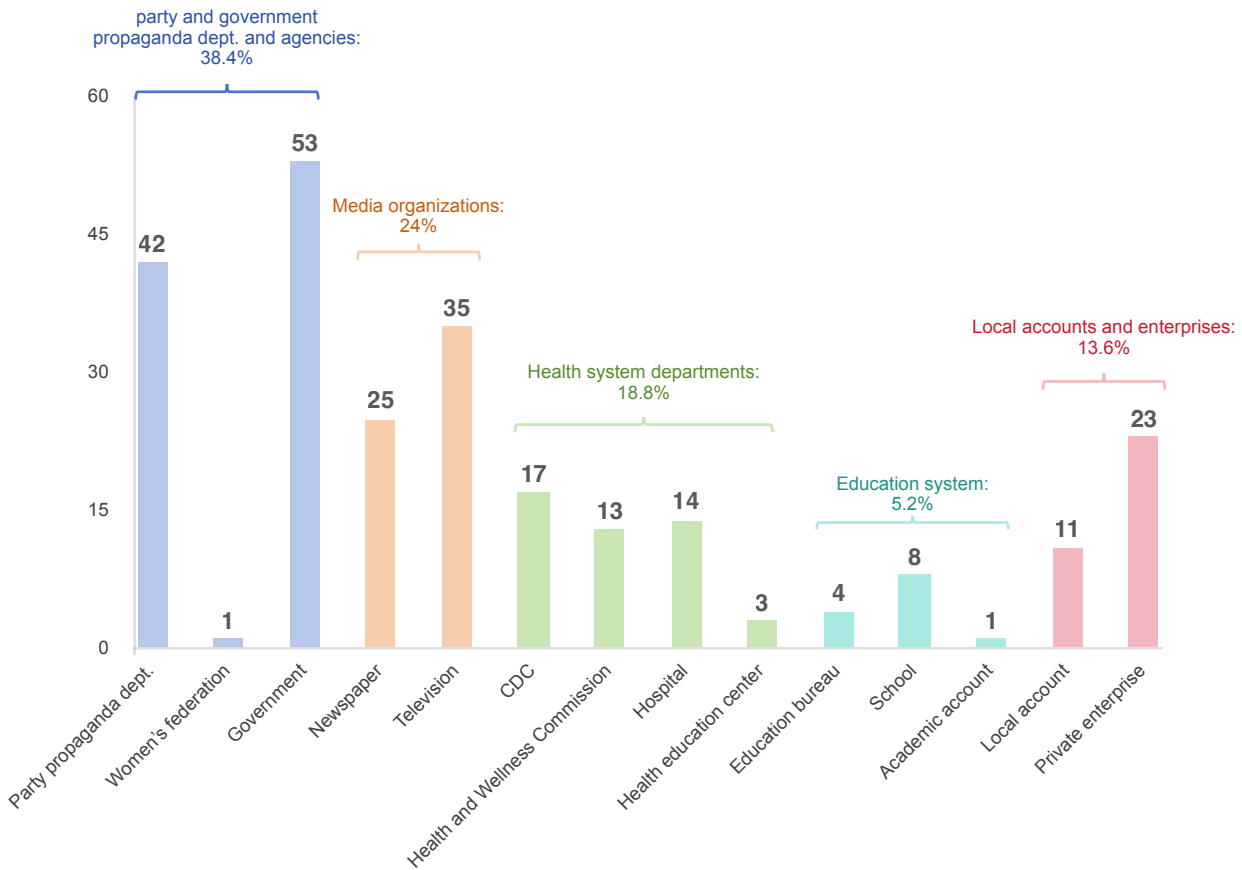
### *Analysis of distribution channels in the WeChat public platform*

First of all, through the analysis of 250 secondary dissemination accounts, it was found that the main distribution channels mainly include the following five categories: party and governmental organs and propaganda departments, media organizations, relevant departments of the health system, the education system, local accounts and relevant enterprises (**Figure 1**). Among them, accounts belonging to party and government propaganda departments and government agencies accounted for 38.4% and those belonging to media organizations accounted for 24%, ranking the top two. The overall share of those belonging to health systems such as the CDC, hospitals, the Health and Wellness Commission, and health education centers was 18.8%. The education system accounted for 5.2 percent and the others totaled 13.6 percent.

### *Sina Weibo: analysis of communication channels in hot search content*

By analyzing the content of the sorted topics, it is found that most of the topics with more than 100 million readers are related to the information on the epidemic in various places, while the topics with more than 10 million readers have a high frequency of content that implies ideological confrontation, such as "comparison of China and the U.S. in fighting against the epidemic". The top 10 hot topics with more than 100 million readers and top 10 hot topics with more than 10 million readers are selected to analyze the path and effect of the epidemic information dissemination. The study found that more than 80% of the microblogging hot topics related to the announcement and discussion of epidemic information and news release were conducted under the auspices of party and government organizations and official media.

Based on the existing samples, in order to explore the secondary information dissemination channels in the above popular microblogs, five popular microblogs with high retweets were selected from each of the samples with more than 100 million readers and more than 10 million retweets, and the secondary retweeting accounts of each microblog were sampled and analyzed,



**Figure 1 | Composition of secondary transmission channels related to the COVID-19 push in "Healthy China"**

resulting in a total of 176 popular retweeted microblog samples. According to the secondary retweeting of popular microblogs, we can initially summarize the characteristics of the dissemination of epidemic information on the Sina Weibo platform: the secondary dissemination of the microblogging field is based on the reprocessing and new release of the original information content; and the types of microblogs are mainly classified into two categories: one is the personal accounts of pan-entertainment and pan-information, and the other is the official microblogs of the Ministry of Propaganda, the departments of political and legal affairs and all kinds of governmental agencies.

**TikTok: analysis of short video content dissemination channels under popular topics**

By categorizing the publishing accounts of the sample content according to account attributes, a total of five main different types were found, including media accounts, personal accounts, government accounts, local accounts and other accounts. Among them, the release channels with the highest degree of heat in TikTok platform are various types of news media accounts, accounting for 55% of the total sample.

**Bilibili: Analysis of distribution channels of long video content platforms**

In order to provide a clear perspective on the types and channels of epidemic information dissemination on Bilibili, this paper first conducts a platform-wide search for epidemic-related information on Bilibili. Based on the amount of interaction (including interaction data of likes, comments, and pop-ups), the video content with the best dissemination effect was preliminarily screened. And then the key words such as "epidemic", "COVID-19", "epidemic prevention and control", "anti-epidemic", "nucleic acid detection" and "COVID-19 vaccine" are searched in Site B. After sorting the videos with the dimension of "most clicks", a total of 500 popular video samples related to the epidemic were obtained, and 399 valid samples were obtained through screening after reviewing the contents of the samples were directly related to the epidemic.

After classifying the communication sources of the cleaned valid samples, four main information channels were found: news media organizations; individuals; party and government organs and group organizations; celebrities, enterprises, and research institutes.

Through the analysis of the above four types of accounts with strong communication effects in the current major social media, it can be seen that from the source of communication, the official social media has absolute

discourse power, from the secondary communication effects, in WeChat, the secondary communication of party and government institutions and media departments is the most prominent, in microblogging, the official microblogging of party and government institutions and media departments also occupies an important position, and in the communication of video social media, the media institutions account for the most important share.

## MICROSCOPIC VIEW: MOTIF AND NODE ANALYSIS

In terms of the complex network formed by these social media, what is the importance of the social media of the official organizations and propaganda departments mentioned above in the whole network? Are there high-frequency interactive behaviors, and do they have a greater influence on other nodes? Does it function of a modular structure in a complex network?

Many complex networks such as biological, technological and social networks share common global structural properties such as small world and scale-free, while at the same time, networks with similar global structural features usually reflect extremely different local features, and this local structure is often reflected in the network in a modular form. A large number of studies have found that most networks have a modular structure, and the module also has its underlying structure, the motif, which is the basic pattern of interactions of a small number of nodes of the network at the microscopic level. In neural networks, food chains and technological networks, researchers have found various motifs with different dynamic functions, such as metabolic networks and signal transduction networks, which have biochemical processes and signal transmission roles.

### Research Design and Data Acquisition

Complex network research has become one of the most important multidisciplinary cross-research fields nowadays, and the motif, as one of the basic topological structures of complex networks or even complex systems, plays an important role in the study of network topology. This part analyzes the structural characteristics and propagation mechanism of epidemic information in social networks based on the network motif. The data was collected from 197 microblog topics related to Xi 'an epidemic between December 12, 2021 and January 16, 2022, including the host, length of time on the list, highest ranking, heat and time, manually screened the hosts and other communicators under the topic, selected the accounts with more than 500,000 followers, and screened the above accounts with the conditions of influence and activity, and finally collected 128 microblog accounts and 3945 microblog information.

This paper selects the social media information communication network during Xi 'an's static urban management period in December 2021 and Shanghai's static urban management period in April 2022 as the research object. This is partly due to the reason of taking epidemic information as the research object, and partly due to the fact that during the period of urban static management, people pay more attention to epidemic information, and all kinds of social media accounts have high willingness to spread epidemic information and high concentration. All kinds of other information have less impact of "perturbation".

At the same time, based on the hot search topic data about the epidemic in Shanghai on Tiktok platform from March 15, 2022 to May 15, 2022, a total of 412 hot search data were collected, and each topic was sorted from highest to lowest according to the total interaction amount of each related content (that is, the total data of the three dimensions of comprehensive retweets, comments and likes). The top 15 pieces of data with the highest interaction volume under each topic were collected, and through the analysis of these 6,180 popular data, initially mapped the dissemination channels of the content related to the novel coronavirus on the Tiktok platform.

Again, it is the demonstration for the third question. That is, for the network with the presence of the motif, the accurate motifs are identified through the method of social network analysis, and the point-in and point-out degrees of each central node are analyzed in order to statistically analyze the type of node subject belongs to.

## Research Analysis and Findings



### *Motif analysis in microblog platform*

Firstly, Fanmod software is used to detect the network mode of topic host and other communicators in the collected microblog data, verify the existence of network motifs in microblogging information dissemination, and analyze the structure and nature of three-point motifs and four-point motifs. Then, with the help of Ucinet software, we construct the social network of Xi'an epidemic information dissemination on the microblog platform, which provides support for the analysis of network structure characteristics. In this paper, the following motif is expressed as the closely related relationship form of nodes in social media platforms in the practice of epidemic information transmission, and the clear, non-random local structural form regulated by the essential characteristics of the correlation between nodes.








Three-point and four-point motifs detection were performed on the data using the Rand-ESU algorithm, and the results in **Table 1** and **Table 2** were obtained respectively.

It can be seen from Table 1 and Table 2 that the P-values of the 9 model subgraphs are all less than 0.01, and their occurrence frequency in the Xi 'an epidemic Weibo topic media association network is higher than

**Table 1 | Three-point motifs of the Xi'an epidemic transmission network on the Weibo platform**

Module Number	Geometry	Frequency	Average Frequency	Standard Deviation	Z-score	P-value
3-1		64.675%	64.48%	0.00059226	3.2947	0
3-2		2.011%	1.8583%	0.00051184	2.9832	0

**Table 2 | Four-point motifs of the Xi'an epidemic transmission network on the Weibo platform**

Module Number	Geometry	Frequency	Average Frequency	Standard Deviation	Z-score	P-value
4-1		39.244%	38.941%	0.0013638	2.2211	0
4-2		0.23514%	0.18247%	0.00018799	2.8016	0
4-3		0.21477%	0.17147%	0.00013086	3.3085	0
4-4		0.0058603%	0.0035641%	1.1414e-005	2.0117	0
4-5		0.0049673%	0.002448%	1.0405e-005	2.4213	0
4-5		0.0022325%	0.001053%	4.2176e-006	2.7965	0
4-7		0.0010604%	0.00054758%	2.22e-006	2.3101	0

that in the random network, which are the motifs of the network.

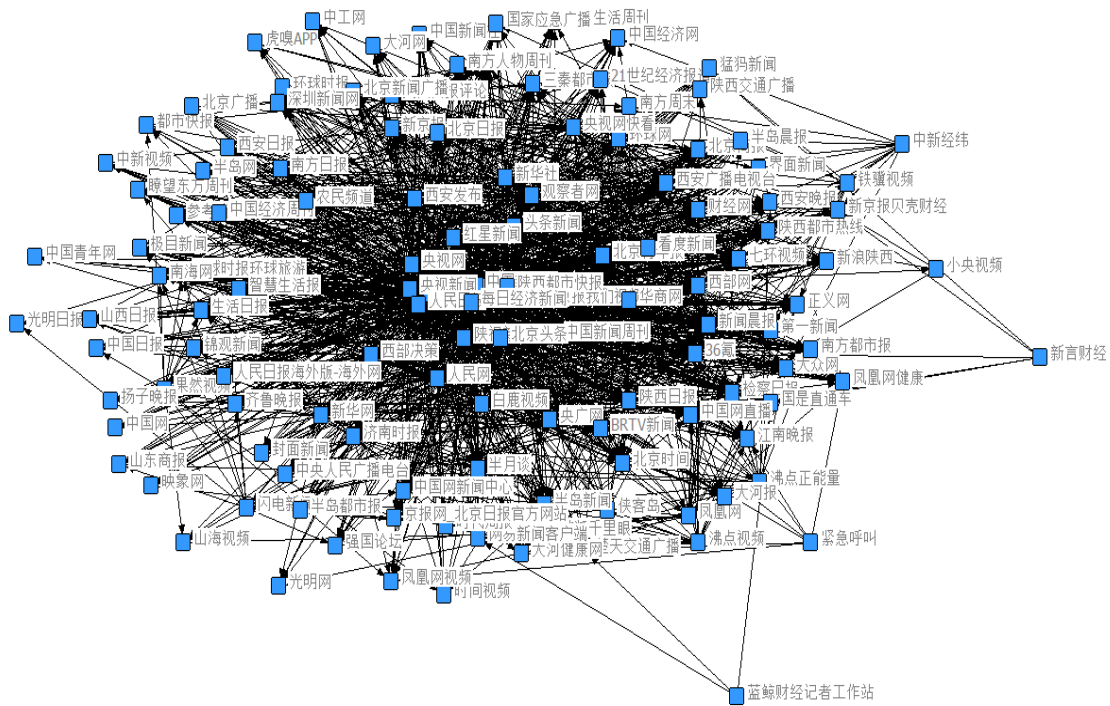
Centralized organizational models can efficiently and accurately achieve their purposes when facing routine events with predictability, but such organizational structures tend to be inflexible when facing unpredictable non-routine events. The centralized organizational model in the social media platform studied in this paper meets the demand for information dissemination while also influencing the flow of information dissemination in the social media era, shaping the ecology of social opinion dissemination. In this case, if the core nodes can bring the information with certain factual basis and controllable information can largely reduce the complexity and chaos of social opinion dissemination, and stabilize the crisis-prone public opinion field. Bavelas and Leavitt defined star, chain, ring and fully connected structures according to the efficacy of the centralized and decentralized networks in different scenarios. For example, the centralized star-type structure of modal numbers 3-1 and 4-1 enables the organization to respond quickly to simple problems, but as the amount of information increases, the central node is easily buried by a large amount of information and it is difficult to make a correct decision, compared with numbers 3-1

and 4-1, the decentralized ring-type structure of 3-2 is more suitable for dealing with unexpected and complex problems.

The above two characteristics reflect the motif characteristics of the centralized structure of media-associated network primitives in China's microblog information dissemination. Meanwhile, according to the figure, the centralized modal 3-1 and 4-1 occupy a larger proportion in the three-point subgraph and four-point subgraph respectively, and such a structure reduces the risk of security of social opinion, but it also has the main problems of rigidity and inertia, which is not conducive to media cooperation and information dissemination in the response to sudden crisis events.

In order to further confirm the position of different nodes in the information dissemination network, this paper uses Ucinet and Netdraw software to construct a network structure diagram of the information dissemination association of microblogging, and the results are shown in **Figure 2**.

In social network analysis, "position" represents a series of nodes embedded in the same position in the network structural relationship, which is the remaining structural feature that strips away the heterogeneity of actors; "role" is the combination of relationships linking



**Figure 2 | Structure of information dissemination network of TikTok platform**

the positions together, and is the behavioral pattern that exists among the positions. According to the network topology diagram, it can be seen that the nodes occupying the middle position in the Xi'an epidemic communication network on the Weibo platform are surrounded by denser black directional lines, indicating that the actor's influence is stronger and it is at the core of the overall social network. From the center to the outside, the nodes at the edge of the core area are the intermediaries of information dissemination, they actively pay attention to the news of the opinion leaders and timely pass the information obtained to the peripheral edge nodes. The nodes at the edge position are the end point of information dissemination in this sampled media, they have less interaction with the nodes in the core area, and they are in the position of being influenced and disseminated in the network.

In order to clarify the node position of the subject of Xi'an epidemic topic dissemination on the Weibo platform, this paper needs to measure the degree of each node on the Weibo platform.

Point degree centrality is a measure of a node's position in the network by focusing on the node's connections, including point out degree and point in degree, which measures a node's ability to associate with other nodes. Higher point centrality proves that the node is connected to more actors and is in a more central position in the dissemination network of information. This part of the relationship network built on media affiliations on the Weibo platform is a directed network, and the point out degree and point in degree of centrality of

a node need to be discussed separately when examining the degree of centrality of a node in the network structure.

In the network structure built on media relations, the point out degree indicates the degree of attention that the node is paid attention by other members, the higher the point out degree indicates that the node directly points to more other nodes, and this kind of node is usually regarded as a more important and influential node. The point in degree indicates the degree to which the node is influenced by other nodes, or the degree to which the node pays attention to other nodes, and the higher the point in degree, the more active the node is in the network structure, and the better it can obtain diversified information.

The adjacency matrix constructed by 128 collected Weibo media nodes is input into Ucinet, and the point out degree and point in degree of nodes are obtained respectively, as shown in **Table 3**.

In the communication network of Xi'an epidemic on the Weibo platform, the top ten outlets are all mainstream media, among which "Huangshang News", "Shaanxi TV News" and "Shaanxi Metropolis Express" are three local media accounts, which have fewer followers than other media accounts, but have high information access efficiency, and the information they release is more likely to be received by users in the first time. On the other hand, the central media, represented by "CCTV News" and "People's Daily", have always maintained a leading position in terms of attention, and the information they publish is widely disseminated and

**Table 3 | Top ten nodes of Xi'an epidemic Weibo platform by node point outdegree**

Sequence	Weibo account	Number of fans	OutDegree
1	Huangshang News	11.049 million	106
2	CCTV News	130 million	104
3	People's Daily	150 million	101
4	Shaanxi TV News	5.06 million	72
5	CGTV News	17.718 million	70
6	China News	76.598 million	62
7	Daily Economic News	48.139 million	60
8	Xinjing News We Video	15.147 million	59
9	People Daily	83.122 million	58
10	Shaanxi Metropolis Express	3.397 million	56

**Table 4 | Top ten nodes of Xi'an epidemic Weibo platform by node point indegree**

Sequence	Weibo account	Number of fans	InDegree
1	36Kr	3.442 million	37
2	Morning Post	39.591 million	32
3	Xi'an Broadcasting Corporation	580,000	30
4	China Webcast	5.633 million	28
5	BRTV News	1.186million	28
6	Beijing Youth Daily	14.407million	27
7	Finance Net	40.392million	27
8	Qihuan Video	3.483million	27
9	Farmer's Channel	1.975million	24
10	Procurator Daily	3.168million	22

highly efficient. The top ten mainstream media, as the center of microblog information transmission of the epidemic in Xi'an, make full use of their own resource advantages in the information dissemination network to increase the attention of the epidemic information in Xi'an.






Compared with the nodes with high point out degree, the top ten nodes with high point in degree of Xi'an epidemic in the Weibo platform dissemination network have fewer followers, but they also have a certain social status and are more active in the information network, which facilitates the wider radiation of the diversified information to different user groups (**Table 4**).

According to the results of point centrality measurement, the media with higher point centrality are local and central mainstream media, which occupy the center position in the information dissemination network and act as opinion leaders in information dissemination. Local mainstream media have an inherent advantage due to their fast information acquisition and release speed,








while central mainstream media have a large number of fans, strong credibility, and the information released can be noticed by a large number of user nodes at the first time, so they have a strong voice and influence in the information dissemination network. When the nodes have a high degree of centrality and greater influence and control in the information dissemination network, the social capital embedded in the network structure becomes the most valuable resource for network members.

Based on the measurement of motif subgraphs and point centrality of Weibo nodes, it is possible to determine the position of nodes in the network and identify opinion leaders. It can be seen that in the Weibo topic discussion about the epidemic in Xi'an, the core nodes are concentrated, including the central and local traditional mainstream media, which have high attention and credibility themselves, while the Weibo platform provides direct links to hot events and government agencies, so that they have more connections compared

**Table 5 | Three-point modal map of the Shanghai epidemic transmission network on the TikTok**

Module Number	Geometry	Frequency (%)	Average Frequency (%)	Standard Deviation	Z-score	P-value
166		1.4941%	1.0021%	0.00067239	7.3167	0
46		3.4396%	2.889%	0.00094223	5.843	0
12		21.346%	20.736	0.0013612	4.4837	0
38		5.1961%	4.6753%	0.0013362	3.8983	0
238		0.99605%	0.69969%	0.00084677	3.4999	0

**Table 6 | Four-point modal map of the Shanghai epidemic transmission network on the TikTok**

Module Number	Geometry	Frequency (%)	Average Frequency (%)	Standard Deviation	Z-score	P-value
158 4-8		3.949%	3.3434%	0.0011294	5.3616	0
2142 4-9		0.22341%	0.15183%	0.00013768	5.1994	0
19150 4-10		0.068211%	0.038065%	5.8921e-005	5.1163	0
590 4-11		0.36462%	0.24388%	0.00023677	5.0993	0
18634 4-12		0.055543%	0.032745%	4.5372e-005	5.0247	0
862 4-13		1.1572%	0.78337%	0.00081269	4.5999	0
222 4-14		0.53311%	0.39742%	0.00030461	4.4546	0

with other nodes, occupying a central position in the information-associated network; the fringe nodes, which are larger, contain industry media, commercial media, official media, and other media, most of which have connections to the nodes in the core area, but at the same time, the degree of communication within the nodes in the edge area is less, which makes a big difference with the nodes in the core area. Overall, the number of core nodes on the dissemination network of the Xi'an epidemic topic information in the Weibo platform is small, with a single type of user and a significant difference with the edge nodes, resulting in the inability to effectively share information among them, and some of the nodes' information can't reach the widest audience.

#### **Analysis of the network motif in the Tiktok platform**

Using the Rand-ESU algorithm to detect three-point and four-point motifs on the data, the results in **Table 5** and **Table 6** are obtained respectively.

Motifs are subgraphs that appear frequently in real networks as opposed to random networks. The analysis shows that the propagation-associated network motif of epidemic information is not a special task output function as the form of motif exercising a specific information processing function in a living network, but it is a non-random specific layout of the topic content produced in the process of production and dissemination of the social network. This localized network topology can locally portray the pattern of node links in social networks, and identify the network topology and its dynamic properties, so as to comprehensively analyze the nature of the network structure and network functions.

From Table 5 Table 6, it can be seen that the Z values of the 12 motif subgraphs are all greater than 0, indicating that the number of their appearances in the media-associated network and the corresponding stochastic network in the information dissemination of the Tiktok platform have positive significance ( $Z > 0$ ), and can be regarded as motifs in the media-associated network in

**Table 7 | Top ten nodes of Shanghai epidemic Tiktok platform by node point outdegree**

Sequence	Tiktok account	Number of fans	OutDegree
1	Hubei News	28.696million	100
2	Knews	28.125million	74
3	Qilu Evening News·Guoran Video	14.466million	59
4	Country + Community	20.403million	51
5	Vista View	19.296million	51
6	Xinhua Daily Telegraph	42.685million	49
7	Chutian Transportation Radio	24.647million	48
8	People's Daily	160million	48
9	Political Affair	23.17million	45
10	CCTV News	150million	43

**Table 8 | Top ten nodes of Shanghai epidemic Tiktok platform by node point indegree**

Sequence	Tiktok account	Number of fans	InDegree
1	Knews	28.125million	51
2	Qilu Evening News·Guoran Video	14.466million	44
3	political affair	23.17million	41
4	East Network	3.601million	41
5	Chutian Transportation Radio	24.647million	37
6	Pengpai News	37.496million	36
7	Xinmin Evening News	3.74million	33
8	Country + Community	20.403million	32
9	Xinhua Daily Telegraph	42.685million	30
10	Hubei News	28.696million	29

the information dissemination. Motifs 3-3, 3-4, 3-6, and 3-7 are all in the form of subgraphs with three nodes connected to each other, indicating that the three users in the network promote the dissemination of the content of the same epidemic topic in different modes with each other. Analyzing the information dissemination association connotations of the four-point motifs, it is noticed that modules 4-8, 4-9, 4-10, 4-11, 4-12, and 4-13 contain module 3-5, which suggests that, as the epidemic information dissemination association network's basic structure, the presence of modal 3-5 also leads to the appearance of modals 4-8, 4-9, 4-10, 4-11, 4-12, and 4-13, demonstrating that higher-level modals are usually revealed by lower-level combinations.

In order to clarify the node position of the communicating body of the Shanghai epidemic topic on the TikTok platform, this paper further measures the degree of each node on the TikTok platform. The relational network established in this part based on the media-associated behaviors on the Tiktok platform belongs to the directed network, and the node's point out degree needs to be discussed separately from the point in degree when examining the node's degree of centrality in the network structure. The adjacency matrix construct-

ed by 162 Tiktok media nodes collected was input into Ucinet, and the point out and point in degrees of nodes were obtained respectively. At the same time, Netdraw software was used to construct the network structure diagram of information transmission of Tiktok platform. They are shown in **Table 7** and **Table 8**.

In the communication network of TikTok platform, the top ten in terms of point out degree and point in degree, except for "Vista View" which is a commercial media, all the others are main stream media. Meanwhile, Hubei News, Knews, Qilu Evening News-Guoran Video, Country+ Community, Xinhua Daily Telegraph, Chutian Traffic Radio, and Political Affair appeared in the top ten in terms of outgoing and incoming, indicating that the media located in the core nodes of the TikTok platform not only have high influence, but also actively participate in the release of relevant topic information. According to the node visualization network community graph of TikTok platform, it can also be seen that there are fewer transition nodes in the middle of the core area and the edge area, and the active degree of nodes in the information network greatly affects their position in the network (**Figure 3**).



development of China's social media is not due to the Chinese government's protection policies, but rather that China's social media are more adapted to the needs of Chinese users. The presence of a large number of government affairs microblog and Wechat content on Chinese social media has greatly promoted the grassroots governance of Chinese society. This study and this research conclusion can form mutual evidence, so as to better play the role of government microblog and Wechat in social governance.

One of the shortcomings of this study lies in the fact that it only analyzes the network structure by categorizing various different types of social media, and future studies can unify the network structure formed by social media of various different platforms. Of course, taking into account that both traditional media and official social media of party and government organizations will operate multiple accounts on different platforms at the same time, while they will be highly shared in terms of content, and thus the effect of the modal structure should be more significant in a cross-platform network.

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