Whose Voice Matter in COVID-19 Discussion?

A Network Actor Analysis Based on Weibo-COV Corpus (2019-2020) *

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Abstract

Based on Actor Network Theory(ANT) and attention-driven media system literature, this study applied computational methods to analyze the "network amplification" in the COVID-19 information flows. First, we used complex network analysis to identify four types of actors: official media, unofficial media, politicized social media influencer and depoliticized social media influencer. Granger causality test shows that, the unofficial media outlet's attention gains impact from other three types of actors. Second, topic modeling on a ran dom sample demonstrate that different actors contribute to different amplified topics. Specifically, official media amplifies the "anti-pandemic propaganda", which being a focus of the public health information promotion. In the meantime, media outlets and social media influencer present some consistency in the topic preference. Last, I discussed the implications of the attention in the hybrid media system.
Keywords: *Covid-19; Network Analysis; Hybrid Media System; Network Amplification; ANT.*

1 Introduction

COVID-19 pandemic is the first time in human history when people massively applied digital techonology and social media to help the public understand and fight against the pandemic. From working from home, online teaching, e-commerce, platform food delivery, social media information acquisition, to health code promotion, trans-border immigration control, COVID push people's daily live to digitalization. In the meantime, the information technology we've been relied on is fostering a "infodemics"(WHO, 2020): an overload of information, both online and offline, with misinformation, disinformation, and mal-information, spread rapidly with the help of media technology, causing public confusion, panic and distrust.

The infodemic is characterized by a high volume of information and the viral spread of conflicting and misleading information. However, as Pulido, Villarejo-Carballido, Redondo-Sama, and Gómez reminds us, power in information society no longer lies in acquiring information, but in managing it. The actor network and power dynamics behind misinformation deserves scholarly attention. Researchers of political communication in the states have pointed out the negative effects of partisan asymmetry in hybrid media system(Zhang, Chen, & Lukito, 2023), while literature focusing China have shown concern for conspiracy beliefs and new waves of nationalism. During the pandemic, conspiracy beliefs, such as "US Virus", not only served to increase internal solidarity and external threat perceptions, but also to put risk on the public health and government prevention solutions(A. Chen, Lu,

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Chen, & Ng, 2024). Although the salient features of this discussion have been examined in some detail, there is still a lack of a holistic view of the power relations behind the networks of public discussion in China at this "critical moment in human history" [1].

We can get a holistic study path to this discussion network by reviewing the mass media environment research. Specifically, we focus on the public attention in contemporary hybrid media system and its actor network. Downs (1973) first proposed the classic "issue attention cycle" model to conceptualize the varied stages of public attention to the issues. This is followed by agenda setting theory(Maxwell, Donald, et al., 1972), information subsidies(Turk & Franklin, 1987) and gatekeeping theory(Shoemaker, 2009), all indicating that a small group of elites participating in shaping public attention dynamics(Y. Chen, 2020; Guggenheim, Jang, Bae, & Neuman, 2015). However, media technology's development has led to an exponential growth of more and more discourses, images, and landscapes, the bandwidth of the public's attention has not grown with the increase in consumable content. This shift in the information overload environment has led scholars to question the explanatory power and applicability of traditional theories.

In the digital media era, attention economist Lehmann, Gonçalves, Ramasco, and Cattuto (2012) posited that, even though information appears to be in abundant apply, attention is scarce. From political economic perspective, attention serves as the "currency" of today's media system. Attaining attention creates avenues for organizations to enhance their social, economic, and political values.

Moreover, digital media systems challenge the traditional assumption of the gatekeeper. Chadwick (2017) explains the contemporary information and communication environment in terms of hybrid media system, which is defined as a system that incorporates both old and new media. The logic of this hybrid system consists of "technologies, genres, norms, behaviors, and organizational forms" that shape "power relations between political actors, the media, and the public.Those involved in the media system can influence the flow of information to suit their own agendas or to exert influence over other actors in different media. The relationships between these groups are dynamic and evolving. This new system creates new opportunities for action by non-elite actors.

The open and complicated information, discourse and landscape during COVID-19 directs our attention to the following questions: Who is influencing the public attention to the issues? The question thus arises as to how these actors influence the public's attention to issues. Moreover, what are the distinctions in issue shaping among diverse actors within a hybrid media system, and how do they connect to influence this information landscape?

2 Literature Review

2.1 Theoretical Context

Actor Network Theory (ANT), originated from Science and Technology Studies (STS) tradition, with basic claim concerns the ambiguous boundary between the social and the

[1] Noam Chomsky's words

material. The main theorist, Bruno Latour, argues that sociology since Durkheim has been dominated by a strucuture-agency view, with its observation approach to research that artificially assumes a distinction between individual and collective levels(Latour, 2010). Latour (2010) draws heavily on Tarde's quantification ideas to establish a single-level starting point for his view of the world. For Tarde, quantification begins at the level of the "monad", which is an empty concept. The network absorbs all the element around the monad, further applied constraints and possibilities to it. Zhang (2020) quoted the main argument from "sociology of association" paradigm, advacted by Latour, to argue that, there is nothing behind behavior, and society is precisely what is to be explained, the end of explannation. This work builds on the theoretical foundation of Zhang (2020): The one more wants to define an actor, the more one wants to deploy its network. Conversely, to understand a network, we need to study the network that constituted by the actors.

2.2 Actors in Hybrid Media System

Digital journalism and communication theories have long been focused on the questions in how to describe the relationships among actors, and a increasingly mediatization digital society. The tradition can traced back to concepts like "public arena"(Hilgartner & Bosk, 1988), "forum"(Ferree, 2002) and "ecosystem"(Anderson et al., 2016). Follow Zhang's framework, we focus on the theoretical concept "system" proposed by Chadwick (2017), which provide us an insightful perspective to examine how different actors in a flexible system connect and coordinate to take actions. This also helps to overcome the shortcomings in the existing communication theory to understand heterogeneous action process(Zhang et al., 2023).

2.3 Curated Flows and Network Amplification

Various actors in the system, for example, journalists, media outlets, social media platforms, influencers and algorithms, as well as the imbalance between supply and demand of the information, have brought the notion of attention to scholarly discussion(Cramer, 2017; Goldhaber, 1997; Hogan, 2001; Klinger & Svensson, 2015; Tufekci, 2013). The most compelling argument, by Webster (2014), provides comprehensive theoretical explanation of this "attention market" and its impact on media consumption and digital society – attention brings conversation from "who has the ability to communicate" to "who has the ability to capture audience attention". Further more, political communication scholar focus on the power aspects in attention's nature: First, attention is necessary for communicators to change the opinions of their audiences; second, attention is potential action, a mechanism for transforming communicative power into other forms of power, such as commercial advertising interests or civic engagement; third, attention is transferable and constitutes a form of currency; and finally, attention is powerful because other people think it is powerful. As the primary currency of power in hybrid media systems, the allocation of attention and how it is transferred and flows among entities is a hot topic of interest to a wide range of researchers(Zhang, 2020).

However, most social issues attract attention briefly and are then quickly forgotten(Castillo, El-Haddad, Pfeffer, & Stempeck, 2014; García-Gavilanes, Mollgaard, Tsvetkova, & Yasseri, 2017). It is unsure that which issues are persistent and attract long-term public attention. In addition, the media environment adds to the complexity of why public attention changes. Specifically, which actors and communication behaviours generate and spread public attention to different social issues/events on different platforms? And the explanatory weaknesses of traditional media theories have led communication scholars to rethink the influences. Furthermore, many studies lack a consistent conceptualization and measurement of public attention(Wu & Huberman, 2007). For example, in agenda-setting study, researchers often use public attention interchangeably with public opinion, public agenda or issue concern. From early agenda-setting studies to more recent research on the dynamics of public attention online, the concept has varied in definition, operational meaning and temporal patterns(Y. Chen, 2020).

Adopting conceptualization of attention in networked communication, this study regard attention as a resource that creates economic, political and social value in hybrid media system(Y. Chen, 2020). As previously argued, existing literature proposed multiple explanation of the attention's generation and spread. Organizational actors (i.e. elite politicians and news outlets) are capable of determining the focus of public attention, for example, Rogers, Dearing, and Bregman; Shoemaker; Yang and Saffer are contribute to this type of analysis.

In the digital media age, McCombs, Shaw, and Weaver (2018) incorporate social and interpersonal media (horizontal) into the agenda-setting process as an extension of mass media (vertical). Vargo and Guo (2017) propose a network agenda-setting model that takes into account the frequency of multiple issues appearing simultaneously in the news, and Vargo, Guo, and Amazeen (2018) further extend the model to account for shifts in attention to issues between social and mass media, and from the news media to the public agenda. Ognyanova, Lazer, Robertson, and Wilson (2020) apply a dynamic, multi-dimensional networked agenda-setting model with embedded audiences, information sources and issues. The model comprehensively integrates the network mechanism, media, media form and interpersonal influence in agenda-setting.

However, although recent models have made many adjustments to traditional agenda-setting models, taking into account the process of complex dynamic interactions. However, key shortcomings remain(Russell Neuman, Guggenheim, Mo Jang, & Bae, 2014). Zhang (2020) argued that these theories still assume that elite actors is the main initiator of public attention, the public just "react" in these models. Also, the operational drawbacks of attention and media effects as key limitations, have led scholars turn to agenda diffusion, or information flow(Weimann & Brosius, 2017). [2]

Information studies have been applied to explain the dynamics of public attention, particularly the networked social movement or digital activism. The key assumption re-

[2]The concept of diffusion is characterized to reflect interactive, multiple-step communication flows, and the networks embedded.

gard the information diffusion as a social process. Networks influence this process through the interdependence of ordinary people, constituting the most basic network mechanism. Empirical results, see Tufekci (2013),Marwell and Oliver (1993), have contributed to new concepts and theoretical framework.

Curated flow is a very compelling framework(Thorson & Wells, 2016). "Flow" not only respond to the classic "two-step flow" concept, but also connect to the liquidity of media environment. Meanwhile, curation is well suited to the environments characterized by speakers, information overload and selective exposure as well as filter bubbles. Thorson and Wells (2016) adopted "egocentric public" proposed by Wojcieszak and Rojas as curator in the system, which provide flow to individual nodes for consideration.

Zhang (2020) proposed a new approach to understand public attention and opinion expression by social actors, by applying new methods for conceptualization and measurement. We mainly uses "network amplification" to discuss the network interactive relationships among social actors during COVID-19 pandemic in China. In detail, attention is regarded as the power currency in media system, display influential power by visible metrics on social media. In other words, network amplification is a process the attention or visibility of a specific object in social media.

In the field of communication, amplification can often be defined as the process of increasing the exposure of a particular idea, object or person and directing public attention to it. Mass media have long been practicing amplificatory activities, including agenda setting or media hype(Freelon, McIlwain, & Clark, 2018). The dynamics of amplification become more complex in hybrid media systems marked by multiple information flows. Different actors can use their networked audiences to amplify social media content and attract public attention. Social movement activists use social media to gain supporters, attract media attention, and publicize movement goals(Zhang et al., 2023). For example, far-right and alternative right-wing activism tweets to amplify Trump's rhetoric(Wells et al., 2016), and extremist organizational actors also amplify their ideology and kidnap media attention on social media through memes and parodies(Donovan & Boyd, 2021). Algorithms and paid actors are further involved in the amplification process, highlighting the procedural and interpersonal interactions that shape amplification(Jungherr & Schroeder, 2021). In short, amplification by various social and algorithmic actors on social media has become an effective way to shape the flow of public communication.

In other words, online amplification on social media is both a mechanism for attracting public attention and a process of information dissemination shaped by online social networks. Viewing amplification in this way allows for a concrete view of the behavior and impact of individual nodes. Although Webster (2014) acknowledged that this agency strategically views users as members of one or more networks who know each other and may influence each other's behavior while already embedded in digital media systems. However, amplification demonstrates a specific manifestation of this agency(Castells, 2013): in political communication environments, where control of information is crucial, individuals are not only aware of their ability to make choices among available information, but are

increasingly aware of the structure in which they are embedded, and which influences how the attention of others is directed(Phillips, 2015). As a result, they have the ability to take action (e.g., through "likes" and "retweets") to influence the metrics and further actions of platforms and other media.

At the same time, "amplifying an idea, object, or person on social media is also a huge information cascade" (Zhang et al., 2023). Whereas there are two noteworthy features of social network structure, a large body of literature supports its homogeneous clustering pattern(Aral, Muchnik, & Sundararajan, 2009). Information is shared between homogeneous nodes, and information on social media is typically spread in an echo chamber. In addition, "heterogeneous flows" imply that social network structure and information dissemination are hierarchical, with most diffusion events following a shallow one-step broadcast process, where information tends to flow directly from elite nodes (including media, celebrities, organizations, and bloggers) to a diverse mass(Goel, Anderson, Hofman, & Watts, 2016). More evidence also suggests that in the echo chamber of social media, the central node attracts most of the attention(Min, Jiang, Jin, Li, & Jin, 2019). These features form the basis for network amplification and further analysis in social media.

Based on the discussion above, this study apply network amplification to observe complex information flows during COVID-19 discussion, and network amplification by different actors.

3 Methodology

3.1 Research Questions

This study attempts to discuss that who voices in COVID-19 discussion using computational methods. What are they talking about? How do they discuss? Based on the relevant literature related to attention and hybrid media system, our research questions are:

RQ1: What types of actors have high influence indicators in the discussion network during the COVID-19 pandemic?

RQ2: What are the discussion topics of different actor networks communities?

RQ3: What types of topics do different actors amplify during discussions?

3.2 Data

COVID-19 is an infectious disease caused by a coronavirus discovered in December 2019. During the pandemic, people's physical contact and interpersonal communication outside their families have been heavily restricted, and they mainly rely on digital devices for communication and interaction. This makes social media platforms such as Weibo an even more important source of information during the pandemic. Sina Weibo is a Chinese social media founded in 2009. It is widely popular in terms of information dissemination and public discussion, especially it allows open and multi-participatory communication among strangers, thus realizing multi-level information dissemination.

Weibo-COV is built from a high-quality Weibo user pool of 20 million active users from more than 250 million Weibo users, then collected posts from all active users during the pandemic, and filtered posts related to the COVID-19 pandemic with 179 representative keywords, and named it Weibo-COV (Figure 1). This dataset covers the period from December 1, 2019 to December 30, 2020, and 65,175,112 tweets were filtered out of 2,615,185,101 original tweets by keywords. The fields of the posts in the dataset are fine-grained, including post-level information, interaction information, location information, and forwarding networks(Hu, Huang, Chen, & Mao, 2020).

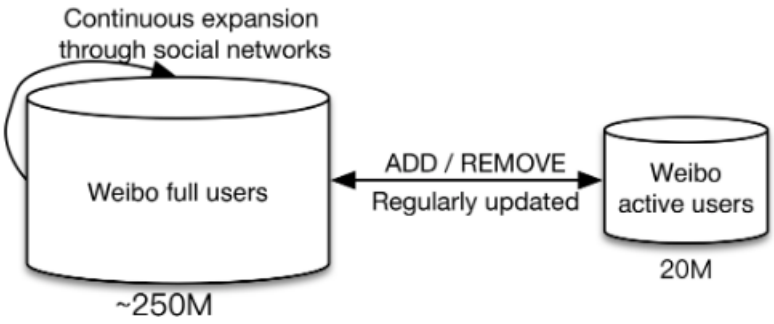

Figure 1: The construction of Weibo active user pool

3.3 Research Design

Researchers first conducted target sampling on influential users on Weibo, specifically, using seed nodes that are known to be highly influential in the community. We built whole network and then conducted targeted sampling of influential users on Weibo . The whole graph is sampled with the help of the Personalized PageRank algorithm and then improved random walk algorithm to obtain subgraphs. Due to the high clustering coefficient and sparse distribution of the network, a random walk algorithm with jumps is used for sampling. In the second step, the community detection method was used on the sampled subgraphs, and the eigenvalue decomposition of the graph was performed through the Laplacian matrix to calculate the smallest `k+1` eigenvalues and their corresponding eigenvectors. The K-means clustering algorithm processes the eigenvector and adds the clustering result to the node attribute as a community label. Next, actor identification was performed based on the Weibo text information, and a Weibo text corpus was generated as the basis for downstream analysis. The third step is to conduct an analysis of the actor text volume on Weibo and the related Granger causality test. At the same time, a 10% random sample was extracted to topic modeling on the Weibo content of different actors, so as to analyze the volume of different actors on different topics. The research framework is shown in Figure 2.

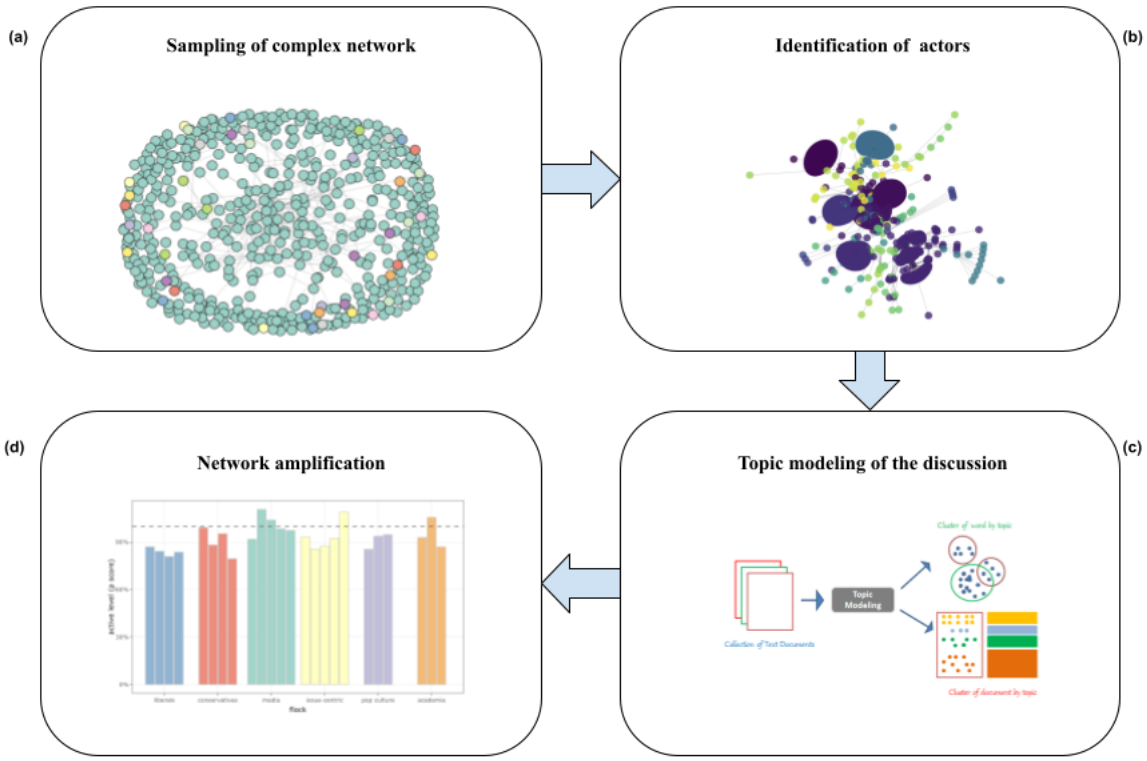

Figure 2: Overall research framework.

3.3.1 Sampling of large-scale complex network

Since the Weibo-COV dataset lacks data that explicitly represents friendship or follow-up-follow information between users, a direct friendship network cannot be constructed. We models the network through indirect user interaction. [3]

Then, I use a seed node set that determined by degree and a Personalized PageRank algorithm to sample this large-scale complex network. Since the social network is a sparse,

[3]In the absence of direct friendship data, the study used heuristic methods to infer the relationship between users. This method is usually based on common activities between users and mutual forwarding. I built a forwarding network data, using the original microblog as a key connection and the user as a node. In the modeling process, the code first creates a directed graph G to represent the forwarding network. Then, it extracts all unique user IDs from the dataset and adds them as nodes to the graph G. This step ensures that each user who participates in the forwarding has a corresponding node in the network. Next, the data is grouped according to the original microblog ID and user ID, and the size of each group, that is, the weight of each edge, is calculated. The purpose of this step is to count the number of times each user forwarded a certain original microblog as the weight of the edge. Finally, the program traverses each edge and its corresponding weight and adds them to the graph G. This step completes the network construction process and obtains a weighted directed graph representing the forwarding relationship. In this network, the nodes represent users, the directed edges represent the forwarding relationship, and the weight of the edge represents the number of forwardings. Through this modeling process, we can transform complex forwarding network data into a network structure that is easy to analyze and visualize, as the basis for subsequent analysis.

high-clustering network, a single random walk algorithm cannot access a sufficient number of nodes. The improved random walk algorithm first uses the seed set to determine the important node set, and creates the personalized dictionary, and calculates the importance scores of all nodes in the subgraph through a personalized PageRank algorithm. Among them, the damping coefficient $\alpha = 0.85$, which represents the probability of a random walk from one node to another. In this sampling process, 100,000 of the most important nodes are filtered as the set. Next, a defined function executes a random walk algorithm to perform a random walk or jump according to a given probability. The nodes visited during the walk are recorded. Each starting node is specified to walk 20 steps, and the jump probability is 0.05. The sampling results are shown as Table 1.

Table 1: Subgraph Sampling Results

Graph Type	**Nodes**	**Edges**
Original Graph	14,544,632	49,456,228
Sampled Subgraph	100,846	41,324

3.3.2 Actor Identification

Subgraph, also referred as virtual community in online social network analysis. For this part, I use graph-Laplacian matrix and K-Means clustering algorithm for community detection in sampled subgraphs. This techniques relies on the Python packages of sklearn.cluster.KMeans and scipy.sparse.linalg.eigsh. Since Laplacian mateix is typically used on undirected graphical models, we converts the subgraph into undirected and converts the in-degree and out-degree into a unified degree. Subsequently, we calculates the minimum k+1 eigenvalues of the graph Laplacian matrix and their corresponding eigenvectors. Next, the subgraph is clustered into 40 communities using k=40, and finally all nodes are traversed and the clustering results are added to the community label. Therefore, in the result, each node is assigned a community label, which is suitable for the next analysis step. The subgraph visualization result is shown in Figure 3[4].

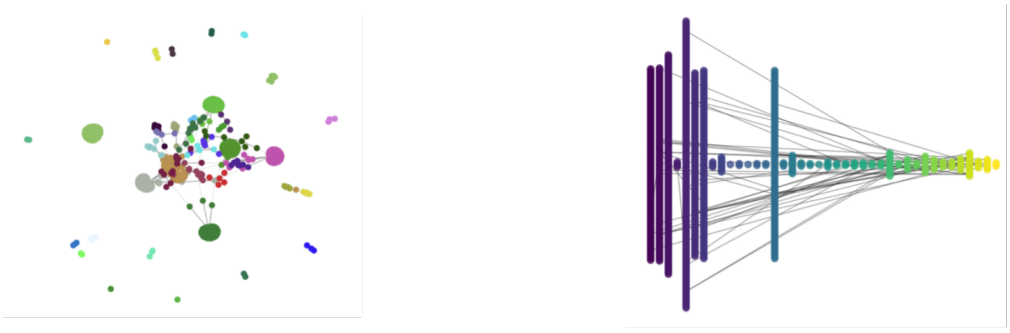

Figure 3: Community Visualization

[4]Since the sampling subgraph for the entire time period is large in scale and takes too long to render, the sampling subgraph for December 2019 is used here for display. It can be seen that the communities of the network are concentrated, and other communities are at the edge of the community network. The force-guided layout is used on the left, and the hierarchical layout is used on the right.

Next, I randomly sampled 5 user nodes from each community, manually identified the Weibo text content of the user nodes, and identified them as 4 actors, belonging to 2 classification modules. Based on the existing discussion on social media actors and microblog networks during the pandemic, I classified them into "official media", "unofficial media", "politicized social media influencers", and "depoliticized social media influencers", belonging to the two categories of media and opinion leaders.

As a supplementary analysis, the Granger causality test was also added to observe the influence of different actors on the attention of the pandemic. Granger causality tests whether variable Y is affected by the lagged variable of variable X in time series data. If variable Y is affected by the lagged variable of variable X, it is said that there is a Granger causal relationship between them. This method has been widely used in papers related to agenda setting research and has a high degree of credibility in explaining the statistical causal relationship between two time series variables.

3.4 Topic Modeling of the Discussion

I first preprocessed the text, deleted stopwords, etc., and used jieba for word segmentation to generate processed text; then, a document-word matrix was constructed, and words with a frequency of less than 0.02% and more than 90% were deleted, and converted using TF-IDF. The generated matrix was used to discover the topic of Weibo text discussion and the topic distribution among different actors. In natural language processing, Latent Dirichlet Allocation (LDA) is an unsupervised learning technique based on a probability model. This method assumes that documents are generated by hidden topic distributions, and each topic is composed of a series of word distributions. Details are presented in the results section.

4 Results

4.1 Identified Actors in COVID-19 Discussion

The literature on social media actors has evolved from initially focusing on emerging actors to focusing on the complex competitive relationships between them, such as using different framing, discourse rhetoric, and other means to attract attention. Based on the typology of social media influencers (SMI) proposed by Tang (2023), I distinguished social media influencers based on the dimension of issue stance. At the same time, based on the Weibo textual clues, four types of actors were identified: official media, unofficial media, politicized SMI, and depoliticized SMI, providing more detailed types than previous uses of this corpus(A. Chen et al., 2022).

First, this study identified the volume of four groups of actors as shown in Figure 4. By calculating the changes in Weibo voice volume from December 2019 to December 2020, it indicates that the four groups of actors have a certain degree of consistency in fluctuation patterns and peaks. Next, the Granger causality test is used to supplement the observation

of the mutual influence of the four groups of actors in volume. The results of the Granger causality test are shown in Table 2.

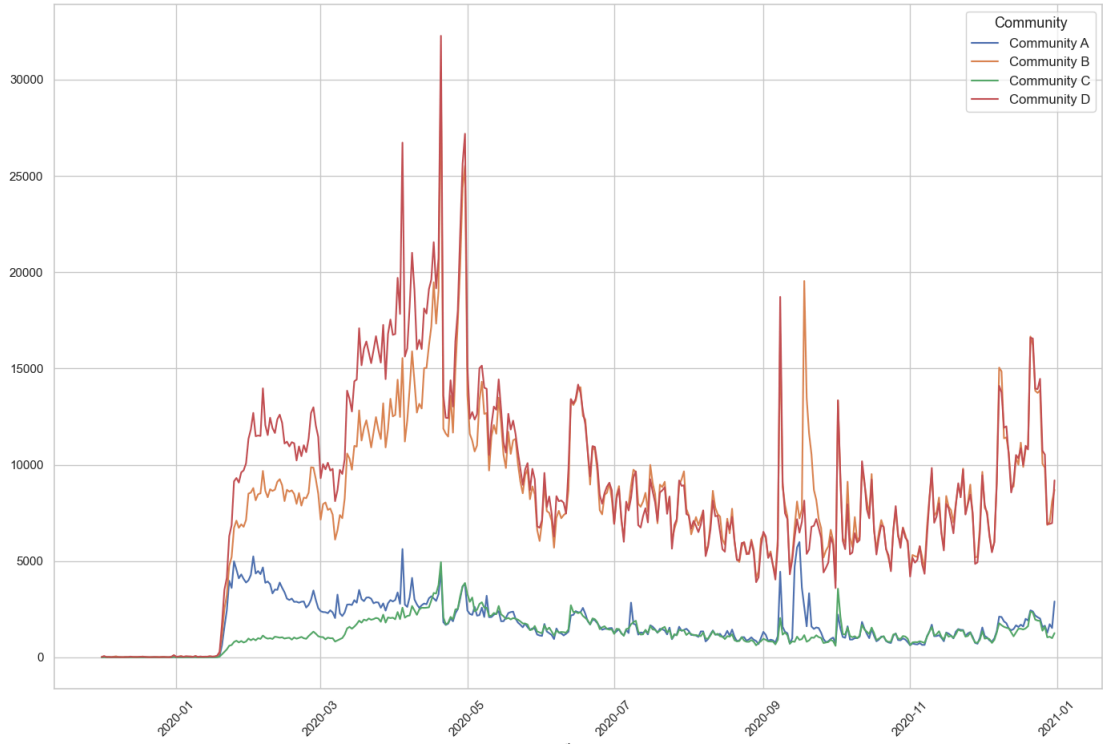

Figure 4: Weibo volume changes with time

Note: A = official media, B = unofficial media, C = politicized SMI, D = depoliticized SMI

The results of the Granger causality test indicate that changes in unofficial media (B) can be statistically predicted by changes in official media (A), politicized social media actors (C), and non-politicized social media influencers (D). Predictions from A are significant at lags of 2 and 3, meaning intervals of 2 and 3 time points, while predictions from C and D are significant at 1 time point. This suggests that the influence of official media may have a longer delay (higher lag), whereas social media influencers impact unofficial media in a shorter time. It is important to note that this only represents the response relationship in terms of attention to pandemic-related topics and does not fully represent causality.

Table 2: Table 4.1: Granger Causality Test Results for Four Groups of Actors

Causal Relationship	Lag Order	F	p	denom	num
A → B	2	3.3500	0.0361*	390	2
A → B	3	2.7500	0.0426*	387	3
C → B	1	4.3996	0.0366*	393	1
D → B	1	5.1261	0.0241*	393	1

Note: Using SSR based F-test, significance level is 0.05.

4.2 Topics Amplified by Actors

I used community mapping to filter a 10% random sample of Weibo posts, resulting in a dataset for text topic modeling (containing 778,331 entries). The statistical description of this dataset is shown in Table 3, with the earliest post dated "2019-12-01 00:31:00" and the latest "2020-12-31 23:58:27". The average post length is 198.099309 characters, ranging from 2 to 7187. During preprocessing, blank characters, punctuation, numbers, and URLs were removed. The Jieba library was used for Chinese text segmentation. Words with frequencies below 0.02% and above 90% were removed, and a TF-IDF transformation was applied to generate a document-term matrix for subsequent topic analysis.

Table 3: Distribution of Actors

	Official Media	Unofficial Media	Politicized SMI	Non-Politicized SMI
Distribution	68,653	315,784	50,624	343,270
Proportion	Media: 384,437 (49.39%)		SMI: 393,894 (50.61%)	

The study employed Latent Dirichlet Allocation (LDA), an unsupervised machine learning technique, for text topic modeling. The LDA model was fitted to the document-term matrix, and the vocabulary distribution for each topic is shown in Table 4. Based on existing literature on COVID-19 discussion topics, the study defined n=8 topics, including social communication response, pandemic statistics news, socioeconomic impacts, anti-pandemic propaganda, public health promotion, international comparisons and policy contrasts, policy discussions, and pandemic and virus testing.

Table 4: Identified Topics and Keywords

Topic Number	Topic Cluster Content	Top 8 Keywords
1	Social Communication Response	转发, 中国, 美国, 疫情, 理由, 我们, 一个, 没有
2	Pandemic Statistics Update	病例, 新增, 确诊, 肺炎, 累计, 输入, 境外, 无症状
3	Socioeconomic Impact	防控, 疫情, 转发, 工作, 口罩, 复工, 微博, 企业
4	Anti-Epidemic Propaganda	武汉, 转发, 抗疫, 微博, 疫情, 致敬, 加油, 战疫
5	Public Health Promotion	转发, 微博, 疫情, 视频, 理由, 病毒, 新冠, 口罩
6	International Comparisons and Policy Contrasts	美国, 新冠, 特朗普, 转发, 病毒, 疫情, 微博, 感染
7	Policy Discussion	中国, 美国, 肖战, 转发, 外交部, 疫情, 理由, 全文
8	Pandemic and Virus Testing	检测, 疫苗, 核酸, 新冠, 病毒, 转发, 人员, 患者

In the following analysis, a document-topic distribution matrix is used to show which actors are more active in certain topics (RQ3). LDA identified latent topics in the text data and provided related scores. The study presents this result using an actor-topic heatmap, where the color/scores in the cells represent average weights, as shown in Figure 5.

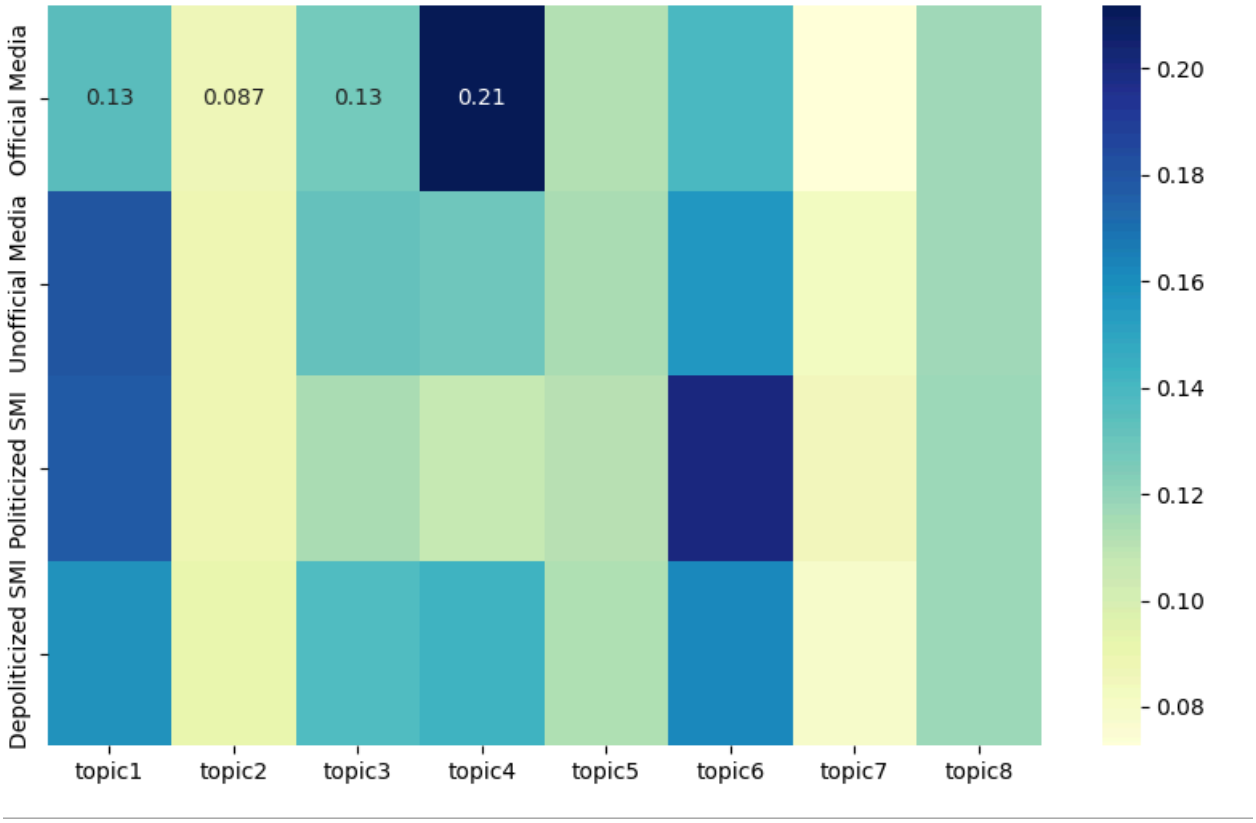

Figure 5: Actor-topic distribution heatmap

A brief phased conclusions can be drawn as follows: Firstly, Official media, compared to other types, focuses more on amplifying "pandemic propaganda," which reflects their emphasis on promoting public health information. Their secondary focus is on "international comparison and policy discussion" and "social communication response." Secondly, Unofficial media amplify "social communication response," and both unofficial media and depoliticized social media influencers have a relatively balanced distribution across different topics, standing out slightly in "international comparison and policy discussion." Thirdly, Politicized social media influencers have the highest focus on "international comparison and policy discussion." Both politicized and depoliticized SMIs amplify this topic online, showing consistency in the order of attention to different types of topics, reflecting the uniformity of discussion topics among opinion leaders.

In a nutshell, different types of media show a relatively balanced attention to "socioeconomic impact," "public health promotion," and "pandemic and virus testing," indicating a consistent framework of cross-media attention.

5 Discussion: Connective Action in Media System

As *New Media & Society*' s 2024 special issue on the Covid puts it, even if a convincing "symptomatic" description of the pandemic is given, the approach of viewing it as a temporary "rupture" event "would still infuriate Fernand Braudel" , for the French Annales historian believed that "an event is an explosion···it fills today' s consciousness with a disorienting cloud of smoke, but it is so fleeting that it disappears almost as soon as its flame is seen." Andrejevic and O' Neill call on media scholars to discover "the defining features of continuity behind apparent ruptures" .

This study first identified actors during the COVID-19 discussion by sampling and clustering large-scale complex networks (RQ1). Consistent with existing findings, traditional official media are still influential gatekeepers on social media, and the role of emerging opinion leaders should also be taken seriously. Secondly, I identified eight discussion topics of different actor networks through unsupervised learning techniques: social communication response, epidemic statistics update, socioeconomic impact, anti-epidemic propaganda, public health propaganda, international comparison and policy comparison, policy discussion, vaccine and virus detection (RQ2), and tested the distribution of these eight topics in different actor networks. Among them, official media paid the most attention to amplifying anti-epidemic propaganda topics, reflecting its focus on promoting public health information; while unofficial media focused more on amplifying "social communication response". Politicized social media influencers tend to amplify "international comparison and policy comparison", while non-politicized social media influencers also have a certain consistency in the ranking of topics amplified by them, reflecting the unity of the internal framework of opinion leaders (RQ3). This study supplements the lack of research on different actors amplifying different topics to a certain extent, and provides new evidence for the topic preferences of actors on Chinese social media.

This identification process supports three viewpoints of ANT as a theoretical framework: first, the object of this study is a system composed of entities, specifically, social media actors in a hybrid media system, and their actions are observed from a relational perspective; second, social media actors and their networks are mutually constituted and they carry out actions through network practices; finally, the study focuses more on the dynamics of the network from a process perspective rather than viewing it as a stable result. The application of ANT-based network analysis methods provides a different method and perspective from the past communication studies on dealing with discourse subjects (such as agenda setting). This innovative method shows that social network structure can be used to identify user networks and further observe the interaction dynamics.

The study identified 8 discussion topics of different actor networks through unsupervised learning technique (RQ2), and detected the distribution of these topics in different actor networks. Among them, the official media paid the most attention to amplifying the anti-pandemic propaganda topic, reflecting its focus on promoting public health information; while the unofficial media focused more on amplifying "social communication response". Politicized SMI tend to amplify "international and policy comparison", while

non-politicized SMIs also have a certain consistency in the ranking of topics, reflecting the consistency of the internal framework of opinion leaders (RQ3). This study is a supplement to the research on different actors amplifying different topics to a certain extent, and provides new evidence for the topic preferences of actors on Chinese social media.

Our empirical study uses the perspective of "network amplification" as a response to the translation process in ANT. Callon (1984) believed that actors define, negotiate and arrange the interests, roles, functions and status of other participants through four stages: problematization, interest, registration and mobilization. Different from classical theories such as agenda setting, the perspective of network amplification is based on the core question of reflection on digital news epistemology: "How is news as a form of knowledge shared, transformed, debated and refuted based on the practice of various actors through numerous digital media platforms." and regard this black box composed of "actors, media, practices and forms" as a news circulation process, that is, a news curation system(Carlson, 2022).

This digital practice embodies the concept of connective action. In the action organization ecology described by Chadwick, which is mainly characterized by hybridity, the emerging connective action type emphasizes the intermediary role of digital media in organizational action and promotes a more personalized action path. Bennett and Segerberg borrowed ANT to understand this digital network mechanism, including organized connections, coordinated actions, information sharing, and leaving digital traces on social networks to spread through relevant mechanisms. This type of action helps to understand the process of network amplification. The practice of actors in weak relationship networks on social media is not a highly organized collective action that forms a collective identity, but "sharing" and "amplifying" the ideas and action goals of organizations/actors through mediated networks.

As a public health crisis, the "filtering" or "amplifying" effect of the media affects the public's perception of risks. The public's perception of risks is too low or too high, which is not conducive to epidemic prevention and control. Therefore, in addition to improving the public's media literacy and fact-checking capabilities, it is necessary to coordinate the media to provide reasonable information. The results show that official media focus on amplifying the theme of "anti-epidemic propaganda". This may be one of the reasons for the change in public sentiment from panic in the early stage to positive and positive emotions after the stable stage. In addition, this focus is consistent with existing research on the media's stance and reporting framework, that is, official media are more likely to adopt action frames and responsibility frames, focus on the government's anti-epidemic actions, avoid causing social panic, and appease public sentiment. At the same time, this also shows the effectiveness of the official media's adaptability in the digital age of "soft propaganda" - the official media matrix during the epidemic has narrowed the psychological distance with readers and attracted more reading, forwarding and comments. Finally, in an environment where fake news is rampant, the fact that official mainstream media continue to play a core role in the digital public sphere helps to combat the negative impact of misleading and false information in the information epidemic.

The amplification focus of unofficial media is on "social communication response", and the Granger causality test shows that it is significantly affected by the other 3 types of actors, showing the potential of non-official media to adopt more diverse issue frames. The results of this study indicate that non-official media are a useful supplement to diverse information sources.

Many empirical studies have pointed out the key role of opinion leaders in the discussion of the pandemic, especially in influencing the public's cognition, attitudes and behaviors(Wang, Yang, & An, 2024). In addition, they may also play a role in bridging the distance between the public and the government. This study links this view to the eye-catching politicized information during the epidemic, especially the study that politicized information is often associated with false information and conspiracy theories(Hart, Chinn, & Soroka, 2020). Politicized SMI can not only directly transmit false information, but also act as amplifiers of original messages, spreading false information and conspiracy theories, and multiplying the total amount of such information(Monaci & Persico, 2022). This study shows that the focus of politicized SMI when amplifying information: international and policy comparison, this result may support the association between this discussion topic and conspiracy theories/false information. In addition, existing studies have demonstrated the impact of politicized news frames on the polarization of public discussions during the epidemic. This study provides some of the paths of action of politicized SMI in the Chinese context. This study adds new evidence and believes that focusing on the relationship between SMI and conspiracy theories can be the direction of future empirical research.

5.1 Limitations

Of course, this study has many limitations due to capacity and technical reasons. First, since Weibo-COV data itself lacks direct friendship relationships, this study uses forwarding networks to model the discussion network. When referring to the conclusions, it is necessary to take into account the unidirectionality and high clustering characteristics of the forwarding network. At the same time, due to time constraints, this study only conducted a small number of iterations to optimize the parameters

Secondly, the identification and analysis of actors in network communication during the COVID-19 pandemic may use richer standards: first, with the development of "images as data" and "videos as data" technologies, researchers may be able to obtain more analytical information from images and videos, further expand the scope of research objects, and include social media such as short video platforms such as TikTok into consideration; thirdly, existing studies have shown that social robots and emerging algorithmic agents are associated with the amplification of partisan media actors, and emotional contagion can also be used as units of meaning(Duan et al., 2022). Due to capacity limitations, the author has not been able to detect more detailed and diverse actors and the dynamics of attention changes, which need to be further clarified in future research work.

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