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The Progress and Trend of Internet Rumor Research at Home and Abroad in the Past Ten Years: A Visual Analysis Based on CiteSpace

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SUMMARY: *This paper, based on the data from China National Knowledge Infrastructure (CNKI) and Web of Science databases, uses CiteSpace to conduct a bibliometric and visual analysis of domestic and international research on online rumors over the past decade. It reveals the progress and evolution trends of the research from aspects such as annual publications, author collaborations, national collaborations, keyword co-occurrences, clustering, and emergent words. The results show that the number of foreign research papers increased from 7 in 2014 to 54 in 2024, reaching a peak of 74 in 2022, showing a continuous expansion trend; while the number of domestic research papers decreased from 55 in 2014 to 12 in 2024, exhibiting a phased fluctuation and contraction feature. The keyword structure indicates that foreign research focuses on social media, false information, and detection technologies, with the top three frequently used keywords accounting for more than half of the cumulative contribution; domestic research centers on "online rumors", with the core theme category accounting for 75.1% of the total frequency of the top 10 frequently used keywords, and the transmission mechanism and governance regulations constitute the main supporting direction. Overall, the research on online rumors is shifting from basic description to modelization, technologyization, and collaborative governance-oriented, but domestic research still needs to strengthen cross-platform data integration, analysis of public psychological mechanisms, and international cooperation to enhance the scientificity and practical effectiveness of online rumor governance.*

KEYWORDS: *Online rumors; Research progress; Bibliometrics; Knowledge mapping; Visualization*

1 Introduction

On August 29, 2024, China Internet Network Information Center (CNNIC) released the 54th Statistical Report on China's Internet Development (hereinafter referred to as the Report) at the "Smart Economy Innovation and Development" exchange activity of the 2024 China International Big Data Industry Expo. According to the report, as of June 2024, the number of Internet users in China will be 1099.67 million, an increase of 7.42 million over December 2023, and the Internet penetration rate will reach 78.0% [1]. In recent years, the emergence of the Internet has become the most powerful loudspeaker invented by mankind, and has also provided a new channel for the spread of rumors [2]. Social media has become a social necessity for the general public with the help of its openness, convenience, anonymity, and fast spreading. Internet users can speak freely, express their opinions, and actively participate in the discussion

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of events of interest in social media. However, on the other hand, social media has also become a platform for some people to spread rumors and vent their negative emotions. With the popularity of social media, the proliferation of online rumors has posed a serious threat to the information ecosystem and caused deep distress among social media users. This part of people not only publish some confusing public opinions, but also try to incite others' emotions to achieve the purpose of spreading rumors, which destroys the good atmosphere on the Internet, adversely affects the benign operation and stable development of society, and further threatens the country's long-term peace and stability. The core value of exploring the issue of Online rumors is reflected in their extensive and profound effects on social stability, public cognitive framework and information dissemination system. The detailed analysis of the rumor spreading mechanism, triggering factors and their consequences can lay a solid theoretical foundation for the construction of targeted prevention and control strategies, which in turn can help the process of clearing the cyberspace, ensure the rational orientation of the public's thinking and judgment, and maintain the stability and harmony of the social order.

This paper will analyze the status quo and development trend of Online rumors at home and abroad from the perspective of bibliometrics, draw corresponding conclusions based on the amount of annual publications, the degree of cooperation among authors, the degree of cooperation among countries, the research hotspots and clusters, as well as the emergence of keywords, etc., and put forward scientific and reasonable suggestions on the topic of Online rumors, so as to contribute to the process of clarification of the cyberspace and to ensure the rational orientation of the public's thinking and judgment, and to In this way, it can help clear up the cyberspace, ensure the rationality of public thinking and judgment, and maintain the stability and harmony of social order.

2 Data Processing and Research Methods

2.1 Data Sources

The domestic data for this article is sourced from the China National Knowledge Infrastructure (CNKI) and the Web of Science (WOS) databases, and the search was conducted on October 4, 2024. These databases serve as the data sources. To ensure the quality of the data for this study, we conducted a literature search in CNKI using "cyber rumors" as the search term. We only selected CSSCI and Peking University Core Journals as sources of journals, and set the time period to the past ten years (from 2014 to the present). The results of the literature search excluded contents such as notifications, book descriptions, book reviews, conference comments, and low-quality information. In total, 3000 articles were obtained. A total of 343 relevant documents were acquired. Similarly, in the foreign data section of Web of Science, the literature search in the core collection selected "TS = cyber rumors" as the search formula, and the search time was set to the past ten years (from 2014 to the present). A total of 374 documents were retrieved.

2.2 Research Methods

The sample visualization and analysis tool used in this study is CiteSpace software developed by Prof. Meichao Chen of Drexel University, with the specific version of 6.3.R1. In this paper, the 343 domestic documents and 374 foreign documents were exported to RefWorks and Plain text file formats and saved to input1 and input2 files, respectively. These samples were then analyzed in depth using CiteSpace 6.3.R1. During the analysis process, graphs of year of publication, author partnership, keyword co-occurrence, topic word clustering, country partnership, and keyword emergence were plotted. These visualization results intuitively show

the academic research dynamics in the field of "Online rumors" from 2014 to the present, and predict the future trends.

3 Analysis of Internet Rumor Research Overview

3.1 Overview of Domestic and International Research

In the time dimension, this study draws an annual trend graph of the number of articles published through the literature data retrieved from CNKI and Web of Science, which helps to survey the overall development trend of the field by analyzing the relationship between the year and the number of articles published. To present the evolution characteristics of this field more clearly, Figure 1 shows the differentiated development trends of domestic and foreign research from two aspects: the annual publication trajectory and the inter-annual growth changes.

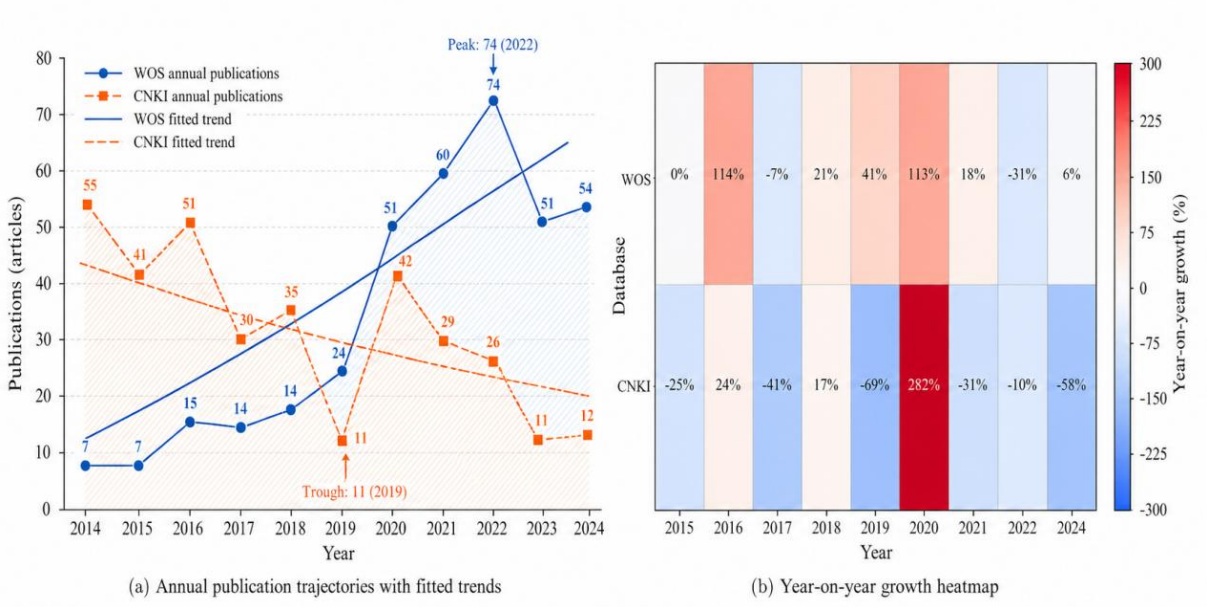


Figure 1: Comparative annual publication trajectories and year-on-year growth of internet rumor research in Web of Science and CNKI (2014–2024).

As shown in Figure 1 (a), the annual publication volume of research on "online rumors" in Web of Science is generally on the rise, increasing from 7 articles in 2014 to 54 articles in 2024, and reaching a peak of 74 articles in 2022, indicating that the popularity of research on online rumors abroad continues to increase. In contrast, CNKI's annual publication volume has shown an overall downward trend, with 55 articles in 2014 and only maintaining a low level of 11-12 articles from 2023 to 2024. As shown in Figure 1 (b), from the perspective of interannual growth rate, although the publication volume of Web of Science fluctuates periodically, it generally maintains a positive expansion trend, especially achieving 114% and 113% growth in 2016 and 2020, respectively. The growth rate of CNKI fluctuated more violently, dropping to -69% in 2019, rebounding to 282% in 2020, and then entering the negative growth range again, indicating that domestic related research is more clearly driven by phased hotspots and relatively lacks development stability.

Overall, foreign research shows a sustained growth and deepening trend, while domestic research shows a certain contraction trend amidst fluctuations. It can be seen that it is necessary for the domestic academic community to continue to pay attention to this issue while

strengthening the reference to foreign research results and methods, in order to enhance the systematicity, continuity, and academic influence of online rumor research.

3.2 Statistics and Co-occurrence Analysis of Foreign Research Authors

According to Price's law, where m is the number of $m = 0.749\sqrt[2]{n_{\max}}$ core authors, set the maximum number of articles issued by Web of Science authors as n. After calculation, under the data statistics of this study, the number of articles issued by core authors is m=1, so the authors with more than 3 articles issued in Web of Science are regarded as their core authors, totaling 127, as shown in Table 1 (selected). Top ten as an example). The authors Bhatia, M P S and Rachik, Mostafa have published 4 articles in the study of "Online Rumor", and the author who published the first article in the study of "Online Rumor" is Bhatia, M P S. "Online Rumor" study was first published in 2017; authors Govindankutty, Sreeraag, Al-garadi, Mohammed Ali, Hosni, Adil Imad Eddine, Bessi, Alessandro, and Li, Kan in the "Online Rumor" have also made excellent contributions to the study of online rumors with 3 publications; the rest of the authors such as Paek, Hye-Jin, Helfroush, Mohammad Sadegh and Almars, Abdulqader M have also contributed to the study of online rumors. have contributed to the research.

Table 1: Information table of foreign Online Rumor research authors (top ten).

Sequence number	Number of articles	Year	Author
1	4	2017	Bhatia, M P S
2	4	2020	Rachik, Mostafa
3	3	2023	Govindankutty, Sreeraag
4	3	2016	Al-garadi, Mohammed Ali
5	3	2020	Hosni, Adil Imad Eddine
6	3	2015	Bessi, Alessandro
7	3	2020	Li, Kan
8	2	2019	Paek, Hye-Jin
9	2	2022	Helfroush, Mohammad Sadegh
10	2	2022	Almars, Abdulqader M

CiteSpace was used to visualize and analyze the author collaborations in Web of Science data, and "Author" was chosen as the analyzing factor to map the author collaborations of Online Rumor studies in Web of Science, as shown in Figure 2. Through the analysis of Figure 2 drawn by Web of Science data, it can be seen that the graph generates a total of 127 nodes, each node corresponds to the author one by one, the larger the node in the graph means that the higher the amount of articles published by the author, and the line between the node and the node represents the authors' cooperation with each other, and the denser the line is, the more closely the corresponding authors cooperate. Figure 2 shows that the density of the network graph is 0.0126, and the team led by authors Bhatia, M P S, and authors Bessi, Alessandro mainly studied Online Rumor, where the node corresponding to authors Bhatia, M P S is the largest. Other authors in the figure also have better cooperation with each other, and most of them have formed a more stable cooperative group structure, but there are still some authors such as Banerjee, Snehasish and Addawood, Aseel, etc. have not yet formed a more stable cooperation with other authors, and from the viewpoint of the link strength of the nodes, the strength of cooperation is weak.

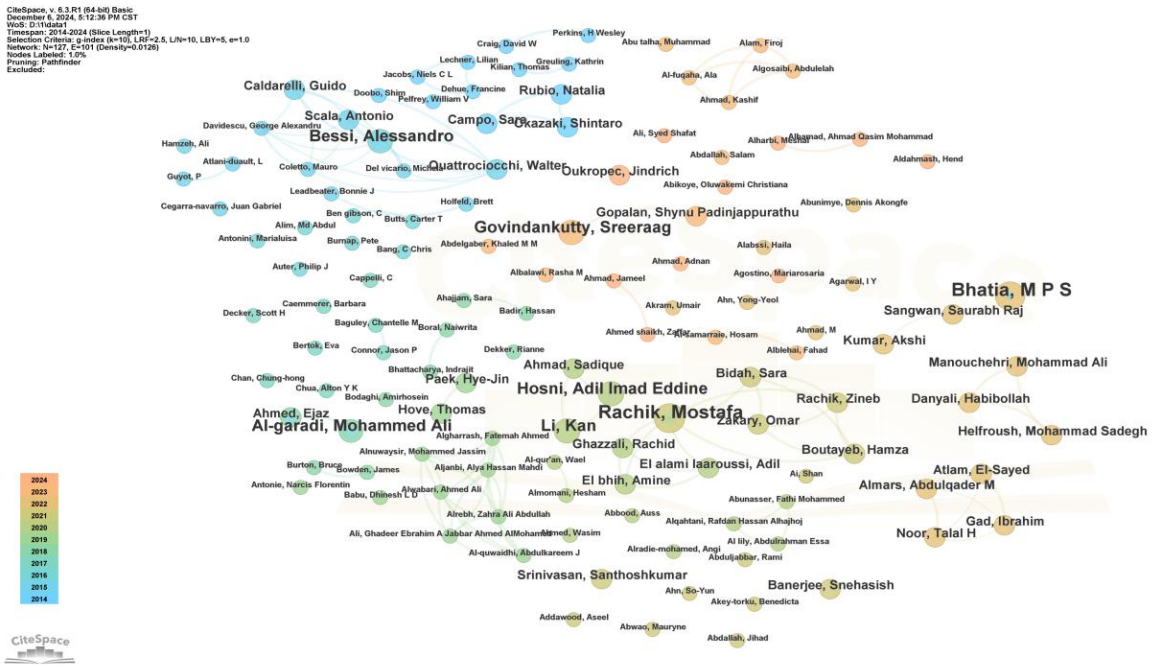


Figure 2: Cooperation co-occurrence map of foreign research authors.

3.3 Domestic research authors statistics and co-occurrence analysis

According to Price's law, after calculation, under the data statistics of this study, the number of articles issued by the core authors is m=2.7, so the authors with more than 3 articles issued in CNKI are regarded as their core authors, totaling 10, as shown in Table 2. Author Lan Yuexin, as a research author in CNKI, has the highest number of publications in the study of Online rumors, which is 13; author Wang Lvwei follows with 7; the rest of the authors, such as Zhang Peng, Li Haoqing, and Wang Hu, have also made excellent contributions to the study of Online rumors, with the number of publications ranging from 3 to 5.

Table 2: Information table of authors of domestic network rumor research.

Sequence number	Number of articles	Year	Author
1	13	2014	Lan Yuexin
2	7	2020	Wang Zhiwei
3	5	2016	Zhang Peng
4	5	2016	Li Haoqing
5	3	2017	Wang Hu
6	3	2018	Pan Xiaozhong
7	3	2017	Xia Yixue
8	3	2016	Zhu Hengmin
9	3	2016	Liu Yongmei
10	3	2016	Chao Shen

The author cooperation of CNKI data was visualized and analyzed by CiteSpace, and "Author" was chosen as the analysis factor to draw the author cooperation map of CNKI network rumor research, as shown in Figure 3. As can be seen in Figure 3, drawn from CNKI data, the graph generates a total of 126 nodes, and the density of the network graph is 0.0056. The team led by authors Lan Yuexin, Wang Liwei, Zhang Peng and Li Haoqing mainly

researches Online rumors, and the node corresponding to author Lan Yuexin is the largest. The other authors in the figure also cooperate with each other, but from the connection strength of the nodes, the strength of cooperation between individual authors is weak, mostly two-way cooperation, less multi-directional cooperation, and the whole is more dispersed, and does not form a stable author cooperation network.

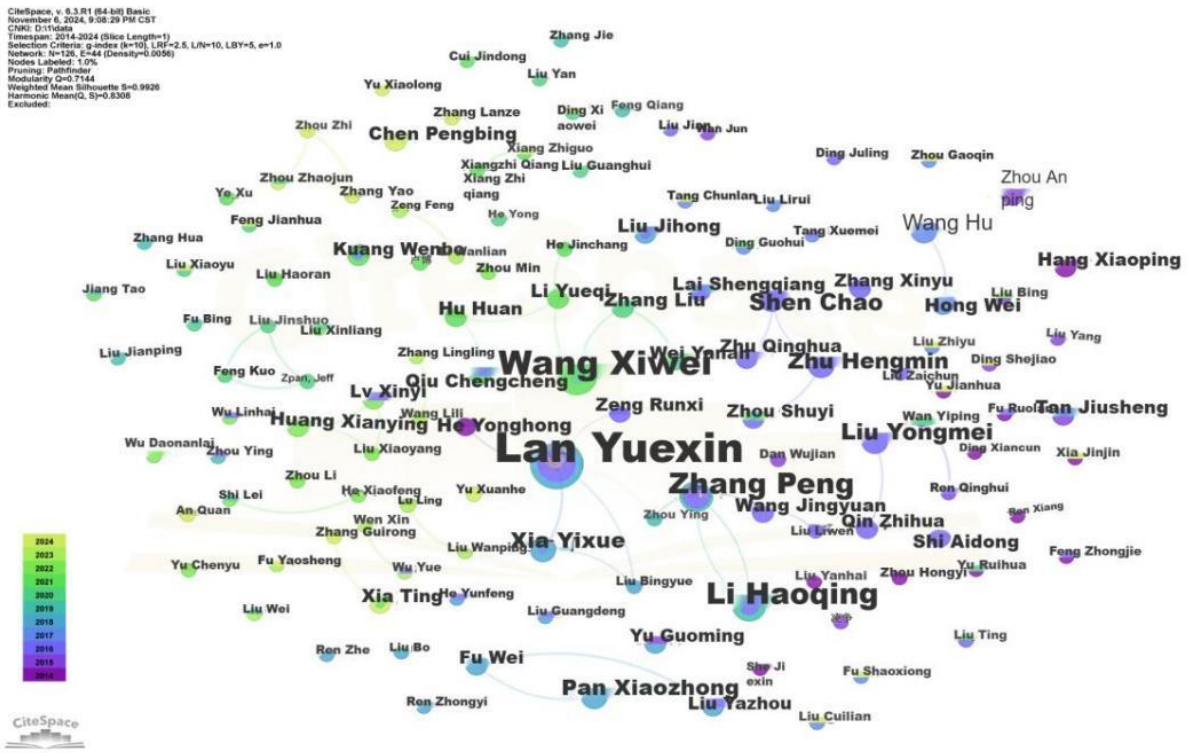


Figure 3: The co-occurrence map of author cooperation in domestic Web rumor research.

Comprehensively, we can see that the degree of cooperation of authors of related studies in Web of Science is higher than that of authors of related studies in CNKI, and the overall cooperation intensity of the two is weaker, and neither of them has established stable and multi-directional cooperation, so it is suggested that the authors of network rumor studies should strengthen communication and interaction in cooperation. It is recommended to deepen the depth of collaboration further and realize resource sharing and complementary advantages in order to improve the overall quality of the study. In contrast, the domestic CNKI data reveal a relatively decentralized collaboration network. Therefore, the authors of this study should take the initiative, actively explore opportunities for cooperation, and commit to building solid cooperative relationships, with special emphasis on strengthening multiple cooperative mechanisms, so as to promote academic dialog and knowledge exchange. At the same time, authors who are newly involved in the study should be encouraged to actively integrate into the existing cooperation framework, so as to jointly promote the development of online rumor research to a deeper level. By deepening cooperation, we can not only enhance the level of research, but also more effectively deal with the many challenges caused by Online rumors, and catalyze resource sharing, methodological exchanges, and thought provocation, thus stimulating the pace of academic innovation, analyzing and observing the complex phenomenon of Online rumors more comprehensively, proposing more targeted coping strategies, and jointly advancing the depth of the research and the breadth of its expansion.

3.4 Analysis of International Cooperation

CiteSpace visualizes and analyzes the national cooperation of Web of Science data, and selects "Country" as the analyzing factor to form the cooperation mapping between countries (shown in Figure 4). Through the analysis of Figure 4, it can be seen that there are 53 nodes in the graph, and the density of the network graph is 0.0392. Each node in the graph represents a country, and the size of the node represents the number of articles published by the country in the related research and the connecting line between the nodes represents the research cooperation relationship between countries. In the field of online rumor research, "The People's Republic of China" (PRC) and "The United States of America" (USA) constitute the two most notable core nodes, which are characterized by significantly thicker lines between them, which deeply reflects the high degree of cooperation between them in this research. In addition, the nodes "South Korea", "Australia" and "The Netherlands" are also strongly related to these two core nodes, which not only reveals the high activity of these countries in research cooperation but also reflects the frequency of research exchanges between them and other countries. This feature not only reveals the highly active status of these countries in related research cooperation, but also reflects the frequency of related research exchange between them and other countries. However, at the macro level, the connectivity between the nodes is generally weak. This is a reflection of the relative lack of international cooperation, as many countries have not yet joined the research network and have not yet succeeded in building a solid and lasting cooperative structure.

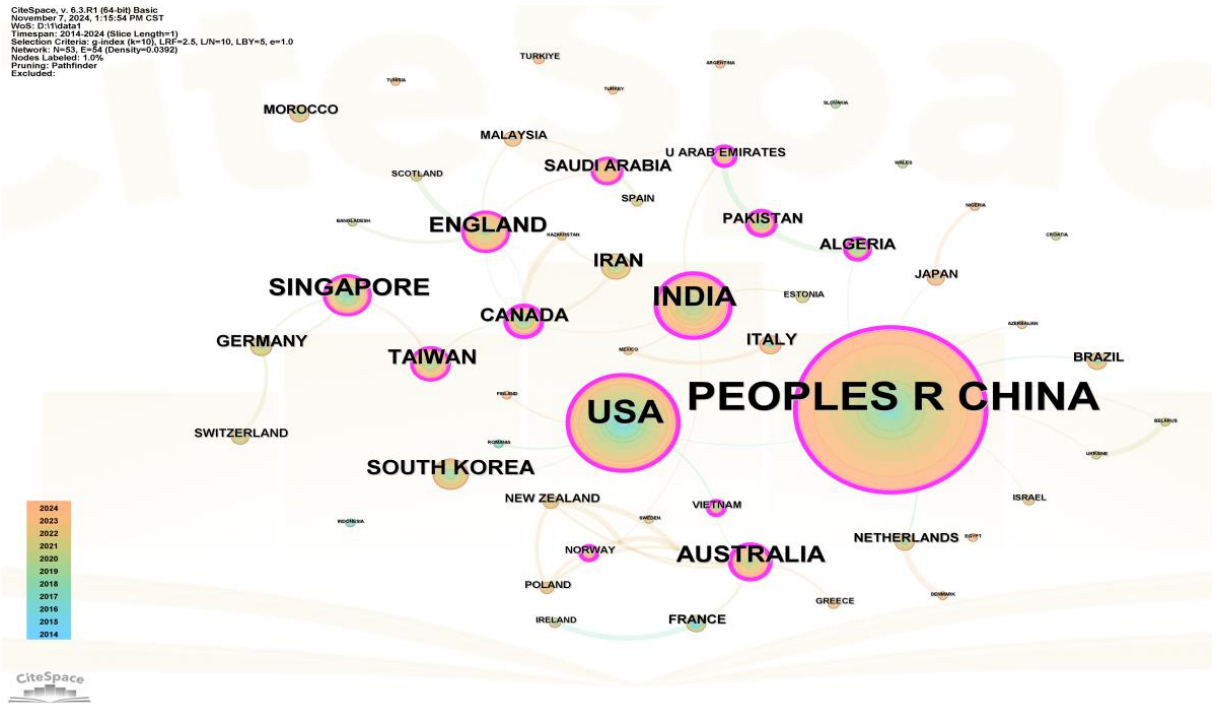


Figure 4: Collaboration mapping of countries for online rumor research in Web of Science.

According to Price's Law, under the statistics of this study, the number of articles published by the core research institutions is m=14.7, so the countries with more than 15 articles in Web of Science are regarded as the core countries of this study, resulting in a total of 8 countries with related research (as shown in Table 3): China has 390 articles, the United States 134, India 56, Singapore 31, Australia 27, England 21, South Korea 18, and Taiwan Province of China 17. articles, 31 articles in Singapore, 27 articles in Australia, 21 articles in England, 18 articles in

South Korea, and 17 articles in Taiwan Province of China. Based on the joint analysis in Figure 4 and Table 3, it can be seen that the total number of publications in China plus Taiwan Province of China is 407, which is far more than the number of publications in other countries. According to the observation in Figure 4, the connectivity between the countries is less, indicating that there is no good cooperation between these countries in this study. In Figure 4, the red color of the node edges represents the centrality $\geqslant$ 0.1, which indicates that the country corresponding to the node is in an important position in the network structure. The centrality of PEOPLES R CHINA and TAIWAN (0.73), USA (0.33), INDIA (0.57), SINGAPORE (0.12), AUSTRALIA (0.37), and ENGLAND (0.16) is all greater than 0.1, and thus these countries are in a more central position in this study and cooperation. central position.

Table 3: Information table of countries for online rumor research in Web of Science.

Sequence number	Number of articles	Centrality	Year	Country
1	390	0.55	2014	PEOPLES R CHINA
2	134	0.33	2014	USA
3	56	0.57	2015	INDIA
4	31	0.12	2015	SINGAPORE
5	27	0.37	2016	AUSTRALIA
6	21	0.16	2018	ENGLAND
7	18	0	2017	SOUTH KOREA
8	17	0.18	2016	TAIWAN, CHINA

Based on the analysis of the above information, it can be seen that research institutions in various countries have not yet established a stable cooperation network. International research cooperation mechanisms can not only integrate research resources and wisdom from different geographical and cultural backgrounds, but also help to jointly address the complex and volatile challenges caused by Online rumors. Cooperation among research institutions in different countries not only facilitates the sharing of academic resources but also accelerates the innovation process of research methodology and greatly broadens the macro- and micro-insights of research. In the international academic field, the promotion of collaboration among multinational research institutions not only enhances the insight into the core characteristics of Online rumors and their proliferation mechanisms but also significantly optimizes the effectiveness and relevance of response strategies. Therefore, this kind of cross-border cooperation model has demonstrated the potential of academic contribution and practical application in advancing the development of the field of Internet rumor research, as well as improving the efficiency and quality standard of Internet rumor governance in the global context.

4 Analysis of Research Hot Spots and Trends of Online rumors

4.1 Foreign Research Hot Spots and Trends

4.1.1 Analysis of Foreign Research Hotspots

The keywords of Web of Science data are visualized and analyzed by CiteSpace, and "Keyword" is chosen as the analysis factor to draw the keyword co-occurrence map of Web of Science Online Rumor, as shown in Figure 5. Through the analysis of Figure 5, it can be seen

that the graph generates a total of 139 nodes, and the network density is 0.0218. The network density is the core index to measure the tightness of the keyword co-occurrence network, and its calculation formula is:

$$D=\frac{E}{N(N-1)/2} \tag{1}$$

where D denotes the network density, E is the number of actual keyword co-occurring edges, and N is the total number of nodes (i.e., the number of keywords) in the network. The formula quantitatively reflects the association strength between keywords by calculating the ratio of the actual number of edges to the theoretical maximum possible number of edges. When D tends to 1, it indicates that the connection between keywords is extremely strong; when D tends to 0, it indicates that the network structure is loose. The network density of Web of Science data in this paper is 0.0218, and that of CNKI data in the later paper is 0.006, both of which reflect the sparseness of the keyword network, which is consistent with the characteristics of the dispersion of research hotspots at home and abroad[3].

Each node in the graph represents a keyword of related research, and the size of the node represents the high frequency of the keyword; the larger the node is, the higher the frequency, while the connecting line between the nodes represents the co-occurrence relationship between the keywords. As can be seen in Figure 5, the study formed a hot keyword map with the words "social media", "information," and "fake news" as the core. The study formed a hot keyword map with the words "social media", "information," and "fake news" as the core. The other keywords shown in the figure are also hot spots in the research of "Online Rumor", which are intertwined and interpenetrated with each other.

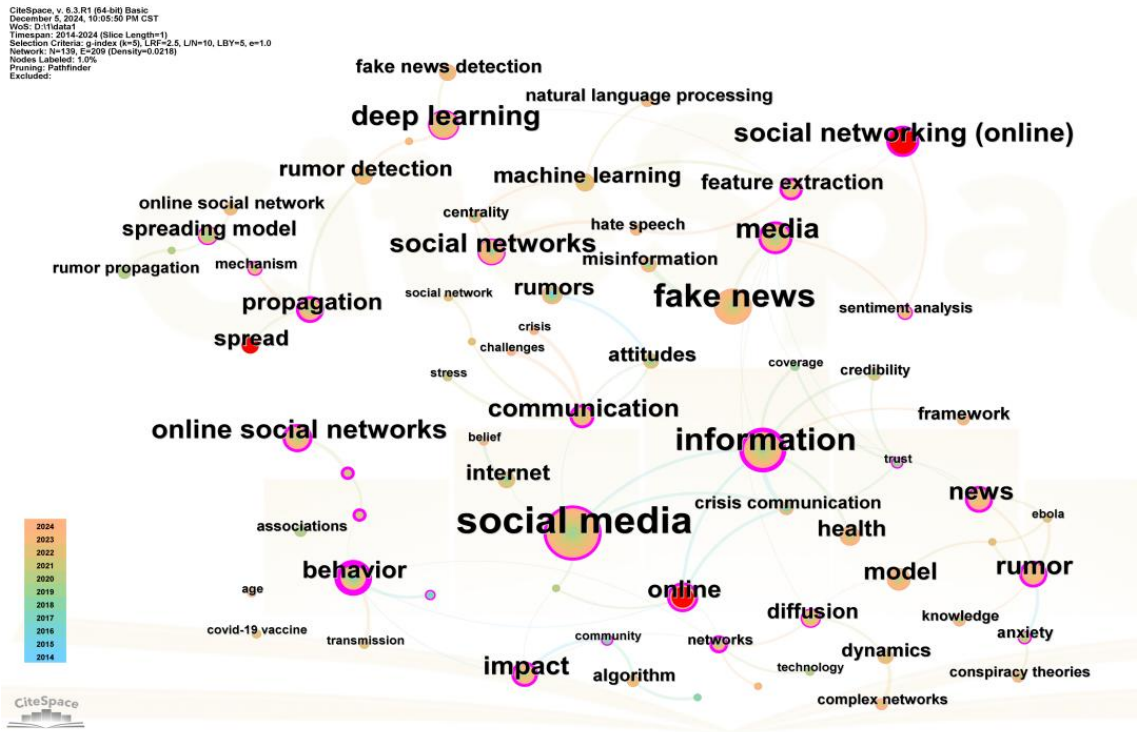
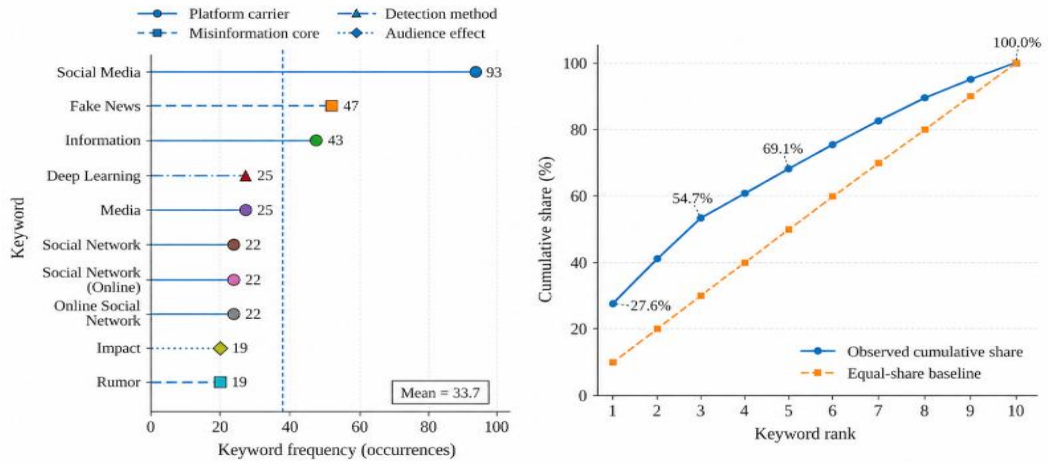


Figure 5: Keyword co-occurrence map of foreign online rumor studies.

In CiteSpace software, this article exports the names and frequency of relevant keywords in Web of Science data, and selects the top 10 keywords by frequency. To avoid presenting frequency differences solely through a simple bar chart, this article further combines keyword

frequency ranking with cumulative concentration for visual expression, as shown in Figure 6. Through the analysis of Figure 6 (a), it can be found that the high-frequency keywords in the Web of Science data exhibit a clear hierarchical structure of "core words supporting words". Among them, the frequency of appearance of "Social Media" is the highest, reaching 93 times, significantly higher than other keywords, indicating that foreign research on online rumors first regards social media as a key field for rumor generation, dissemination, and governance. From the cumulative concentration curve in Figure 6 (b), the top ranked "Social Media" has contributed approximately 27.6% of the keyword frequency, with the cumulative contribution of the first three keywords exceeding half, and the cumulative contribution of the first five keywords being approximately 69.1%. This indicates that research on online rumors abroad is not evenly distributed across all keywords, but is clearly focused on a few core topics such as social media platforms, false information identification, and information dissemination mechanisms.



(a) Ranked lollipop plot of high-frequency keywords (b) Cumulative concentration curve of top-10 keywords

Figure 6: Analysis of high-frequency keyword ranking and cumulative concentration in foreign online rumor research.

According to the common analysis of Figure 5 and Figure 6, it can be seen that the research mostly takes the information on the Internet and social media as the object of research, and the social platforms on the Internet have become the gathering place of online rumors, and at the same time, they also cause a bad influence. Therefore, the research will mostly focus on the misinformation and related impacts and so on.

4.1.2 Clustering analysis of foreign research

Cluster analysis of keywords in related fields can explore the degree of connection between keywords in the field. In CiteSpace, select "Clustering" to perform cluster analysis, and choose the LLR algorithm to generate the keyword map, as shown in Figure 7. Figure 7 shows that the modularity Q of the keyword clustering of Online Rumor research in Web of Science is 0.751, which is a significant result that shows the high credibility of the clustering structure, and the Sihouette S is 0.9235>0.5, which proves that the clustering results are reasonable. A total of 10 clusters were obtained as shown in Table 4. The reasonableness of the clustering results can be further verified by the Silhouette Coefficient, which is calculated as:

$$S(i)=\frac{b(i)-a(i)}{\max(a(i),b(i))} \quad (2)$$

where a(i) is the average distance between sample i and other samples in the same cluster (cohesion), and b(i) is the average distance between sample i and the nearest heteroclustered samples (separation). s(i) takes the value of [-1,1], and the closer it is to 1 indicates that the clustering effect is better. The clustering profile coefficient of Web of Science data in this paper is 0.9235, and that of CNKI data in the later paper is 0.9926, which are much larger than 0.5, indicating that the clustering results have high validity, and the consistency of keywords within clusters and the differences between clusters are significant [4].

Based on the confirmation that the clustering results have high validity, the keyword clustering labels for the Online Rumor study in Web of Science are specified as follows:

#0 Social media; #1 Rumor propagation; #2 Network analysis; #3 Bullying; #4 Model; #5 Rumor spreading; #6 Fake news; #7 Influential users; #8 Psychology; #9 Online social networks, which can be roughly divided into three categories by analyzing the clusters:

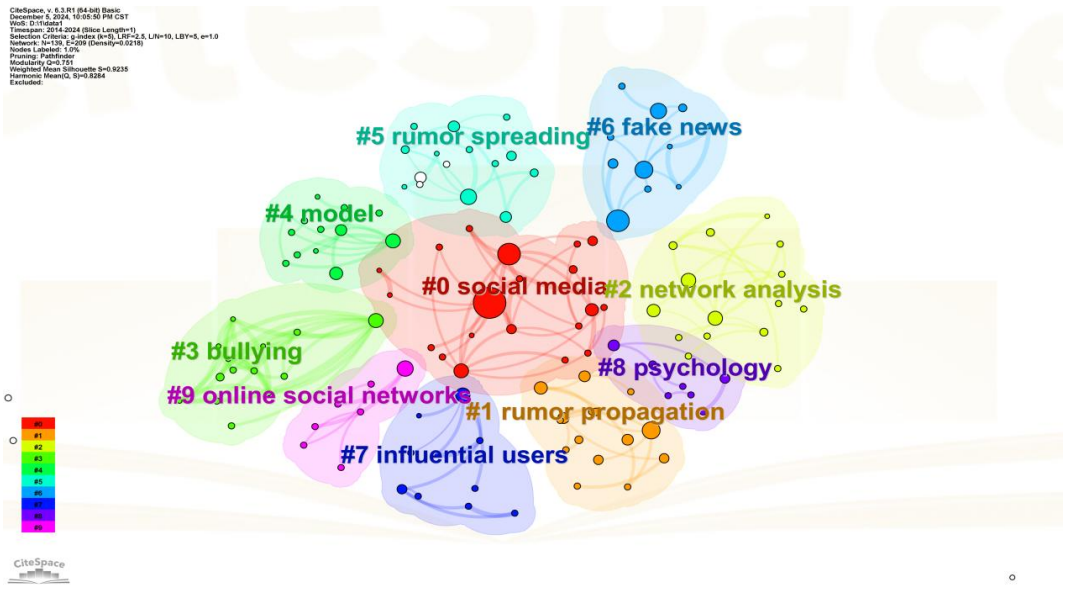


Figure 7: Clustering mapping of foreign Online Rumor research keywords.

(1) Topics Focused On by Online Rumor Research, Recognition and Dissemination. The first category includes clusters #1 Rumor propagation, #3 Bullying, #5 Rumor spreading, #6 Fake news, and #7 Influential users. The keywords for these five clusters include: rumor propagation; rumor detection; deep learning; artificial intelligence; bullying; domestic violence; online rumors; rumor spreading; feature extraction; fake news; social networking (online); influential users. influential users; network evolution; etc. Globally, social media platforms have become the preferred means of information exchange for millions of users, who frequently share the latest news and insights on a variety of topics on a daily basis[5]. The rapid progress of the Internet and social media has facilitated the wide circulation of information, but also led to the proliferation of false information, rumors, and misleading content, which poses a serious challenge to the formation of public opinion and the stability of the social order, and even induces a number of social problems[6]. Given that the potential harm of rumors to human society has become increasingly prominent, it is particularly urgent to curb the spread of rumors effectively. In this context, the rumor clarification mechanism is regarded as a key strategy to control the spread of rumors. To implement this strategy, rumor prevention messages can be disseminated through diversified media platforms, which include online social media, television media, and offline direct communication activities[7]. Currently, academics are actively exploring the use of tools such as IC control strategy, SIDR-SIR model[8], binomial

logistic regression analysis[9] and SAIRIgRg model[10] OTI (Optimization of Term Frequency - Inverse Document Frequency) to construct vector matrices of comments and words for rumor identification[11], SIS rumor propagation model[12], and so on. The research tools are used to deepen the understanding and analysis of the mechanism of rumor clarification, identification and dissemination.

(2) Carrying Subjects of Online Rumor Research. The second category includes clusters #0 Social media, #9 Online social networks. Keywords of these two clusters include: social media; crisis communication; deep learning; information sharing; online social networks; rumor control; anti-rumor spreading; intention to follow, etc. Social media platforms have been adopted by millions of users around the world as a broad medium for information exchange, and they frequently post massive updates and personal opinions on diverse topics on such platforms on a daily basis. At the same time, politicians use this channel to articulate policy ideas and action plans, while businesses use it to promote their goods and services. The prevalence of social media in contemporary society is due in large part to the popularity and continued availability of core elements such as high-speed and easily accessible Internet communication technologies. These favorable conditions have greatly facilitated the efficient dissemination of information among users in their neighborhoods within a given social media platform, as well as across the entire social network. However, recently the medium has unfortunately evolved into a hotbed for malicious activities, especially the spreading of rumors[13]. As a result, the online social network (OSN) environment is increasingly becoming a breeding ground for rumors, misleading information, false content, and other undesirable information[14]. To address this challenge, academics are currently actively using a variety of research methods to explore the rumor propagation mechanism on social networks, including but not limited to the application of the SMQIR rumor propagation model, the comparative analysis between the SIR and SIHR models[15], the development of the rumor-blocking (CRB) algorithm[16], and the exploration of the nonlinear SEIDR propagation model[17]. These research tools aim to deeply understand and effectively respond to the propagation dynamics of rumors on social networks.

Table 4: Keyword clustering information table of foreign Online Rumor studies.

Cluster Label	Profile Value	Year	Keywords
#0 Social media	0.872	2017	Social media; crisis communication;deep learning; computer-mediated communication; information sharing
#1 Rumor propagation	1	2020	Rumor propagation;rumor detection; deep learning; transfer learning; artificial intelligence
#2 Network analysis	0.858	2020	Network analysis; covid-19 vaccination; conspiracy theories; disasters; cluster analysis
#3 Bullying	0.993	2015	Bullying; domestic violence; online rumors; canada; circular economy
#4 Model	0.922	2018	Model; communication; crisis; floods; vaccine acceptance
#5 Rumor spreading	0.901	2019	Rumor spreading; social networks; machine learning; feature extraction; complex networks
#6 Fake news	0.966	2019	Fake news; social networking(online); computational modeling; bit error rate; transformers
#7 Influential users	0.899	2017	Influential users; graph based; nodes; identification algorithms; network evolution
#8 Psychology	0.967	2021	Psychology; influence maximization; network epidemics; delay; adoption
#9 Online social networks	0.862	2020	Online social networks; rumor control; anti-rumor spreading; intention to follow; truth spreading

(3)Analyzing Detection and Research Techniques for Online Rumor Studies. The third category includes clusters #2 Network analysis, #4 Model, and #8 Psychology keywords for these three clusters include: psychology; influence maximization; network epidemics; vaccination (vaccination/preventive measures, here in the metaphorical sense, refers to measures to prevent the spread of cyber viruses or rumors); conspiracy theories; disasters; cluster analysis; model; communication (communication; crisis; etc. The rapid development of social networks has greatly facilitated the development of social networks. The rapid development of social networks has greatly facilitated the rate and breadth of information dissemination. However, the lack of regulatory measures and the relatively loose freedom of expression on social platforms have allowed a large amount of unverified information to circulate unchecked. Therefore, rapid and effective identification of rumors in social networks is crucial for creating a clear cyberspace and safeguarding public safety[18]. Currently, scholars are actively exploring the use of various research methods to enhance the ability of online rumor detection, which include, but are not limited to, the MDE-Grey model (Explainable Rumor Detection Model based on Grey clustering) [19], the Hybrid Rumor Detection Model (CoAHRD) [20], and the Early Rumor Detection Model based on Dual-Channel (ERD-DC) [21] and so on. Therefore, some scholars point out that the governance method of online rumors in recent years has developed from decentralized management to collaborative management, emphasizing the active management of the process of online rumor dissemination, which provides a scientific method for building a clear cyberspace [22].

4.1.3 Analysis of foreign research evolution

In this paper, we use CiteSpace to carry out burst analysis (Citation Burst) on the basis of keyword co-occurrence network, which is one of the important tools for literature content mining at present, reflecting active or cutting-edge research nodes. The analysis of keyword emergence map of foreign network rumor research in the past ten years contains the cutting-edge evolution of 23 emergent words, and the results are shown in Figure 8.

Based on the visual econometric analysis of foreign network rumor research papers, combined with Figure 8, the research can be divided into three stages:

(1) The stage of research focusing on the nature and connotation of Online rumors (2014-2018). During the development of this academic research, foreign scholars' exploration of Online Rumors goes deep into its essential attributes and deeper meanings, and the specific attitudes and subtle features of rumors are extensively and exhaustively examined. The research focuses on revealing the diversity of rumors' essential attributes and deeper meanings, as well as the complexity of online social network structure. At this stage, the research adopts the classical theoretical discursive method, focusing on in-depth analysis and construction from the essential theoretical level, aiming at laying a solid foundation for the construction of a more rigorous and systematic theoretical structure. Based on the above research history, foreign scholars' profound analysis of online rumors has opened up a valuable exploration path for subsequent academic research. This research not only reveals the nature of rumors and the complexity of online social network structure, but also lays a solid foundation for the construction of a more rigorous and systematic theoretical framework, which is of great reference value for subsequent research and practical intervention.

(2) Conducting rumor carrier deepening research stage (2015-2019). In the research stage, foreign scholars gradually shift the focus of inquiry to the deep exploration of the rumor carrier, deepening the understanding of the relationship between the rumor carrier and the crisis. Scholars have skillfully adopted cutting-edge analytical tools such as the ERD-DC model to conduct more precise identification and in-depth analysis of rumors circulating on the Internet, especially those rumors with the nature of crises, and to portray the unique attributes of crises

exhaustively. This series of efforts has not only greatly deepened the public's knowledge and understanding of the nature of rumors but also introduced more diversified and scientific observation perspectives to the field of rumor research, greatly enriching the theoretical and practical basis of the field. The progress achieved in the above research stage opens up a broad value space for future rumor research. Deepening the understanding of the relationship between rumor communication media and crises, as well as applying cutting-edge analytical tools such as the ERD-DC model for accurate identification and in-depth analysis, not only enhances the public's awareness of the nature of rumors but also introduces a more comprehensive and scientific perspective for rumor research. On this basis, future research can further explore the new media and mechanisms of rumor dissemination, as well as the evolution of rumors in crises, so as to provide theoretical support and practical guidance for the construction of a more effective rumor prevention and control system, thus effectively responding to the challenges posed by Online rumors and maintaining social stability and information security.

(3) Focus on the use of technical stage (2019-2024). In this stage, foreign Online Rumor research flourishes, deepening and flexibly applying models (such as the aforementioned ERD-DC model, CoAHRD model, SMQIR rumor spreading model, SIR and SIHR model, etc.) to study various details of online rumors, improving the quality of research. Models play a key role in online rumor management by quantitatively analyzing the rumor propagation law, accurately predicting the rumor spreading trend, and providing a scientific basis for the formulation of effective rumor coping strategies, so as to improve the management efficiency, reduce the adverse effects, and guarantee the health and stability of the online environment.

Firstly, scholars apply the model to quantitatively analyze the spreading speed, scope and influence of rumors by combining various models and theories, so as to more intuitively understand the degree of harm of rumors. Secondly, based on historical data and current dissemination situation, scholars flexibly use the model to predict the future spreading trend of rumors, which provides prospective guidance for the governance work. Finally, by comparing the rumor spreading situation under different governance strategies, scholars use the model to evaluate the effect of various strategies, which provides the basis for optimizing the governance scheme. In summary, the deepening research and flexible application of the model provide strong support for the development of scientific and efficient rumor response strategies.

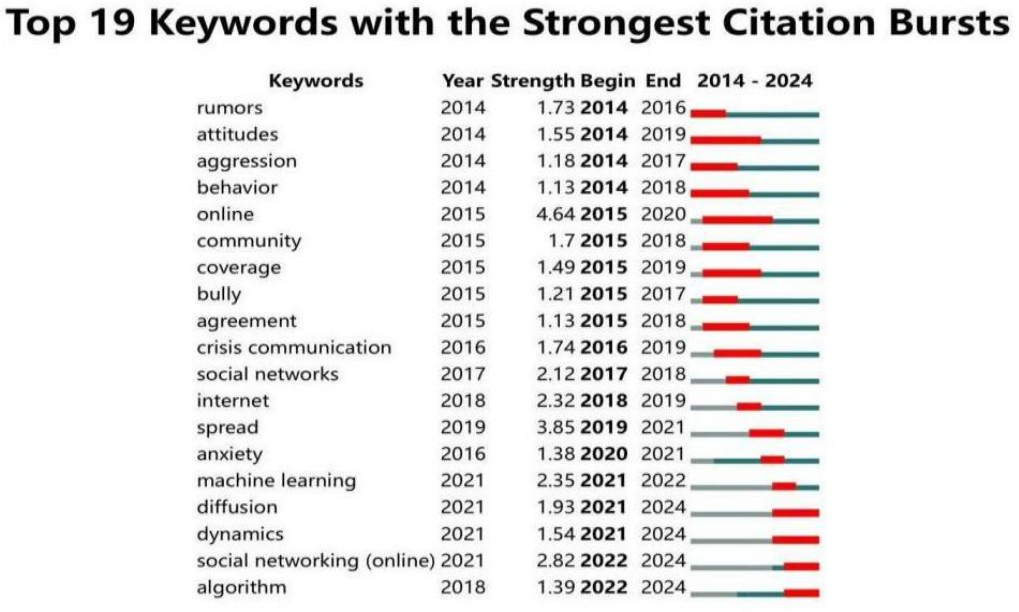


Figure 8: Keyword emergence chart of foreign Online Rumor research.

4.2 Domestic Online Rumor Research Hot Spots and Trends

4.2.1 Analysis of Online Rumor Research Hot Spots

The keyword co-occurrence map of online rumors in China's CNKI database was drawn using CiteSpace for visual analysis of keywords in domestic CNKI data, with "Keyword" selected as the analysis factor, as shown in Figure 9. Analysis of Figure 9 reveals that the map generated 193 nodes, with a network density of 0.006, which is much lower than that in the field of Web of Science abroad. It can be seen from Figure 9 that this field has formed a hot keyword map with "online rumors" as the core. Other keywords such as "rumor spread", "rumor", "rumor governance," and "freedom of speech" have also formed their keyword connection networks. These keywords reflect the hot trends of research on online rumors in China's CNKI. Through the analysis of nodes such as "governance", "spread" and "legal regulation", it can be seen that there are in-depth studies on the governance countermeasures of online rumors in China's CNKI, striving to solve the problem of online rumors.

After exporting the names and frequency of relevant keywords in CiteSpace, this article selected the top 10 keywords in terms of frequency ranking and visualized them from two dimensions: "ranking frequency distribution" and "topic structure aggregation", as shown in Figure 10. From Figure 10 (a), it can be seen that the high-frequency keywords in domestic online rumor research exhibit a clear head concentration structure. As the core theme word, "Online Rumor" appears with a frequency of 243, indicating that domestic research first focused on the basic object of "online rumors". In addition to the theme words, the frequency of "Rumor Dissemination" is 26, ranking first among non theme words, indicating that the dissemination process is still one of the most important entry points for domestic research. From Figure 10 (b), the top 10 high-frequency keywords can be categorized into four main themes: core themes, communication mechanisms, governance and regulation, and public opinion. Among them, the core theme category only contains 2 keywords, but the total frequency reaches 260, accounting for 75.1% of the total frequency of the top 10 keywords, indicating that domestic research still focuses on "online rumors" and their directly related concepts overall.

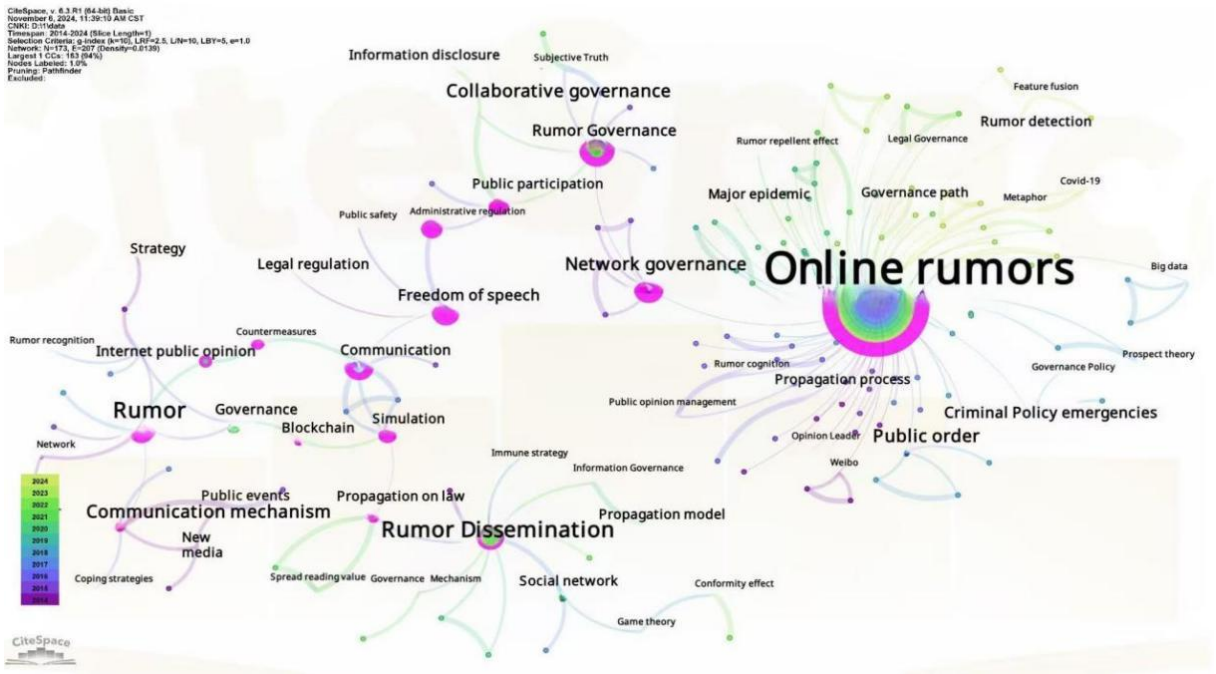


Figure 9: Keyword co-occurrence map of domestic Internet rumor research.

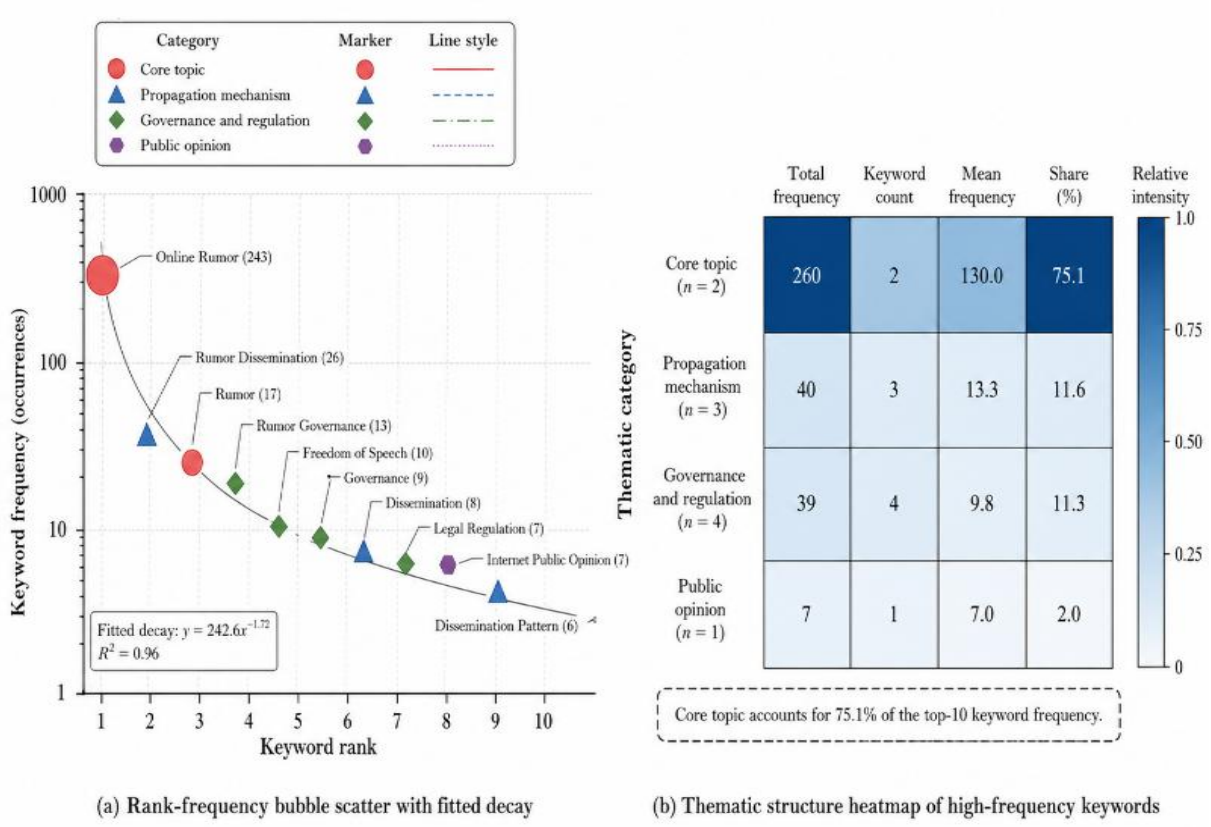


Figure 10: Analysis of high-frequency keyword structure in domestic online rumor research.

According to the common analysis of Figure 9 and Figure 10, it can be seen that domestic research mostly focuses on the rumor itself, the dissemination of rumors and how to manage rumors, analyzes the factors affecting Online rumors based on multiple perspectives, and conducts in-depth analysis of each feature of Online rumors.

4.2.2 Cluster analysis of network rumor research

Cluster analysis of the keywords of related research can explore the degree of connection between the keywords of the research. Choose "Clustering" in CiteSpace to perform cluster analysis, use LLR to extract keywords and automatically identify them to generate a keyword map, as shown in Figure 11. Through Figure 11, we know that the modularity Q of keyword clustering in CNKI is 0.7144, which is a significant result that shows the high credibility of the clustering structure, and the Sihouette S is 0.9926>0.5, which proves that the clustering results are reasonable. A total of six clusters were derived from this clustering, as shown in Table 5. The cluster labels contain #0 Rumor spreading, #1 Rumor, #2 Propagation law, #3 Freedom of expression, #4 Communication mechanism and #5 E-governance, etc. These cluster labels show the scholars' in-depth profiling of the characteristics and correlations among the clusters of this research, and the clusters can be roughly classified into three categories:

(1) Direction of Research Focus on Online rumors. The first category includes clusters #1 Rumors and #3 Freedom of Expression, and the keywords of these 2 clusters include: rumors; public participation; communication; governance; online public opinion; governance countermeasures; freedom of expression; administrative regulation; rumor governance; collaborative governance. The spread of rumors can disrupt social order, endanger national

stability, and cause public panic, and the widespread use of social platforms makes the information spread faster and reach a wider range, increasing the negative impact caused by rumors [23]. Therefore, it is crucial to study the topic of Online rumors in terms of its impact on social stability, public rights and interests, media literacy, information authenticity, legal improvement and network ecology. Timely analysis of rumors can reduce the social impact and expose the truth, which not only enhances the public's ability to analyze rumors but also improves the public's critical thinking and information screening power and promotes the authentic and efficient dissemination of information. At the same time, it can also protect people's rights and interests, provide empirical evidence for the formulation of laws, and help build a healthy and orderly network ecology.

(2) Spreading of Online rumors. The second category includes #0 Rumor spreading, #2 Propagation law and #4 Propagation mechanism. The keywords of these three clusters include: rumor spreading; freedom of speech; network public opinion; propagation; propagation law; herd effect; scale-free network; network rumor; propagation mechanism; audience; public event; coping strategy; and new media. In the age of intelligence, online rumors grow and spread geometrically on various social platforms, posing new challenges to social order, social governance, etc. [24]. Currently, in exploring the mechanism of online rumor propagation, Chinese academics have widely adopted such methods as LDA algorithm [25], situational awareness theory [26], rumor propagation ecology [27], MATLAB simulation [28], using rumors on the Internet as an entry point to establish a new rumor propagation model [29], SIR model, SPIDR model (Susceptible-Promoted-Infective-Debunked-Recovered) [30] and the "5W" theory of information dissemination [31], and other theoretical frameworks have been analyzed in depth and detail. The core purpose of these researches is to comprehensively analyze the propagation paths and patterns of online rumors, so as to provide scientific basis and practical guidance for the effective management of online rumors, more accurately grasp the propagation dynamics of online rumors, and contribute to the development of targeted coping strategies, the reduction of negative impacts brought by rumors, and the maintenance of a healthy order in cyberspace.

(3) Governance of Online rumors. The third category of rumors includes #5 E-governance, and the keywords of this cluster include e-governance; public management; information society; network governance; when dealing with Online rumors, it is necessary to absorb people's opinions widely, take the initiative to overcome the practical problems faced by the public, and quickly and effectively guide the direction of network public opinion. At the same time, it is necessary to deeply analyze the new dilemmas faced by rumor management, so as to establish a set of long-term and effective network rumor response mechanisms. In recent years, China has been increasing its efforts to deal with online rumors, and the Office of the Central Network Security and Informatization Commission (CNSIC) has deployed and implemented a series of special actions called "Clearing the Air," which aim to implement special remedial measures against online rumors and other online chaos. When studying the governance of online rumors, we should assess the social impact of intelligent online rumors as a systemic risk, and plan the governance path by taking into account technical regulation and rebuilding systemic trust, so as to enhance the public's emotional experience and cultivate their emotional identity by reshaping the social interaction and dialogue mechanism that meets the requirements of the new era, create and accumulate new trust capital, create a clear cyberspace, and build and share online civilization [32].

Table 5: Clustering information table of keywords for domestic network rumor research.

Cluster label	Cluster profile value	Year	Clustering Keywords
#0 Rumor spreading	1	2018	Rumor Spreading; Freedom of Expression; Internet Public Opinion; Dissemination; Online rumors
#1 Rumors	1	2016	Rumor; Propagation; Governance; Internet Public Opinion; Governance Countermeasures
#2 Propagation law	0.986	2018	Rumor spreading; Communication law; Crowd effect; Scale-free network; Internet rumor
#3 Freedom of expression	0.953	2015	Freedom of expression; Public participation; Administrative regulation; Rumor governance; Collaborative governance
#4 Dissemination mechanism	0.987	2015	Communication mechanisms; Audience; Public events; Response strategies; New media
#5 E-governance	0.997	2015	Electronic governance; Public management; Information society; Network governance; Rumor dissemination

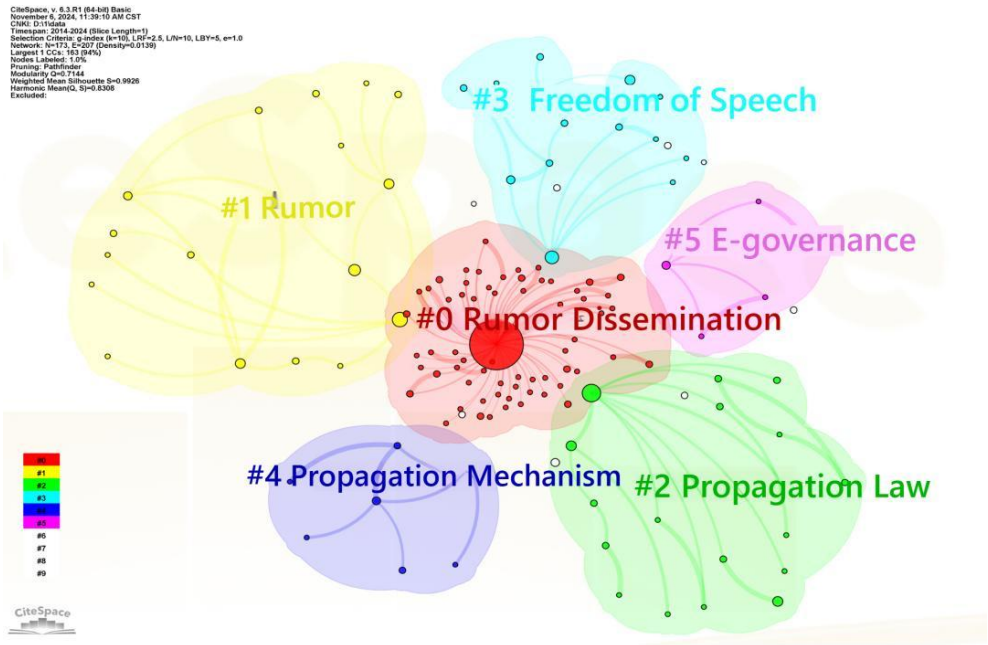


Figure 11: Clustering map of keywords for domestic online rumor research.

4.3 Analysis of the evolution of online rumor research

In this paper, we use CiteSpace to conduct burst analysis (Citation Burst) on the basis of keyword co-occurrence network, which is one of the important tools for literature content mining at present, reflecting active or cutting-edge research nodes. The analysis of keyword emergence map of domestic network rumor research in the past ten years contains the cutting-edge evolution of 25 emergent words, and the results are shown in Figure 12.

Based on the visual econometric analysis of domestic network rumor research papers, combined with Figure 12, the research can be divided into three stages:

(1) Stage focusing on basic theory research (2014-2017). At this stage, domestic network

rumor research is based on the basic theory, focusing on the characteristics of the subject, governance strategy and dissemination mechanism for in-depth exploration. Scholars focus on the proliferation of rumors on social platforms and analyze their dissemination mechanisms in different environments. The research not only focuses on the characteristics of rumor makers, but also explores legal, technological, educational and other means of governance, and puts forward coping strategies according to the characteristics of each platform, aiming at improving public information literacy and rumor resistance. Overall, the research has achieved significant results in both theory and practice, providing strong support for building a healthy online information environment.

(2) Data-based research phase (2017-2018). In this phase of domestic academic research, scholars actively use big data technology to conduct in-depth exploration of the identification and governance of online rumors. Researchers focus more on the governance strategy of Online rumors in the context of emergencies and strive to achieve more profound research results in this field. Through the effective use of big data technology, researchers have not only improved the accuracy of network rumor identification but also further enriched and improved the theoretical system and practical path of network rumor governance, which promotes the development of the field of network rumor research to a deeper level.

(3) Stage focusing on coordinated governance (2020-2024). In the current prosperous development stage of domestic network rumor research, academics have not only extensively explored the diversified channels of network rumor generation but also conducted comprehensive and in-depth analyses of network rumor cases emerging in recent years [33]. One of the focuses of the research is to understand the extensive influence of Online rumors on society deeply, and on this basis, the systematic and comprehensive examination of the main body of Online rumors, the mechanism of propagation dynamics, the path of diversified governance, and the strategy of governance in accordance with the law has been conducted. This series of academic efforts not only deepens the understanding of the nature and influence of Online rumors but also provides powerful theoretical support and practical guidance for creating a clear and healthy cyberspace.

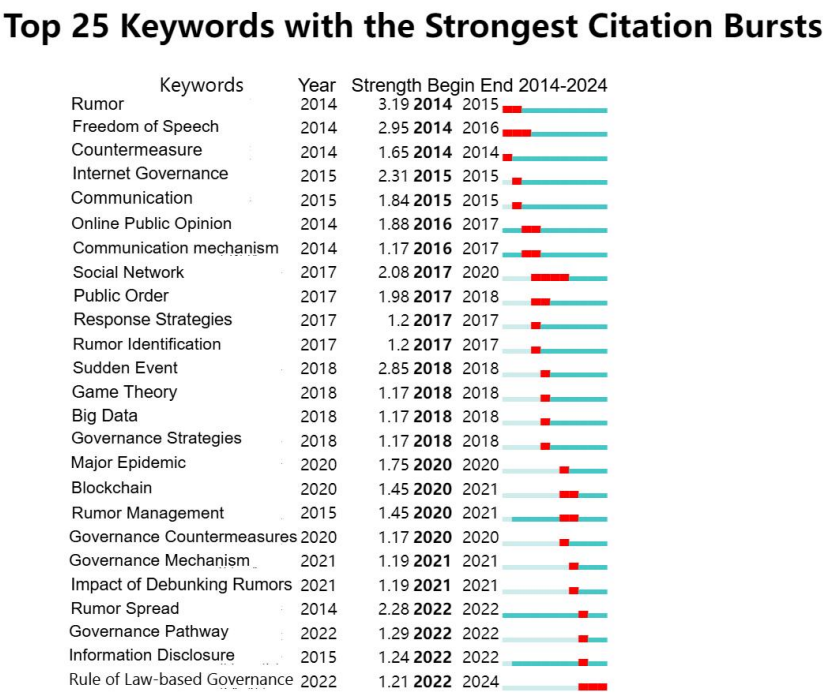


Figure 12: Keywords of Domestic Internet Rumor Study.

5 Conclusion

This study employed CiteSpace and bibliometric visualization methods to compare the research progress and topic evolution of online rumor studies in CNKI and Web of Science over the past ten years. By integrating publication trends, author collaborations, international cooperation, keyword co-occurrences, keyword rankings, clustering, and sudden detection, this study reached the following conclusions.

The development trajectory of research on online rumors in China and abroad shows significant differences. The number of Web of Science publications increased from 7 in 2014 to 54 in 2024, reaching a peak of 74 in 2022. This indicates that international research has entered a stage of continuous expansion. In contrast, the number of publications in CNKI decreased from 55 in 2014 to 12 in 2024, with a temporary rebound in 2020. This suggests that domestic research is more likely to be driven by short-term public events and policy issues, while international research has formed a more stable and continuous growth path. Therefore, future domestic research should strengthen continuity, expand the comparative perspective, and avoid over-reliance on sporadic hot issues.

(2) The collaboration structure in this field remains relatively loose. The author collaboration networks of Web of Science and CNKI have a low density, and domestic collaborations are particularly scattered. The analysis of international cooperation also indicates that although China, the United States, India, Singapore, Australia, and the United Kingdom occupy relatively central positions, cross-national cooperation has not yet formed a highly integrated research community. This means that the study of online rumors still requires strengthening interdisciplinary and cross-regional cooperation, especially in aspects such as data sharing, platform comparison, model validation, and governance evaluation.

(3) The keyword analysis reveals that there are differences in the emphasis of themes between domestic and international research. International studies have focused mainly on "social media", "fake news", and "information". The revised frequency structure of the keywords further indicates that the top three Web of Science keywords account for more than half of the total frequency, while the top five account for approximately 69.1%, suggesting that international research mainly focuses on platform-based misinformation dissemination, algorithm detection, and social impact assessment. In contrast, domestic research has formed a structure centered around "online rumors", with "rumor dissemination", "rumor governance", "freedom of speech", and "legal regulation" as secondary themes. The revised Figure 10 shows a significant ranking frequency decay pattern, with core theme categories accounting for 75.1% of the frequencies of the top 10 keywords. This indicates that domestic research still strongly focuses on the basic objects of online rumors, while the dissemination mechanism and governance supervision constitute two main supporting lines.

(4) Cluster and burst analysis further indicate that the research on online rumors is shifting from descriptive discussions to analysis based on models, technologies, and governance-oriented approaches. International research increasingly emphasizes rumor detection, deep learning, network modeling, and intervention strategies, while domestic research focuses more on governance paths, legal regulation, public opinion guidance, and collaborative governance. However, the proportion of keywords related to public opinion in CNKI is relatively low, which also suggests that domestic research should pay more attention to users' cognitive characteristics, emotional responses, and behavioral mechanisms. Since the sharing of false information is closely related to individual characteristics and psychological tendencies [34], future research should combine computational detection with psychological analysis, platform governance, and public communication strategies. Overall, the research on online rumors is moving towards a more refined, model-based, and interdisciplinary direction. Future work

should strengthen cross-platform data integration, improve early warning and intervention models, and build a collaborative governance framework involving the government, platforms, media, researchers, and users to enhance the scientific basis and practical effectiveness of online rumor governance.

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