

Visualization Analysis of Foreign Online Public Opinion Research Based on Knowledge Graphs: Postprint

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Abstract

[Purpose/Significance] This study aims to provide a comprehensive overview of foreign online public opinion research, laying an important foundation for domestic online public opinion research and governance practice. [Method/Process] Taking journal papers on foreign online public opinion research from the Web of Science database over the past 17 years as the research object, this study employs the CiteSpace V visual knowledge network analysis tool and bibliometric methods to quantitatively analyze the research status, research foundation, and research hotspots of foreign online public opinion. [Results/Conclusion] The study finds that: over the past 17 years, foreign online public opinion research has demonstrated a steady upward trajectory, exhibits an interdisciplinary trend, and features extensive geographical collaboration; the research foundation focuses on the “antecedents” of public opinion (agenda setting, framing analysis), the formation “process” of mass public opinion (spiral of silence, RAS model), and the “consequences” of online public opinion (political participation, government trust); research hotspots include the influencing factors of online public opinion, monitoring and analysis of online public opinion, and the impact of online public opinion on public online political participation. Finally, based on foreign online public opinion research, suggestions for domestic online public opinion research are provided.

Full Text

Visualization Analysis of Research on Foreign Network Public Opinion Based on Mapping Knowledge Domains

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Abstract

[Purpose/Significance] This study aims to provide a panoramic understanding of the state of foreign network public opinion research, laying an important foundation for domestic network public opinion research and governance practice. **[Method/Process]** Taking journal articles on foreign network public opinion from the Web of Science database over the past 17 years as the research object, this paper employs CiteSpace V visualization knowledge network analysis tools and bibliometric methods to quantitatively analyze the research status, research foundation, and research hotspots of foreign network public opinion. **[Result/Conclusion]** The study finds that over the past 17 years, foreign network public opinion research has shown a steady upward trend, with increasing interdisciplinary integration and extensive regional cooperation. The research foundation focuses on the “antecedents” of public opinion (agenda setting, framing analysis), the formation “process” of mass opinion (spiral of silence, RAS model), and the “consequences” of network public opinion (political participation, government trust). The research hotspots include factors influencing network public opinion, monitoring and analysis of network public opinion, and the impact of network public opinion on public online political participation. Finally, based on foreign network public opinion research, suggestions are provided for domestic network public opinion research.

Keywords: network public opinion; research foundation; bibliometric analysis; visualization analysis

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The development of diversified communication platforms such as the Internet and new media has expanded public space for opinion expression and channels for political participation, while also bringing numerous negative effects such as online political rumors and cyber violence, which threaten social stability and national security. Consequently, network public opinion governance has become a common challenge faced by countries worldwide. The evolution of China’s current social public opinion ecology is a dynamic process of game-playing among political, technological, and social forces, which poses enormous challenges for Chinese governments at all levels in guiding and governing network public opinion. Factors such as government response time limits, authenticity of released information, resolution of real-world problems, and official accountability directly affect the effectiveness of network public opinion governance. The lack of media responsibility and imperfect media accountability mechanisms lead to false reporting by some media outlets, causing significant deviations in network public opinion. Some netizens express irrational opinions in cyberspace while paying little attention to official government responses, resulting in frequent network public opinion deviations that threaten social stability, mislead public

decision-making, and weaken public cultural identity.

In governance practice, developed capitalist countries such as the United States, United Kingdom, and Germany generally govern network public opinion through legislation, administration, and industry self-discipline, while strengthening mutual cooperation to keep network public opinion within controllable ranges. Domestic network public opinion governance measures focus on responding to netizens' demands on livelihood issues, safeguarding netizens' legitimate rights and interests, guiding netizens toward rational thinking, and building consensus among different social strata. However, these governance measures and their effectiveness urgently need improvement and enhancement. In academic circles, domestic scholars' research on foreign network public opinion mostly conducts qualitative analysis in combination with domestic network public opinion research, with few in-depth studies on the research foundation and hotspots of foreign network public opinion.

Analysis of the current state, research foundation, and hotspot topics of a particular theme can employ visualization knowledge mapping methods—that is, through visual analysis of literature information in that field, enabling readers to quickly and intuitively understand the research status, hotspot topics, and classic literature of that theme. This paper adopts bibliometric methods based on knowledge mapping to reveal, through in-depth analysis of existing research literature, the research status, research foundation, and hotspot topics of foreign network public opinion from 2000 to 2017, enabling scholars to promptly understand the current international research situation of network public opinion and laying an important foundation for future network public opinion research and improving the effectiveness of domestic network public opinion governance.

1.1 Data Sources

The literature used in this paper comes from the core collection of the Web of Science database, which is the Science Citation Index Expanded of the Institute for Scientific Information in the United States. The retrieval date was May 23, 2018, using “online public opinion” or “network public opinion” as subject terms. The document type was set as journal articles (Article), with a time span of 2000-2017. After organizing and cleaning the retrieved literature data, 940 valid documents were finally obtained.

1.2 Research Methods

This paper employs bibliometric analysis to examine the temporal and spatial distribution of foreign network public opinion research and highly cited literature, providing a holistic analysis of the distribution structure, quantitative relationships, and changing patterns of network public opinion research. For the research foundation of foreign network public opinion, this paper adopts co-citation network analysis of cited references in the sample. For hotspot topic distribution in network public opinion research, this paper employs co-word anal-

ysis. The software used for data analysis in this paper is CiteSpace V. C. Chen believes that this software can generate cluster maps and timeline views based on cited literature and keyword co-occurrence analysis, and through algorithmic operations on cutting-edge professional terminology, dynamically identify the research foundation and hotspot topics of a research field.

2 Research Status of Foreign Network Public Opinion

2.1 Temporal Distribution of Research Literature

The temporal distribution of research literature can to some extent reflect the research popularity, status, and trends of change in a research field. The statistics on the number of foreign network public opinion research documents and the growth trend of publications from 2000 to 2017 are shown in Figure 1 [Figure 1: see original paper].

As shown in Figure 1, the number of publications on foreign network public opinion research has shown a steady upward trend over the past 17 years. From 2005 to 2008, the first small peak appeared, possibly because the U.S. Central Intelligence Agency established the Open Source Center in 2005, which can monitor network public opinion in English, Chinese, and other languages on global websites, chat rooms, and social networks, attracting foreign scholars' attention to network public opinion. From 2009 to 2011, the number of research publications showed another small peak, possibly due to the launch of the U.S. government data portal data.gov in 2009 and the introduction of the Open Government Directive, which marked the basic formation of the data openness policy framework and improved the legality and possibility of obtaining network public opinion data. From 2012 to 2017, foreign network public opinion research entered an explosive stage, with the number of research publications increasing sharply from 37 in 2011 to 72, possibly because "big data" became a hot topic since 2012—appearing on the cover of columns in The New York Times and The Wall Street Journal, in news on the White House's official website, and in lectures and salons on international Internet topics. The emergence of big data laid an important foundation for obtaining network public opinion data.

2.2 Distribution of Co-Cited Journals

The international journal co-citation network of network public opinion research is shown in Figure 2, and Table 1 lists the top 10 international journals in terms of co-citation frequency in the field of network public opinion, most of which are top international journals in the field of communication studies, indicating that relevant theories and research methods in communication studies are an important foundation supporting network public opinion research.

[Figure 2: see original paper] Co-citation network of source journals

Specifically, among the top 10 journals in Table 1, those ranked 1st, 4th, and 5th—*Journal of Communication*, *Communication Research*, and *New Media &*

Society—are all top-tier journals in the first quartile (Q1) of communication studies. The 2nd-ranked *Public Opinion Quarterly* is a top journal in Q1 of communication studies, Q2 of political science, and Q1 of sociology and interdisciplinary fields. The 3rd-ranked *Political Communication* is a top journal in Q1 of both communication studies and political science. The 6th and 7th-ranked *American Political Science Review* and *American Journal of Political Science* are both top journals in Q1 of political science. The 8th-ranked *Journal of Computer-Mediated Communication* is a top international journal ranked first in Q1 of communication studies. The 9th-ranked *Journal of Personality and Social Psychology* is a top journal in Q1 of psychology and sociology. The 10th-ranked *Journalism & Mass Communication Quarterly* is a top journal in Q2 of communication studies. Overall, current foreign network public opinion research is mainly concentrated in two major disciplines: communication studies and political science, with sociology, psychology, and interdisciplinary fields also exploring network public opinion.

2.3 Cooperation Networks of Research Institutions and Regions

From the cooperation network of research institutions (see Figure 3 [Figure 3: see original paper]), major collaborative institutions include Harvard University, University of Texas at Austin, University of Michigan, Stanford University, and University of California, San Francisco in the United States; British Columbia University in the United Kingdom; Vienna University in Austria; and Tsinghua University, City University of Hong Kong, and The University of Hong Kong in China. From the regional cooperation network (see Figure 4 [Figure 4: see original paper]), major cooperating countries include the United States, United Kingdom, China, Australia, and South Korea.

[Figure 3: see original paper] Cooperation network of research institutions

[Figure 4: see original paper] Cooperation network of countries/regions

3 Research Foundation

The knowledge base is composed of a collection of co-cited literature, while the research frontier is composed of citing literature that cites this knowledge base. The knowledge base has relative stability and helps to discover research trends and predict research frontiers. Using CiteSpace V software to analyze the valid literature, with Node type selected as Cited Reference, a knowledge map of co-cited literature was finally drawn (see Figure 5 [Figure 5: see original paper]). Meanwhile, the top 10 highly cited literature in terms of co-citation frequency were compiled (see Table 2).

[Figure 5: see original paper] Knowledge map of co-cited literature

Table 2 shows the top 10 literature, authors, and publication dates in the field of network public opinion research in terms of co-citation frequency from 2000 to 2017. The most frequently co-cited article is “The agenda-setting function of mass media” by M. E. McComb and D. L. Shaw, published in *Public Opinion*

Quarterly in 1972. This study posits that there is a significant influence relationship between the public's perception of important issues in social public affairs and the reporting activities of mass media—that is, mass media influences the public's focus of attention and perception of the social environment by endowing various issues with different degrees of “salience.”

The second most co-cited article is “The spiral of silence: a theory of public opinion” by E. Noelle-Neumann, published in *Journal of Communication* in 1974. This study argues that for a controversial issue, people form a perception of the “opinion climate” regarding that issue and judge whether their own opinion belongs to the “majority.” When people feel their opinion is in the majority, they tend to express it; conversely, they remain “silent” to avoid “isolation.” This research attempts to reveal the role of mass media in the formation or guidance of public opinion and the mechanism of public opinion formation. However, network communication has brought tremendous impact to mass media, causing important changes in the spiral of silence.

The third most co-cited article is “Framing: toward clarification of a fractured paradigm” by R. M. Entman, published in *Journal of Communication* in 1993. This study argues that framing analysis is a precise way to explain the impact of information communication on human consciousness, and points out that framing is a way to select certain aspects of objective reality in information communication and make them more salient, thereby promoting the definition of real-world problems, causal interpretation, moral evaluation, and treatment recommendations. It also proposes trying to use new technologies and new management systems to solve public crises.

The fourth most co-cited article is *Hearing the Other Side: Deliberative versus Participatory Democracy* by D. C. Mutz, published in 2006. This book mainly studies how the public's daily discussions of political disagreements affect the formation of public opinion and public political participation. Deliberative democracy requires an ideal political environment with high tolerance and participation, thereby promoting citizens' effective participation in online political discussions and the healthy development of network public opinion.

The fifth most co-cited article is *The Nature and Origins of Mass Opinion* by J. R. Zaller, published in 1992. This book proposes the Receive-Accept-Sample (RAS) model of public opinion formation—that is, a model of receiving, accepting, and sampling information. The study argues that mainstream media's “sensational” political discourse reporting enhances public political awareness, and that elite-driven communication influences public opinion, with political awareness playing a mediating role in this process. Meanwhile, J. R. Zaller used the RAS model to conduct numerous empirical studies on the dynamic changes of public opinion in domestic and foreign policy, government trust, ethnic equality, and presidential elections.

The sixth most co-cited literature mainly studies sentiment analysis and opinion mining. The seventh to tenth most co-cited literature all involve the impact of

network public opinion on political communication. The eighth most co-cited literature, by S. Iyengar and K. S. Hahn, found that news media can perceive changes in news demand brought about by differences in audience political preferences, and that the diffusion of new media and enhanced media selection helps to further segment news audiences. The tenth most co-cited literature is a study by M. E. Wojcieszak and D. C. Mutz on netizens' political discourse in cyberspace and the impact of network public opinion on cross-domain political communication.

In summary, the above highly co-cited literature has conducted in-depth research from the perspectives of the “antecedents” of public opinion (agenda setting, framing analysis), the formation “process” of mass opinion (spiral of silence, RAS model), and the “consequences” of network public opinion (political participation, government trust), laying a solid research foundation for subsequent studies.

4 Research Hotspots

4.1 Visualization of Research Hotspots

4.1.1 Analysis of Major Topics in Network Public Opinion Research

Using CiteSpace and Carrot2 to cluster and visualize foreign network public opinion literature from 2000 to 2017 (see Figure 6 [Figure 6: see original paper]), the Foam Tree Visualization of network public opinion research has the following characteristics:

[Figure 6: see original paper] Foam Tree Visualization of network public opinion research

First, the topic at the core position is the development of the public, with surrounding related topics including public response, opinion of users, communication and public opinion, news opinions, public health, and attitudes and opinions.

Second, many research topics involve the monitoring, evaluation, and analysis of network public opinion, with sub-topics including survey conducted, focus groups, data show, analysis shows, and investigated the effects.

Third, the topics frequently mention network public opinion and public political participation, with main research clusters including effects of political, influence political, media and political, political discussion, government policy, and increase participation.

Finally, many topics involve the impact and implications of network public opinion, with main research clusters including discuss the implications, findings are discussed, results are discussed, suggest that social, social influence, and reported findings.

Additionally, the author found that the main carriers of foreign network public opinion research are Twitter and Tweets, with main research clusters includ-

ing Twitter discussions, public Tweets, and Tweets collected. Student groups are also important research subjects in foreign network public opinion research, with main research clusters including students' attitudes and students' opinions, particularly focusing on the mutual influence between university students' viewpoints, opinions, and network public opinion.

4.1.2 Keyword Knowledge Map Analysis of Network Public Opinion

Research Table 3 lists the top 40 high-frequency keywords based on word frequency analysis software, which to some extent reflects hotspot topics in network public opinion research. Among them, the word frequency of "public opinion" reaches 205 times, "internet" and "online" reach more than 100 times, and "social media," "media," and "communication" also reach more than 90 times.

Based on keyword co-occurrence analysis, CiteSpace software was used to form a keyword co-occurrence knowledge map in the field of network public opinion research (see Figure 7 [Figure 7: see original paper]). From the overall structure of the map, the more influential nodes correspond one-to-one with the higher-frequency keywords in Table 3. At the same time, combining the research results of highly co-cited authors can reveal hotspot topics in foreign network public opinion research.

After clustering the keyword knowledge map in Figure 7, literature is divided into different clusters. By extracting nominal terms from the titles of citing literature to name the clusters (see Figure 8 [Figure 8: see original paper]), the cluster parameter values are consistent with Figure 3, indicating that the network community structure obtained by this naming method is also significant.

[Figure 7: see original paper] Keyword knowledge map (2000-2017)

[Figure 8: see original paper] Clustering of keyword knowledge map in network public opinion research (TF*IDF)

Based on this, the author combines the analysis results of major topics in network public opinion research and the keyword knowledge map, using Figure 8 as a benchmark while combining the cluster naming in Figure 9 [Figure 9: see original paper] to determine the clusters of network public opinion bias research, and then summarizes three major hotspot research areas in foreign network public opinion research.

[Figure 9: see original paper] Clustering of keyword knowledge map in network public opinion research (LLR)

4.2 Analysis of Visualization Results

4.2.1 Influencing Factors of Network Public Opinion ("Antecedents")

The high-frequency keywords (frequency) for this research theme include internet (126), social media (99), Twitter (53), Facebook (34), mass media (30), social network (29), and framing (14). The involved network clusters include:

Cluster 2 agenda setting, Cluster 3 online community, Cluster 8 open space | attitude, and Cluster 12 new technology. This shows that the development of the Internet has promoted the transformation and development of social media (such as Twitter and Facebook) and mass media, facilitated the online expression of personal opinions, and accelerated the spread of online expression and the formation of network public opinion through the formation of social networks. Important node literature analysis is selected as follows:

- (1) Agenda setting affects network public opinion. J. K. Han, S. Lee, and M. McCombs found that online communities significantly affect the agenda setting of news portal websites. Although they focus on different stakeholders and different attributes of events at the beginning of a crisis, their agendas become increasingly similar over time. Y. J. Son believes that the effects of news agenda setting from different sources are cumulative and have varying degrees and directions of political impact on presidential candidates' voting rankings—that is, agenda setting by different media influences the trend of public opinion.
- (2) News framing affects network public opinion. D. Chong and J. N. Druckman found that news framing affects audience thoughts, attitudes, and behaviors. One-sided news reporting frames create stereotypes, making it easy for audiences to ignore the world “outside the news frame,” thereby affecting public opinion.
- (3) Use of information media affects network public opinion. D. V. Shah et al. found that the rapid development of the Internet has enriched sources of political information and expanded the space for public expression. Whether traditional news sources or online public affairs, the use of information media will promote interpersonal political discussions and online information dissemination, thereby promoting civic participation. The news framing effect of online media largely influences the spread of network public opinion.

4.2.2 Impact of Network Public Opinion on Political Participation (“Consequences”) The high-frequency keywords for this research theme include attitude (67), impact (48), perception (45), democracy (25), political participation (17), and selective exposure (15). The network clusters for this research theme include: Cluster 1 stakeholder | trust in government, and Cluster 10 information | impact analysis. Important node literature analysis is selected as follows:

The interactive influence between organizations and stakeholders occurs simultaneously in both physical space and virtual cyberspace. R. Cropf found that the Internet and related technologies have had an important impact on citizens' online political participation. On the one hand, they create new public spaces for politically oriented dialogue, promoting the formation of network public opinion. On the other hand, inequality in information access and new media lit-

eracy damage representation in the virtual domain. Internet-based technology enables people to discuss issues from all corners of the world, but also accelerates audience segmentation, often making political discourse fragmented.

D. Mutz and P. Martin found that individuals' ability and willingness for selective exposure are key factors determining network public opinion. Compared with interpersonal political discussions, political viewpoints formed through new media are far different, and network public opinion influences the degree of individuals' political viewpoints and political participation.

Network information is a key factor affecting public opinion and citizen behavior. T. Im et al. found that the more time individuals spend on the Internet, the lower their trust in government and the lower their degree of compliance. However, this negative impact of the Internet can be mitigated by citizens' greater use of e-government. In the public policy formulation stage, comments posted by netizens on social media (the "big data" of network public opinion) can be used to obtain meaningful information. A. Ceron and F. Negri found that data on network public opinion on social media can help policymakers rank available policy options according to citizens' preferences, help policymakers monitor citizens' feedback in real-time during policy implementation, and capture the mobilization behavior and processes of stakeholders—that is, network public opinion can effectively promote the formulation and implementation of public policy.

4.2.3 Monitoring and Analysis of Network Public Opinion ("Process")

The high-frequency keywords (frequency) for this research theme include risk (32), sentiment analysis (25), and survey (16). This research theme has not yet formed research clusters, possibly due to the difficulty of network public opinion monitoring and data acquisition. The monitoring and analysis of foreign network public opinion mainly include:

- (1) Monitoring and analysis based on survey data, conducted by V. Luoma-Aho and M. Vos through questionnaires, telephone interviews, and face-to-face interviews. For example, through content analysis, surveys, and interviews, they found that Finnish politicians, power companies, and regulatory agencies are the main participants in discussing nuclear energy issues, but they hardly hear voices from NGOs and citizen groups, while the role of public relations personnel should be to safeguard citizens' discourse rights. M. A. Tarusin and V. V. Fedorov described how Russia conducts residential questionnaires on 1,500 residents over 18 years old every six years to monitor public opinion on the state of Russian society, in order to grasp public opinion in a timely manner and better conduct social governance.
- (2) Monitoring and analysis based on social network analysis methods, which obtain the dynamics of network public opinion evolution by analyzing the network structure and connections among stakeholder subjects. A. W.

Baur found that transparency, participation, and collaboration are the core pillars of open government. To systematically involve citizens and other stakeholders in the process of public policy formulation and public value creation, their expectations, complaints, and public opinion status must be considered. S. Stieglitz and D. Li used social network analysis methods of text mining and sentiment analysis to monitor political discourse in online communities to discover “opinion leaders” or influential users, and to obtain the status of polarized controversial political communication and the influence relationships among various stakeholders, thereby analyzing their political preferences on specific political issues.

- (3) Monitoring and analysis based on network big data. F. Neresini and A. Lorenzet used media such as online news and social media to obtain relevant data for public opinion monitoring. For example, by analyzing the content of Italian media coverage of nuclear power issues from 1992 to 2012 and comparing it with longitudinal public opinion surveys, combined with an innovative method of processing large amounts of text data and using the probability of “risk vocabulary” appearance as a substitute for measuring public opinion risk, they found that by observing how media discuss controversial public issues, the state of public opinion can be inferred, and measures to control public opinion risk can be taken through discourse analysis of media and public discussions on nuclear power issues.

5 Conclusion

Using CiteSpace V software, this paper conducted statistical and visual analysis of 940 documents in the field of network public opinion research from the Web of Science database from 2000 to 2017, analyzing the current state of foreign network public opinion research, excavating its research foundation, and distilling its hotspot topics. The specific analysis results are: The current state of foreign network public opinion research shows that the number of documents in this field has shown a steady upward trend, with research popularity continuing to rise; The research foundation of foreign network public opinion mainly includes the “antecedents” of public opinion (agenda setting, framing analysis), the formation “process” of mass opinion (spiral of silence, RAS model), and the “consequences” of network public opinion (political participation, government trust); The main hotspot topics in foreign network public opinion research include factors influencing network public opinion, the impact of network public opinion on public political participation, and monitoring and analysis of network public opinion. This study has important implications for China’s future network public opinion research and governance practice.

First, one hotspot in foreign network public opinion research is “factors influencing network public opinion,” which examines the impact of agenda setting, news framing, and use of information media on the formation of network public opinion, focusing on media factors’ influence on network public opinion. When conducting network public opinion research in light of China’s special national

conditions, attention needs to be paid to the impact of public psychological and behavioral characteristics (cognitive level, opinion leaders, etc.), local government behavioral characteristics (response, supervision, accountability, etc.), and the status of Internet legislation on network public opinion. In governance practice, given the important influence of agenda setting and news framing on network public opinion formation, government departments should continuously establish and improve media accountability mechanisms, enhance media's sense of social responsibility and policy identification, enable media to participate in network public opinion governance through reasonable agenda setting and news framing, play the role of a bridge between government and the public, and reduce network public opinion bias.

Second, another hotspot in foreign network public opinion research is “the impact of network public opinion on public political participation.” Research finds that network public opinion affects the public's political concepts, government trust, and the formulation and implementation of public policy. Analyzing in depth the influence mechanism of foreign network public opinion on public political participation and governance measures has important reference significance for China to carry out public governance of network public opinion. In governance practice, given the impact of network public opinion on public political participation, government departments should do a good job in top-level design of network public opinion governance, establish and improve mechanisms for public online political participation, achieve effective communication between government and the public, and enhance public trust in government.

Finally, the third hotspot in foreign network public opinion research is “monitoring and analysis of network public opinion,” which mainly uses survey research, social network analysis, and network big data analysis methods to obtain relevant data on network public opinion for analysis and research. The above methods for obtaining network public opinion data have already been used in domestic network public opinion research. Future research should use these methods to deeply excavate panel data on network public opinion and conduct corresponding empirical research on the “influencing factors (antecedents)—monitoring and analysis (process)—political participation (consequences)” of network public opinion, thereby providing empirical evidence for a comprehensive understanding of the formation mechanism of network public opinion and improving government network public opinion governance capabilities. In governance practice, given the complexity and rapid evolution of network public opinion, government departments should, on the basis of existing network public opinion monitoring platforms, build case databases for network public opinion governance for different types of incidents, and simultaneously use advanced data monitoring and processing technologies such as big data and cloud computing to monitor, evaluate, and guide the development of network public opinion in real time, promote rational online political participation by netizens, and improve the governance performance of network public opinion.

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

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