

Study on the spatial characteristics of network public opinion and social governance measures under public health emergencies

——Take Wuhan metropolitan as an example

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Abstract

With the development of economic globalization and social informatization, network public opinion, as a new urban environment, poses new challenges to the global cities in response to the outbreak of infectious diseases such as COVID-19, H1N1, SARS, and puts forward higher requirements for the ability of government departments to deal with public health emergencies. Network public opinion is an important embodiment of public will and the correct guidance and supervision of it will help urban managers to ease public sentiment and reduce social conflicts. Wuhan metropolitan, as a severe disaster area of COVID-19, is a typical network public opinion concentration area. This paper extracts the geographical entity nouns within the scope of Wuhan metropolitan and analyzes the word frequency and emotion, based on the public opinion text data of mainstream social network platforms in China during the six months after the outbreak of the epidemic. The results show that the areas with high word frequency form multiple agglomeration centers along the edge of Wuhan Central City; the spatial distribution of positive and negative orientation of emotion in Wuhan metropolitan is unbalanced, and the difference between cities is significant; the correlation between word frequency and emotional orientation forms five typical regions in space. Based on this, this paper focuses on the areas where the word frequency is high and the emotional orientation is negative. In view of the problems exposed by the government departments in response to public opinion, combined with the similarities and differences of economic, cultural, educational level and other factors in this region, this paper discusses the social governance mode of the hot spots comprehensively and puts forward the countermeasures: (1) linkage with government departments at all levels to build a multi-subjects emergency public opinion warning and response system; (2) improve the government's top-down policy transmission channel, and block the spread of rumors with authoritative information; (3) enlarge the role of public opinion supervision of social organizations appropriately and liberate the discourse hegemony of the government; (4) comply with the development trend of the new media, strengthen the network standardized management; (5) weaken the information asymmetric and establish a new cooperation mechanism between the official departments and non-governmental organizations. The purpose of this study is to provide reference for the social governance of public opinion environment and support the construction of healthy city.

Keywords

Healthy city, public health emergencies, network public opinion, emotional analysis, social governance

1. Introduction

The global epidemic of infectious diseases has been challenging human civilization. In recent years, the global pandemics of infectious diseases such as COVID-19, H1N1 and SARS have brought unpredictable disasters to human beings. In the development of urban civilization, urban infrastructure and medical service facilities are constantly improved, and the ability of human cities to resist epidemic diseases has become stronger. However, it has been proved that the development of science and technology in cities is still not enough to eliminate the crisis caused by epidemic infectious diseases. On the contrary, as a new product brought about by the development of science and technology, the urban Internet environment has become another battlefield for the city to cope with the challenge of epidemic diseases, and has a subtle impact on everyone in the city. The urban Internet environment gathers the demands of all citizens in the city to form network public opinion, which is presented to the urban public in the fastest and most direct way. Good guidance of network public opinion can help urban managers to make the better social governance and deal with the public health emergencies; the bad one will intensify the contradictions between citizens and the government, resulting in negative social impact.

In December 2019, a seafood market located in Hankou railway station in Wuhan city found the case of viral pneumonia, and the virus spread quickly to hundreds of countries and regions around the world in just two months. On January 12, 2020, the World Health Organization named the virus COVID-19 for the first time. As China's national central city and the capital city of Hubei Province, Wuhan has become the disaster areas of the global epidemic, and is the forefront of the global fight against the epidemic. Compared with the quite perfect public health emergencies response facilities, Wuhan and its surrounding cities need to explore the means to deal with the network public opinion. This paper extracts the text data of mainstream social networking platforms and Internet news media in Wuhan metropolitan from December 2019 to July 2020 to analyse the network public opinion, reveals the spatial distribution characteristics of network public opinion and the differences of public opinion sentiment value in Wuhan metropolitan, so as to provide inspirations for the government of big cities to deal with global public health emergencies.

2. Study area and data sources

2.1. Study area

Considering the inextricably relationship between Wuhan and its surrounding cities, the research scope of this paper is not limited to the city centre and seven suburbs within the scope of Wuhan City, also including adjacent areas such as Xiaonan, Hanchuan, Xiantao, Honghu, Jiayu, Xianan, Liangzihu, Daye, Huangshi, Echeng, Huangzhou, Huarong and Tuanfeng, which form the Wuhan metropolitan (Figure 1). As the capital of Hubei Province and the central city of China, Wuhan covers an area of 8467 square kilometers, with

11.081 million permanent residents and 8.8969 million urban residents, with an urbanization rate of 80.29% (in 2018).



Figure 1 Administrative division of Wuhan Metropolitan

2.2. Data sources

The data sources of this paper are as follows:

- (1) Administrative division data of Wuhan metropolitan. The vector data of administrative division of Wuhan metropolitan at county level is provided by relevant departments of Hubei government.
- (2) Network public opinion data. The epidemic rumors and news media information in this paper are from 10751 valid text data collected by Dingxiangyuan from January 21, 2020 to July 14, 2020; the public network comments data is extracted from 100136 valid text contents based on epidemic topics published by users of Sina Weibo, the mainstream network forum platform of China, from December 1, 2019 to July 14, 2020.

3. Methodology

3.1. Spatial distribution of network public opinion: GIS spatial association

In this paper, according to the text data of epidemic, the word frequency and word emotions values of the names which refer to the names of administrative divisions of Wuhan and its surrounding areas are extracted. Then the results are associated with the geographical entities of vector in GIS related software to realize visual analysis of spatial distribution characteristics of network public opinion.

3.2. Distribution characteristics of network public opinion: spatial coupling analysis

According to the result of GIS spatial entity association, spatial correlation analysis was carried out in the study area. Word frequency can reflect the hot issues that people concern about, and word emotions can reflect the public's likes and dislikes of the things. Based on this, the paper selects the word frequency and word emotions values in the network public opinion as factors, and then translates them into the attention and contradiction of geographical entities in Wuhan metropolitan, and conducts bivariate Moran'I analysis and local bivariate Moran'I analysis through GIS related software. Moran'I can be used to judge the spatial correlation of two objects. The value range of Moran'I is $-1 \sim 1$. When Moran'I is negative, it indicates that two objects are negatively correlated in space, otherwise, it is positively correlated. In addition, when Moran'I approaches 0, it indicates that there is no spatial correlation between two objects. For specific calculation method of Moran'I, see formula (1) (2):

$$I(d) = \frac{\sum_{i=1}^n \sum_{j=1}^n (X_i - \bar{X})(X_j - \bar{X})}{S^2 \sum_{i=1}^n \sum_{j=1}^n W_{ij}} \quad (1)$$

$$S^2 = \sum_{i=1}^n (X_i - \bar{X})^2 / n \quad (2)$$

Where: X_i and X_j is the observation value of the area, W_{ij} is the weight matrix of the region.

3.3. Content analysis of network public opinion: text analysis

This paper further analyses the text emotion of the network public opinion in the "hot spot " referring to the result of spatial coupling analysis, reveals the public concerns and social contradictions in the "hot spot ", and puts forward the social governance strategies and suggestions for the city to deal with the network public opinion under the public health emergencies. Text analysis includes two parts: feature word extraction and word emotion:

(1) The text feature words are extracted by an unsupervised classification method, and a total of 6462 entity nouns are obtained.

(2) In this study, the collected news data are analyzed by emotion dictionary method to obtain the expression meaning. Using pre-defined commendatory and derogatory words as "seed words", self-learning combined with text materials, and finally forming an emotion dictionary with emotion values. According to the emotion dictionary, all the emotional scores in the sentences to be analyzed are averaged, and the results are used to judge the emotional tendency of sentences. The SO-PMI algorithm is used in emotion rating, and there are no upper and lower bound constraints on the score results. Therefore, in order to facilitate the statistics, this paper limits the score results to the range of [- 1,1]. The closer the value is to 1, the more favorable the emotion is to praise, and the closer the value to - 1, the more derogatory the emotion contained.

4. Result

4.1. The spatial distribution of network public opinion is unbalanced

(1) The spatial distribution of network public opinion in Wuhan metropolitan has formed the core of high concentration, which shows a downward trend in the periphery of central city. The results(Figure 2) show that: ① the urban central area is a high-value area of network public opinion. Relying on the good urban built-up environment and high population density, it has attracted more attention in public health emergencies. ② the number of online public opinion shows a circular downward trend. The area adjacent to the central area is radiated by the central city, and is concerned by the network public opinion. However, the population and economic development level far away from the central city is lower than that of the central city, which leads to the low emotional attention of the public opinion energy formed through the network.

(2) There are few and stable contradictions in Internet public opinion in Wuhan, while there are many and polarization in other areas adjacent to Wuhan. The results(Figure 3) show that: ① the emotional value of Internet public opinion in big cities is higher than that in surrounding areas. The living standard and education level of residents in big cities are better than those in the surrounding areas. Although more attention has been paid to it, under the guidance of a good social atmosphere, the shield conflict point is actually very small, which reflects that the government of big cities has taken better measures in dealing with public opinion. ② the emotional value of network public opinion is higher in the areas with superior natural environment around big cities. Such as Liangzihu, its good natural environment also helps to create

a healthy social and psychological environment and resolve the conflicts and contradictions of network public opinion. ③ economic strength is directly related to the city's resources and environment, municipal facilities, transportation facilities, basic medical facilities, relief materials and other material environment, and has a direct impact on the emotional aversion of urban residents. For example, Xiانتao is in a weak position in the process of development and competition with other cities in Wuhan metropolitan. The imbalance of development has caused the psychological gap of local residents, so Xiانتao ranks the bottom in terms of emotional score.



Figure 2 The number of network public opinion

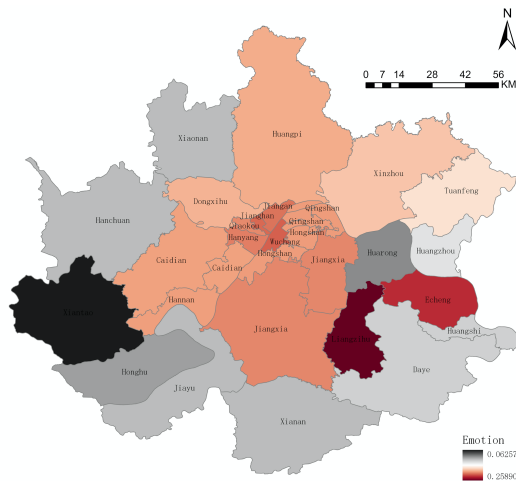


Figure 3 The sentiment of network public opinion

4.2. The coupling relationship of network public opinion is characterized by spatial heterogeneity

(1) There is a spatial correlation between the distribution of emotional value and word frequency. The word frequency distribution and emotional value distribution of Internet public opinion generated by GIS software are reclassified, and the distribution results are analyzed by using two variable Moran index. The Moran index is positive 0.49, indicating that there is a certain correlation between word frequency distribution and emotional value distribution. The popularity of network public opinion will affect the emotional value orientation of public opinion in the region, and there is a good coupling relationship between the two.

(2) The coupling relationship between network public opinion discourse frequency and emotional value distribution shows spatial heterogeneity, which can be divided into five typical regions. In this paper, GIS software is used to generate bivariate local Moran index analysis map. On the premise that the overall spatial correlation is positive, this paper further analyzes the spatial correlation between the word frequency distribution and emotional value distribution of network public opinion in Wuhan metropolitan, and discusses the local spatial relationship between them. Results as shown in Figure 4, five kinds of spatial relationship regions were analyzed. ① high emotional value - high attention area, corresponding to the network public opinion emotional value is better and the social attention is higher. These areas are mainly distributed in the central area of Wuhan, whose urbanization level is high, residents are concentrated and public service facilities are relatively perfect. ② high emotional value - low attention area, corresponding network public opinion is better, but the social attention is lower. These areas are mainly distributed in Echeng. The novel coronavirus pneumonia epidemic prevention command headquarters issued a Notice

No. eighth in February 6, 2020 and fully opened temporary rescue channels for temporary staff members, which became a typical case of actively guiding public opinion on the network. ③ low emotional value - high attention area, the corresponding network public opinion emotional value is poor, but the social attention is high. It mainly includes two categories: the areas with rapid urbanization and the old industrial areas. For example, as a New District of Wuhan, Donghu high tech Zone has accumulated a large number of migrants due to the rapid development of urbanization. However, restrictions on population movements during the outbreak also caused negative emotions among the people in the region. How to correctly guide the emotion of floating population is an important task of the local government; in addition, as the old industrial zone of Wuhan, the Qingshan's government is also facing an important task. In recent years, with

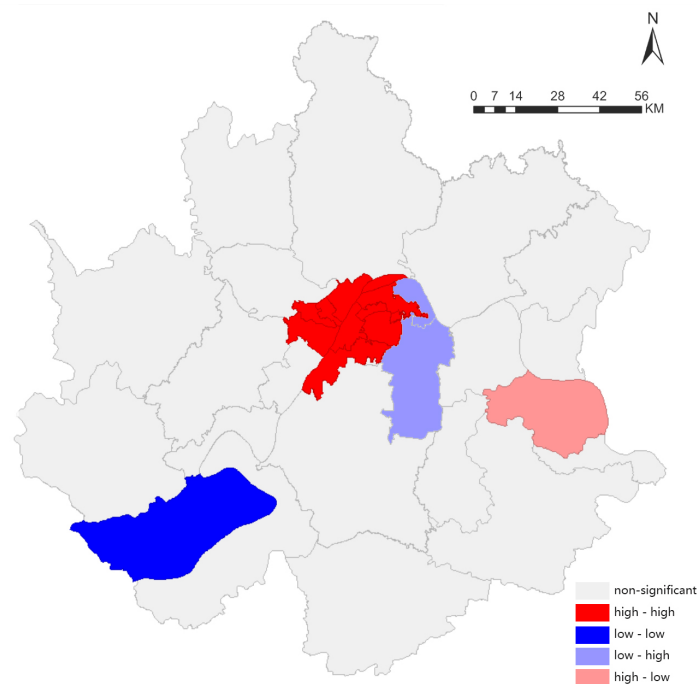


Figure 4 The spatial coupling analysis of network public opinion

the industrial relocation of large cities, most of the old residential areas and staff dormitories are still in this area. In the face of public health emergencies, the closed management mode will highlight the disadvantages of poor infrastructure service quality, which will greatly reduce the residents' satisfaction with life. It is the fundamental way to improve the people's life satisfaction in the old urban areas to actively face the problems and difficulties existing in the environmental transformation of the old city. ④ low emotional value - low attention area, the corresponding network public opinion emotional value is poor, and the social attention is low. These areas are mainly distributed in areas with sparse population and low urbanization rate, such as Honghu in the southwest of Wuhan metropolitan, which has 102 lakes, among which honghu is an important wetland protection area in China.

4.3. Public opinion in hot spots mainly concerns about medical safety, and social relief provided by government departments is an important source of public confidence

Low emotional value - high attention areas are hot spots. On the one hand, due to the unbalanced development of the region and the poor level of economic development, the voice of the masses in hot spots is stronger than that of the ordinary people; on the other hand, due to the dense population and high degree of epidemic damage, the hot spots has been widely concerned by the society. The research results

can be divided into three categories: person name, special name and institution name. The results are shown in Table 1 :

(1) Trust in government organizations is the cornerstone for citizens to form a good network public opinion environment. Positive emotions: ① the government responded to public opinion, sent investigation team to actively respond to social hot events, and guided the healthy development of public opinion. The emotional value of "Li Wenliang" and "Carrie Lam" is the highest, among which "Li Wenliang" is the "Whistler" of the epidemic, whose death has a great impact on public opinion at home and abroad. ② through the formulation of social security and immigration management policies in special period, it can effectively rescue the stranded people and greatly improve the public's confidence in fighting the epidemic. Among the organization names, "Social Security Bureau", "WHO", "Xinhua News Agency", "National Immigration administration" and "Wuhan Red Cross Society" have the highest emotional value. During the epidemic period, due to the full implementation of the isolation control policy, the management of population flow has become an important problem to be solved by urban management departments. ③ traffic problems and necessities are the focus of urban residents. The emotional value of proper terms is "port passenger station", "supply chain", "necessities of life", "preferential policy", "health certificate", "leave Wuhan ", etc. in a specific period, urban managers should ensure the daily life needs of urban residents under the premise of controlling population flow, which is a necessary condition for the normalization of urban social governance during the epidemic period.

(2) Medical safety is the fuse of public opinion crash. ① the frequent coverage of the epidemic situation by public media will lead to negative social emotions. "Jia Jianjing", "Li Jiannan" and "Ni Zihui" have the lowest emotional value. These people are the staff of the news media, who report the spread of the epidemic to the public every day. Long term exposure to this information can cause excessive public panic. ② medical facilities are the main places for the intensification of social public conflicts. The lowest emotional value of institution name is "fever clinic", "infectious disease hospital" and "designated hospital". Sudden public security incidents will make the demand for urban medical facilities surge, and the limited medical equipment and medical staff can not meet the needs of the public, which will intensify social conflicts. ③ the symptoms of an epidemic and the number of deaths can depress urban residents. The lowest emotional value of proper nouns is "causing more than 30 people", "asymptomatic", "1 death", "medical observation", "critical" and "death". Correct medical guidance to the public is an important guarantee for the public to fully understand the epidemic situation.

Table 1 Analysis of subject emotion

Positive emotions (top 40)				Negative emotions (top 40)			
Noun	Emotion	Noun	Emotion	Noun	Emotion	Noun	Emotion
Social Security Bureau	0.506	Xinhua News Agency	0.264	suspected case	-0.312	critical	-0.191
maximum	0.381	Emergency	0.263	Briefing	-0.305	Resident population	-0.191
Port passenger station	0.373	medical apparatus and instruments	0.262	still exist	-0.291	New discoveries	-0.19
human resources	0.367	medical and health work	0.259	To more than 30 people	-0.276	Close contact	-0.183

Li Wenliang	0.333	State Administration of immigration	0.257	Health Committee of Hubei Province	-0.265	Fever clinic	-0.18
Tide over difficulties together	0.332	Control	0.256	Asymptomatic	-0.252	Two	-0.178
Supply chain	0.331	Carrie Lam	0.248	Jia Jianjing	-0.229	suspected case	-0.174
3rd day of the first lunar month	0.328	Protective clothing	0.246	The Johns Hopkins University	-0.228	Entry into GATT	-0.174
World Health Organization	0.311	Public officials	0.244	turn the tide	-0.227	Epidemic report	-0.173
necessaries	0.310	long-term	0.238	National Health Commission	-0.221	Hubei Health Commission	-0.171
favoured policy	0.308	Wuhan Tianhe Airport	0.235	One person died	-0.219	Infectious disease hospital	-0.168
All units	0.308	Further notice	0.228	living environment	-0.216	Mild disease	-0.166
health certificate	0.303	Normalization	0.225	Serious damage	-0.209	sign	-0.165
Federation Working Group	0.300	Huoshen mountain	0.222	Li Jiannan	-0.206	disease	-0.164
Leave Wuhan	0.296	From now on	0.222	assist in an investigation	-0.2	Total number of people	-0.164
Spring Festival holiday	0.285	Isolation area	0.217	Ni Zihui	-0.198	Designated hospital	-0.159
High school attached to the National People's Congress	0.283	Work leading group	0.215	Mirror	-0.196	Hospitalization	-0.157
post	0.279	Wuhan Red Cross Society	0.209	Li Lin	-0.196	Death	-0.154
life safety	0.274	Ministry of Foreign Affairs	0.205	leave hospital	-0.194	Case investigation	-0.153
good health	0.264	Red Cross Society of China	0.205	Medical observation	-0.194	Segregation policy	-0.15

5. Discussion

In the process of epidemic development in hot spots, the government plays an important role in social governance. However, the phenomenon of government discourse hegemony is very significant, and there is a serious information asymmetry phenomenon in the process of communication with the public. In order to effectively respond to the needs of urban residents, predict the next step of public demand when public health emergencies occur, and alleviate the potential safety hazards in the future, the following suggestions are put forward for the region:

(1) Linkage with government departments at all levels to build a multi subjects emergency public opinion warning and response system. In the face of public health emergencies, in addition to traditional functions, government departments need to give new functions in order to better respond to emergencies. Especially in the network public opinion battlefield, the government departments need to actively deal with the adverse situation in the process of the outbreak of the epidemic, explore new governance ideas in time, and take the initiative to make a series of attempts, for example, led by the local government propaganda department, taking television as the main platform, United Press, publishing house and other major network platforms to voice.

(2) Improve the government's top-down policy transmission channel, and block the spread of rumors with authoritative information. Rumors can easily cause secondary injury in public health events. In the process of this epidemic, there were strong rumors, such as: "the mask that can't burn in the middle layer is true", "setting off fireworks can prevent new coronavirus", "body temperature gunshot injury to the eyes, causing permanent injury", "salt water gargling can prevent new coronavirus infection". In addition to a small number of rumors maliciously rumored by some lawless elements, thus disturbing the social order, most rumors are news media in order to attract people's attention and attract traffic. Bad news media often make the citizens make mistakes in fighting against the epidemic through one-sided interpretation of authoritative people's words or exaggeration of the characteristics of research reports. Such rumors greatly waste the positive power of Internet public opinion guidance, sacrifice the credibility of news media and consume public resources. Therefore, in public health emergencies, the government should strictly control the behavior of news media, form a complete accountability mechanism, so that rumors can be traced back to the source, reduce the output of rumors, and reduce the adverse impact on society.

(3) Appropriately enlarge the role of public opinion supervision of social organizations and liberate the discourse hegemony of the government. Wuhan metropolitan has adopted closed management measures and achieved good results. However, in terms of government administration, it has followed the previous one size fits all policy management model, especially in the management system of public places, which has been criticized by the public. This dissatisfaction directly arouses public attention through network public opinion, and indirectly breaks the discourse hegemony of the government, which is a kind of bottom-up discourse power. When the government is faced with the feedback of network public opinion, on the one hand, it should avoid blind blocking, and establish a healthy and efficient bottom-up information transmission channel. On the other hand, the government should not blindly rely on the social network violence to force the government managers to compromise. At the same time, the government should also consider the fairness of vulnerable groups and avoid falling into the trap of false public opinion that "the louder the voice, the more fair and just".

(4) Comply with the development trend of the new media, strengthen the network standardized management. New media is a new technology of network development. It makes citizens free from the bondage of authoritative information and avoid falling into the cage of information. In this trend, everyone is the producer and disseminator of information. City managers need to actively cater for new development concepts and strengthen the management of the Internet, so that the Internet should not become an

external rule, such as actively using WeChat public official account and micro-blog platform and other social platforms to participate in the public's online life.

(5) Weak the information asymmetry and establishment a new cooperation mechanism between the official departments and non government organizations. Information asymmetry is the biggest communication barrier between government administrators and urban residents. In areas where public power is dominant, private power such as social organizations and organizations will shrink infinitely, leading to people's distrust of government authority. Due to the closed nature of community management, the community culture in Wuhan metropolitan is rising again in social governance. In the case that the government has no time to take care of the citizens of the city, the community mutual aid action led by the neighborhood committee has achieved remarkable results in fighting the epidemic. Therefore, the government can appropriately carry out cooperation with social organizations and expand the private rights and discourse rights of non-governmental organizations, which is of great significance for saving public resources and promoting healthy and democratic social governance.

6. Conclusion

In the era of rapid development of emerging technologies such as big data and 5G, the research on the temporal and spatial evolution characteristics of epidemic situation and public opinion characteristics can provide data support for the country to formulate policies and measures to deal with major disasters, which has positive significance, scientific epidemic prevention, effective control of urban diseases and improvement of urban disaster resistance capacity.

This paper takes the Internet public opinion of Wuhan metropolitan in COVID-19 period as the research object, discusses the problems existing in the field of negative public opinion of the government, and puts forward targeted social governance measures to provide countermeasures for the healthy development of Wuhan metropolitan.

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