

Construction and Analysis of Opinion Leader Network in Micro-blog Topic Communication

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Abstract. [Purpose/Significance] The rapid growth of micro-blog users and the popularity of mobile Internet make Micro-blog an increasingly important channel for information dissemination. As a result of shortening the distance between ordinary users and opinion leaders, opinion leaders on the micro-blog platform have become more prominent. Therefore, it is very important to identify opinion leaders in micro-blog and study their role in the process of information dissemination. [Method/Process] This article first identifies opinion leaders through the improved HITS algorithm; Then build opinion leader network to analyze the role of opinion leader in the process of information dissemination; Finally, using emotion recognition technology, the ability of opinion leaders to infect other users is analyzed in depth. [Result/Conclusion] The study found that the role of media users as a source of information was weakened in micro-blog platforms, but that media opinion leaders were involved in topics and information dissemination capabilities were stronger. The authority of users is more related to the quality of information, and many users with fewer fans can also become opinion leaders. In terms of degree distribution, no user can have a high monopoly on authoritative information sources. But the channel of information dissemination is more concentrated, and the channel of communication of a topic is often controlled by a few users. Through emotional recognition analysis of the appeal of opinion leaders, it was found that other users tend to be more inclined to non-negative emotions when forwarding opinion leaders' microblogs. The appeal of opinion leaders is generally strong.

1. Introduction

Opinion leaders generally refer to minorities with strong influence and activity in information dissemination and interpersonal activities. Lazarsfeld, an American scholar of communication, first put forward the concept of opinion leader in his book *People's Choice*^[1]. He pointed out that some audiences would actively accept and redistribute the information and views disseminated by the media, who are called "opinion leaders". It also holds that information is disseminated according to the mode of "media-opinion leaders-audience". As a new social network platform, micro-blog is rapidly developing into a popular Internet product worldwide with its real-time, convenient, interactive and open characteristics. With the rapid growth of micro-blog users and the popularity of mobile Internet, micro-blog has become an increasingly important channel for information dissemination. It's of great practical significance to identify opinion leaders in microblogs and study their role in the process of information dissemination.

The rapid development of social networks such as micro-blog has changed the way people get information and communicate with each other. In the communication of information in social

networks, the role of opinion leaders is more obvious. Considering that the social media attribute of micro-blog is stronger than that of social network, every user is not only the source of information, but also the distributor of information. A growing number of studies have found that opinion leaders have more influence on public issues, word-of-mouth effects, online marketing and other aspects than the media and government in the social network. With the rapid development of micro-blog platform, it's more important to identify opinion leaders in micro-blog. Combining emotional recognition, complex networks and other technologies and knowledge, it is undoubtedly promising to study more intelligent and effective opinion leader recognition algorithm, evaluate the appeal of opinion leaders, and further analyze the actual role of opinion leaders in information dissemination.

2. Related researches

Opinion leaders and information dissemination in microblogging have always been the focus of research at home and abroad, and there is also a strong correlation between these studies. Research on opinion leaders can better understand the reasons for information dissemination, while research on information dissemination may better measure the influence and transit ability of opinion leaders. In recent years, domestic and overseas scholars have mainly studied opinion leaders in two aspects:

1. To identify opinion leaders or measure users influence, and build a series of models and methods for identifying opinion leaders. At present, the most commonly used identification methods are social network structure analysis and index analysis.

An important way to measure the importance of users by using social network structure is "centrality" analysis. PageRank or similar Web structure mining algorithms are usually used in opinion leader recognition algorithms using node centrality. Haveliwala^[2] proposed Topic-sensitive PageRank for PageRank improvement. Its main improvement is to consider the different choice probability of users for different topics, and improve the accuracy of the algorithm, which is very useful for the research of microblog. Xiao Yu and et al^[3] put forward LeaderRank's recognition algorithm based on PageRank and adding sentimental orientation weight. Chen Yuanyuan and Liu Xinyu^[4] used the method of identifying opinion leaders through the centrality and structure hole position of social network. And they also propose a hot topic detection method based on the participation behavior of opinion leaders on micro-blog. Chen Zhixiong, Wang Shihu and Gao Rong^[5] added the sentimental orientation of micro-blog posts into the opinion leader recognition model with taking Sina Micro-blog data as the research object, then a method of opinion leader recognition based on sentimental orientation analysis was proposed. Zhang Jidong and Yang Yang^[6] added the activity factor of mobile social network users on the basis of sentimental orientation, and proposed a user influence measurement model based on interactive behavior and sentimental orientation.

The index analysis method is based on the characteristics of opinion leaders and establishes the corresponding index system for identification. Liu Zhiming et al^[7] constructed a relatively complex index system by using two first-level indicators of user influence and activity, and seven second-level indicators of forwarding, commenting, mentioning, original micro-blog numbers, self-replying behavior, the number of replies to other people's posts and active days. Chen Fen, Chen Peifan et al^[8] put forward a model of online opinion leader recognition which integrates user characteristics and multi-level emotional inclination from five aspects: influence, activity, professionalism, support and communication, which constructed a more comprehensive index system of online opinion leader identification. Wang Jiamin, Wu Peng and et al^[9] proposed to use

an improved analytic hierarchy process (AHP) to determine the weight of indicators from the two dimensions of influence and activity, and combined with the characteristics of microblog dissemination, to build the microblog opinion leader index system. The system can scientifically and effectively identify the opinion leaders of micro-blog in emergencies.

2. Research on the dissemination of micro-blog information. The simplicity and convenience of micro-blog, as well as the unique network structure that allows one-way attention, make the dissemination of information on micro-blog platform very different from that on other platforms.^[10] Yiran Xie et al.^[11] proposed a new model to capture and simulate the information dissemination process in the micro-blog platform, considering the influence of the underlying network structure and other non-local information sources. And the empirical results show that the model has superiority in the task of fitting and forecasting information diffusion. Peng Ye and Chanbo Wang et al.^[12], in order to track the process of micro-blog information dissemination and analyze its characteristics from different perspectives, track Micro-changes and detect abnormal user behavior, an information diffusion function (IDF) model is proposed to analyze the mechanism of microblog forwarding, and display the dynamic process of information dissemination and track user behavior in combination with visualization. Li Feng and Du Timon C^[13] proposed a frame for identifying opinion leaders and maximizing information dissemination through the analysis of existing microblogs. The frame enables companies to identify marketing themes, select keywords, retrieve micro-blog content and blog information, form ontology, estimate and analyze the impact index of bloggers, identify opinion leaders, and maximize the dissemination of information. Pan Jun et al^[14], through analyzing the data and information disseminated by the micro-blog of real group events, it's found that there are periodicity, individual heterogeneity and paroxysmal behavior characteristics among the participants of social group events in their micro-blog speeches. Liao Haihan and et al^[15] took specific public opinion events as an example to explore the hot spots of public opinion and the main points of communication content that different communicators pay attention to in the period of public opinion dissemination on micro-blog, and then find out the characteristics and rules of public opinion dissemination, which provides the basis for public opinion analysis and decision-making. Huang Xianying, Yang Linfeng and Liu Xiaoyang^[16] focused on the dissemination of micro-blog information under the hierarchical opinion leaders, and proposed an OLL hierarchical opinion leader mathematical model to effectively analyze the role of opinion leaders in the dissemination of micro-blog online social network and the life cycle of micro-blog information dissemination.

Classically, the existing research has made some achievements on opinion leaders and information dissemination. However, there is still room for improvement in the construction of user relationship network, the identification method of opinion leaders and the measurement of opinion leaders influence. Therefore, this paper will improve the HITS algorithm to adapt to the identification of opinion leaders in micro-blog platform. And this paper studies the role of opinion leaders in the process of information dissemination by constructing a network of opinion leaders, combining with network structure characteristics, information dissemination and emotional recognition technology.

3. Research design

3.1. Data Acquisition and Data Preprocessing Scheme

In this paper, the topic as a unit to research opinion leaders and information dissemination, and need a large number of micro-text data and user data as samples. Through the API of Sina Micro-blog and the web crawler, a large amount of data can be obtained quickly. Therefore, we use Sina Micro-blog API interface and web crawler to obtain data.

The data acquired from API is highly structured JSON format data, which is more standardized. However, there are many abnormal data from the crawler, including error code and missing data, which need to be excluded separately. In addition, both the data from API and crawler need to be further separated and transformed for subsequent use.

Data cleaning work first needs to separate user data and micro-text data according to field settings, then delete the error code data and missing key fields. It chooses to identify and construct opinion leader network by “forwarding relationship”, but Sina currently doesn’t provide an interface to directly obtain user information on the forwarding path. Therefore, it’s necessary to separate the intermediate users on the forwarding path from the micro-text by programming. Each user may add his own comments when forwarding the tweets of others. And the comment content represents the user's attitude and emotion towards this micro-blog. This paper argues that influential opinion leaders will undoubtedly affect users' attitudes and emotions. Before emotional analysis of users' forwarding content, it’s necessary to separate users' forwarding content. User forwarding involves forwarding time. This paper assumes that the information is propagated uniformly from the original user to the current user, that is, the intermediate user equalizes all the time intervals. The data initialization process is based on the separation of forwarding relationships, including deleting users without fans, updating user weights and so on.

3.2. Identifying Opinion Leaders and Network Construction

According to literature research, there are many characteristics of opinion leaders, and massive identification of opinion leaders is based on some characteristics of opinion leaders, such as a large number of fans, high frequency of microblogging and so on. However, at present, the understanding of the characteristics of opinion leaders isn’t uniform, and the attributes are not independent, but have a certain correlation. Relatively speaking, it is simpler and more intuitive to identify important information sources and intermediaries directly from the process of information dissemination. Important information sources indicate that opinion leaders have certain authority, and important information intermediaries represent the centrality of opinion leaders. Therefore, this paper improves the existing network structure mining algorithm to identify opinion leaders, and then constructs opinion leaders’ network through information dissemination network.

3.2.1. Improved HITS algorithm

In the paper ^[17], we choose “forwarding relationship” as the leading edge, and add forwarding times and user weights to the original HITS algorithm. The improved algorithm is called HITS-BOWR. In this paper, we use the improved HITS algorithm, where N is the number of user fans, R is the forwarding relationship, A is the lead matrix, $a(p)_i$ is the authority value of user p after the first iteration, $h(p)_i$ is the center value of user p after the first iteration, and $w(p, q)$ is the

weight of user q to user p.

The flow chart of HITS-BOWR algorithm is as follows:

Begin

input N, R

Calculate $w(p, q)$

Create A

While $a(p)_i$ and $h(p)_i$ converge do

Calculate $a(p)_i, h(p)_i$

Print result

End

After the calculation, the authoritative value and the central value are sorted in order from large to small, and the users in front can be regarded as the authoritative users or the central users in the topic respectively. They are all the opinion leaders defined in this paper. Among them, authoritative opinion leaders refer to users with high authoritative value, which is characterized by many important out-degrees. Central opinion leaders refer to users with very high central values, which are characterized by their many important in-degrees.

3.2.2. Network Construction Based on UCINET

In the micro-blog information dissemination graph, opinion leaders usually have a large number of edges. Because of the interest, professionalism of the topic itself, or the knowledge in real life, these opinion leaders tend to have some connections with each other, which constitutes a “rich-club”^[18], where it is “Opinion Leaders' Network”. Referring to the steps of extending HITS algorithm from root set to foundation, this paper calculates the ranking of opinion leaders by HITS-BOWR algorithm^[17], and selects the top ten authoritative users and central users as the root node set. Then, the nodes directly related to them are found in the forwarding relation Table, which is extended to the base set, where the direct connection includes the forwarding or forwarding relationships with which all the root set users participate. After the basic set is obtained, the adjacency matrix is regenerated. Because the weight is not considered in the graph, here, the adjacency matrix can be expressed as:

$$L_{pq} = \begin{cases} 1, & \text{User P forwards microblog user q's microblog text} \\ 0, & \text{User P doesn't forward user q's microblog text} \end{cases} \quad (1)$$

By inputting the adjacency matrix into the social network mining software UCINET, a visualized opinion leader network can be obtained.

3.3. Emotional Recognition Design

This paper uses the method based on emotional dictionary to judge the emotional polarity of Micro-blog. On the basis of NTUSD-Simplified Chinese Emotional Polarity Dictionary of Taiwan University^[19], a positive and negative emotion dictionary is constructed by adding micro-blog emoticons^[20]. The emoticons added to the dictionary are those that frequently appear on microblogs and have relatively definite emotional polarity. According to the emotional dictionary constructed, the number of positive and negative emotional words in each micro-blog is recorded. The final positive vocabulary was 2826 and the negative vocabulary was 8291. If the number of positive emotional words is larger than that of negative emotional words, the emotions of

micro-blog are positive; if the number of negative emotional words is larger than that of positive emotional words, the emotions of micro-blog are negative; if the number of positive emotional words equals the number of negative emotional words, the emotions of micro-blog are neutral.

3.4. Analysis of Network Characteristics of Opinion Leaders

The analysis of the characteristics of opinion leaders' network can explain the reasons of information dissemination, and the analysis of emotional infection can further understand the appeal of opinion leaders. This paper will analyze the opinion leader network from three aspects: the characteristics of information dissemination, network structure and emotional infection ability. Generally speaking, the breadth, depth and speed of information dissemination are the main indicators of information dissemination of opinion leaders' network [22]. Combining with literature research, it's found that the research on network structure characteristics has been very mature. This paper will directly use the results of these studies and choose the index of auditing to measure the network characteristics of opinion leaders. On the micro-blog platform, users often bring their subjective feelings when forwarding micro-messages. This paper will use the method of emotional recognition to analyze the emotional change of the topic after the opinion leader, and measure the emotional infection ability of the opinion leader.

4. Empirical analysis

4.1. Data collecting and pre-processing

There are a large number of “zombie powder” or “network navy” users in micro-blog. The value of information released by these users is very low and must be excluded. To reduce this part of the interference, we selected “Helping the Elderly” as the keyword of social topics, using Sina Micro-blog API interface and web crawler to collect data, which spanned 378 days from January 1, 2013 to January 12, 2014. Finally, we collected 71,331 microblog users and 283 1264 microblogs.

There are a lot of wrong data in the data acquired by API interface and network crawler. So the data can be calculated and studied by the algorithm only after pretreatment. Data pre-processing includes data cleaning, microblog user data processing, microblog text data processing and so on.

4.1.1. Micro-blog User Processing

User data processing includes deleting non-fans users, deleting random records and other abnormal data. With the topic “Helping the Elderly” as the Keywords, we randomly get the top 10 user sets of fans. The set of most fans is micro-blog secretary and the least is headline news. The majority of users are authenticated users, including personal authentication and institutional authentication. As a typical social media platform, micro-blog is characterized by a large number of media users' participation. Therefore, this paper doesn't exclude the media in the user special treatment. The user sets are shown in Table 1:

Table 1 Topic “Helping the Elderly” Fans TOP10 (Unit: Millions)

Micro-blog name	Micro-blog Secretary	Li KF	Xie N	He J	Han G	Lee H	Le J	Han H	Yang M	Headline
Number of fans	8.22	5.14	4.38	4.28	4.17	4.11	3.92	3.44	3.07	2.98

4.1.2. Micro-blog Text Processing

Micro-blog text processing includes cleaning, extraction, conversion and loading. It includes separating forwarding relationship, separating forwarding text, initializing and so on. Detailed data are shown as follows:

Table 2 Topic “Helping the Elderly” Text Processing Information

Topic	Forwarding Relationships Numbers	Forwarded Microblogs Numbers	Intermediate Content Numbers	Unique Relation Numbers
Helping the Elderly	69064	29725	35740	30305

1). Separate forwarding relationship

Separating micro-blog user forwarding relationship is a key link in constructing topic propagation network, which includes reading data, substring, matching user ID, inserting records and so on. The topic “Helping the Elderly” has a very high frequency of forwarding every tweet. Considering that each tweet has a maximum of 140 words, and this means that the topic may not add too much content each time it is forwarded.

2). Separate forwarding content

To analyze the emotional appeal of Opinion Leadership Network, this paper needs to separate the text content of each user who forwards the microblog. Because of the mechanism of Sina Micro-blog, it's impossible to get the forwarding time of the intermediate micro-text directly when separating the content of the intermediate micro-text forwarding. When considering the forwarding time, the paper divides the time interval between the original micro-blog and the current micro-blog equally. The number of separated forwarding content (i.e. the number of intermediate content) is much smaller than that of forwarding relationship, because only one user is involved in the content, while two users are involved in the relationship.

3). Initialize

The purpose of initializing data is to generate adjacency matrix. In the database, the adjacency matrix is stored in the form of triples. The number of unique relationships is less than the number of intermediate contents, because in the process of initialization, the initialization algorithm updates the weight of the relationship to ensure the uniqueness of the forwarding relationship.

4.2. Micro-blog Data Statistics

4.2.1. Topic User Degree and Degree Distribution

Generally speaking, web pages and social networks belong to scale-free network.^[10] The main feature of scale-free network is that the degree distribution of nodes in networks is a power law distribution. The number of users' attention in the micro-blog platform is also a kind of degree, which has been proved to obey power law distribution in some literatures on the relationship of micro-blog attention. This paper studies the forwarding relationship of microblog, in which the number of users being forwarded can be considered as another out-degree. The topic “Helping the Elderly” appears as follows:

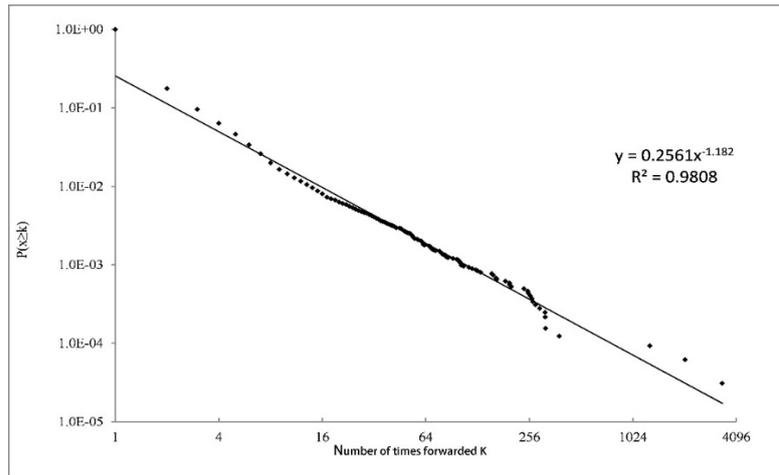


Figure 1 Degree Distribution of Forwarding Number of Topic “Helping the Elderly”

As can be seen from the figure above, the number of forwards of the topic “Helping the Elderly” is the closest to the standard power law distribution. The power exponent γ of the degree distribution is 1.182. User forwarding network is also a scale-free network. The general power law index $2 < \gamma < 3$ [23]. It shows that even if the forwarding network is sparse matrix, there are many nodes with large number of forwarded nodes in the network, and there is no dominant authoritative user. And this can preliminarily explain that it is very difficult for one or a few users to monopolize the voice rights on the micro-blog platform.

4.2.2. Topic microtext statistics

The degree of attention, the trend of times' change and the number of original microblogs are different for each topic. According to the previous research [24], user authentication and original micro-blog situation have a more important descriptive role in topic dissemination. In this paper, the statistics of various indicators on the topic of “Helping the elderly” are as follows:

Table 3 Micro-text statistics on the topic of “Helping the Elderly”

Topic	Total search results numbers	micro-blogs collected numbers	user numbers	micro-blogs forwarded numbers	original micro-blogs numbers	original user numbers
Helping the Elderly	2831264	78317	71331	29725	52848	45636

Topic “Helping the Elderly” is relatively high in authentication including authenticated user numbers and institutional authentication numbers, and also in original including original user numbers and original microblogs numbers(OMN), which shows that micro-blog users prefer to express their views on social and livelihood issues, and the stronger the entertainment, the higher the topic forwarding rate.

Driven by different factors, the degree of attention on Micro-blog is also different. The topic of “helping the elderly” changes with time as shown in the figure.

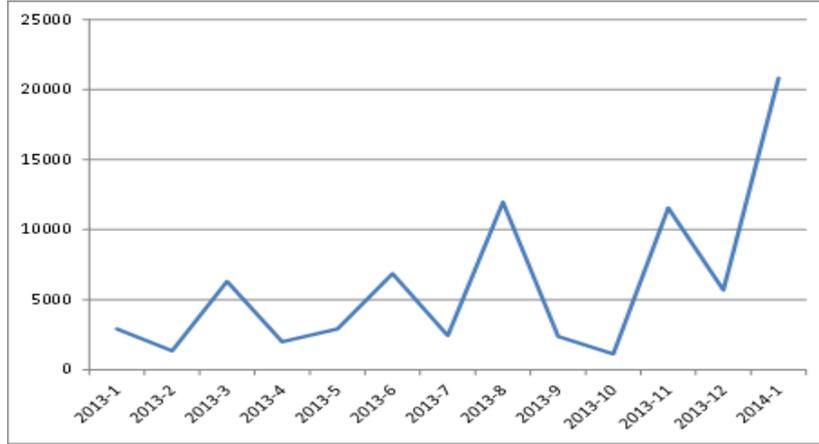


Figure 2 Time Trend Graph of Topic “Helping the Elderly”

“Helping the elderly” is a hot topic in recent years. From time to time, there are news reports on Micro-blog that some people are blackmailed by the elderly for helping the elderly, which leads to widespread discussion. The topic “Helping the Elderly” has been concerned for a relatively even and lasting time, which shows that “Helping the Elderly” is an event-driven topic.

4.3. Micro-text Emotion Recognition

This paper uses the method based on emotional dictionary to judge the emotional polarity of micro-blog text. Through sampling, the results of emotion and micro-text recognition are as follows:

Table 4 Effect of Micro-text Emotion Recognition(Unit:%)

Topic	Positive			Negative			Neutral		
	Recal l	Precisio n	F	Recal l	Precisio n	F	recal l	Precisio n	F
Helping the Elderly	73.68	53.85	62.22	75.41	83.64	79.31	45.00	47.37	46.15

Table 5 Topic Micro-text Recognition Results

Topic	Positive	Proportion	Negative	Proportion	Neutral	Proportion
Helping the Elderly	21081	24.99%	36126	42.83%	27138	32.17%

It can be seen that the recall rate, precision and F value of negative emotion recognition are more than 60%, and the proportion of negative emotion is 42.83%. This shows that the algorithm has better recognition effect on negative emotion in general, while the neutral recognition effect is the worst. This may be because more negative words can identify more negative emotions.

4.4. Identifying Opinion Leaders

HITS algorithm is convergent, and the improved HITS-BORW algorithm^[17] is still convergent. Because of the particularity of Micro-blog, a large number of traditional medias have become micro-blog users, and this part of users has not been excluded in the paper. However, media users have some characteristics different from ordinary users. In this article, opinion leaders belonging to the media are called media opinion leaders.

Table 6 Topic “Helping the Elderly” Opinion Leaders

Rank	Authoritative Value Top 10				Central Value Top 10			
	User Name	Fans Numbers	Auth Type	Central Value	User Name	Fans Numbers	Auth Type	Central Value
1	Sina New Observation	7751	e	0.87	Headline News	29855059	e	0.86
2	Sina Video	6704682	e	0.26	Sina Video	6704682	e	0.49
3	Sina News Video	6486140	e	0.25	Hot News Videos	3572915	0	0.1
4	Peace DC	1208	e	0.21	Lawyer Yuan	4073330	p	0.04
5	Sina Pictures	966560	e	0.13	Mi RR	189328	p	0.04
6	Sina Review	572191	e	0.1	Ren ZQ	18584154	p	0.02
7	Hot News Videos	3572915	0	0.1	People's Daily	16043030	e	0.01
8	Headline	29855059	e	0.08	Luo YH	5657376	p	0.01
9	Legal Evening	3130421	e	0.07	Li KF	51499902	p	0.01
10	Sina Hunan	475306	e	0.0732	Wang Y	1162792	p	0.01

In terms of the authoritative value of the topic “Helping the Elderly”, the top ten are all institutional certification opinion leaders, and the types are all media opinion leaders. Even the eighth “hot news video” is a news distribution user. For central users, there are many individual authenticated users. In this topic, the role of opinion leaders goes back to Lazarsfield's traditional opinion leader model.

4.5. Construction of Opinion Leader Network

In the process of information dissemination, opinion leaders tend to establish contact with each other and form a network of opinion leaders. According to the design of network construction based on UCINET in the previous section, a network of opinion leaders on the topic of “helping the elderly” is constructed, as shown in the figure.

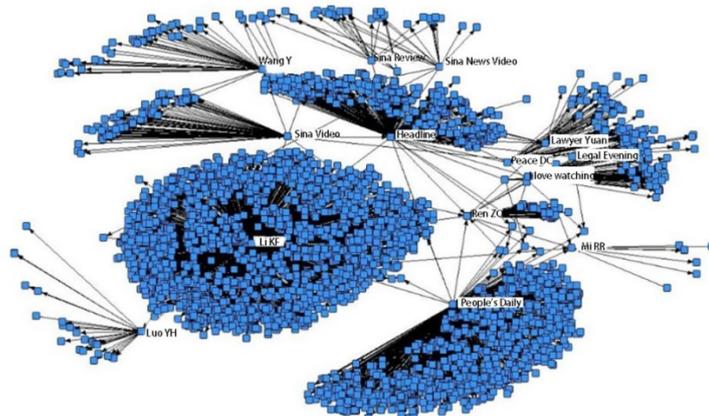


Figure 3 Topic “Helping the Elderly” Opinion Leaders Network

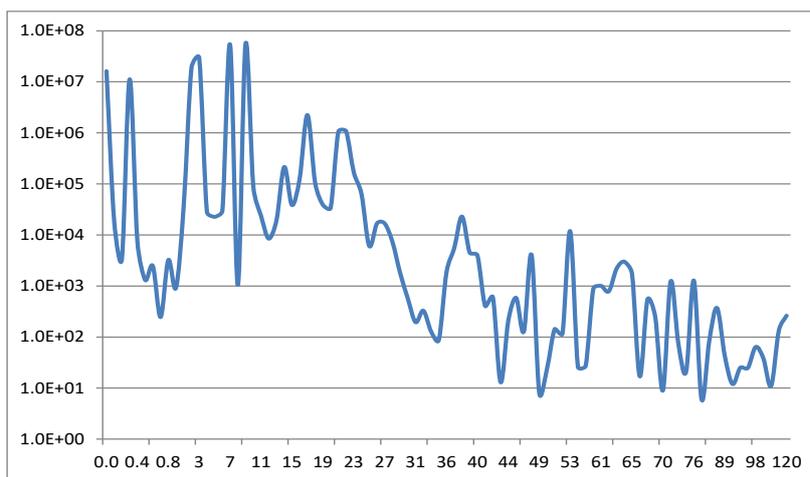


Figure 5 The spread of micro-blog ID “3613086533764601” (“Helping the Elderly”)

The role of media opinion leaders in information dissemination is very significant in the topic of “helping the elderly”. The microblog ID “3613086533764601” on this topic has been disseminated 3034 times. It attracted over ten million “Big V” fans, such as “Li KF” and “Ren ZQ”, and there was also sufficient exchange among opinion leaders. The microblog has reached the coverage of millions of people many times in 24 hours.

2. Emotional Infection Ability

The strong dissemination ability of opinion leaders does not mean that they have strong influence or appeal, which is mainly determined by the emotional attitude of their forwarders. If a disseminator of an opinion leader mainly holds negative views, it indicates that the influence of the opinion leader is negative.

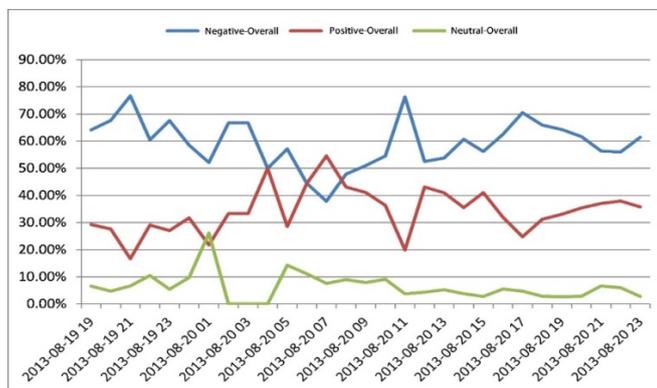


Figure 6 Topic “Helping the Elderly” Overall Emotional Recognition

In the topic “Helping the elderly”, although the overall negative emotions are still the majority, but in this microblog, because of the influence of users such as “Kaifu Lee”, positive emotions are the majority and have an upward trend. The topic is a multipolar network, and there is a close connection between opinion leaders. Opinion leaders have strong emotional contagion ability, and the role of opinion leaders is very obvious.

5. Conclusion

Based on Sina Micro-blog platform, this paper studies the identification and analysis of opinion leaders. Through the improved HITS-BOWR algorithm^[17] to identify opinion leaders, and build a network of opinion leaders, and then analyze the role of opinion leaders in the process of information dissemination. Then, through the analysis of the characteristics of information dissemination and emotional recognition, the dissemination ability and emotional appeal of opinion

leaders are analyzed in detail.

It is found that in the micro-blog platform, the role of media users as information sources is weakened, which is the inevitable result of the development of micro-blog self-media. The authority of users is more related to the quality of information, and many users with fewer fans can also become opinion leaders. In terms of degree distribution, there is no user who can monopolize authoritative information sources. But the channel of information dissemination is more centralized, and the channel of a topic is often controlled by a few users. Deliberately truncating a few nodes can interrupt the information transmission of the whole network. Different opinion leaders' networks have different network characteristics. In the minority topics, the interaction between opinion leaders is closer, the whole network of opinion leaders is more robust, and information dissemination is smoother. In addition, with the participation of media opinion leaders, the ability of information dissemination is stronger. At the same time, through the analysis of the appeal of opinion leaders through emotional recognition, it is found that other users tend to be more non-negative emotions when forwarding opinion leaders' microblogs, and the appeal of opinion leaders is generally stronger.

In the process of research, this paper only focuses on the topic "Helping the Elderly" opinion leader network and its characteristics analysis. The data is insufficient and can be compared with other topics in the future. Although HITS-BOWR algorithm can identify opinion leaders very well, its time complexity is too high to meet the requirements of large-scale computing. In the future, it can be optimized to improve the efficiency of the algorithm. The method of affective recognition is affective dictionary. Although the method of affective dictionary is simple and easy to operate, its accuracy has room for improvement. In the future, machine learning can be used to improve the accuracy of emotional recognition and to analyze the appeal of opinion leaders more accurately.

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