Revista Argentina de Clínica Psicológica
2020, Vol. XXIX, N°5, 265 - 271
DOI: 10.24205/03276716.2020.1028

Research on the evolution and trend prediction of Internet users' psychological emotion under the network public opinion

Yang Bin[1,2*]

Abstract

Traditional methods of predicting the evolution trend of user psychology and emotions cannot give a quantitative relationship between the online public opinion and the changes in user psychology. The prediction results have greater uncertainty and the prediction time is long. Aiming at the above problems, study the psychology of Internet users in the online public opinion. Emotional evolution trend prediction method. On the basis of analyzing the evolution characteristics of users' psychological emotion under the network public opinion, the evolution model of users' psychological emotion under the background of public opinion is established. According to the established model, the evolution trend of users' psychological emotions can be predicted by means of quantitative and qualitative analysis. Analysis and comparison of experimental results show that the prediction accuracy of the proposed prediction method is significantly higher than that of the existing methods, the prediction results are more reliable, and the prediction time is shorter, which has the advantages of accuracy and speed.

Keywords: Internet public opinion; Internet users; user psychology; emotional evolution; trend prediction

1. Introduction

With the development and popularization of mass media, the Internet has become an important platform for network users to obtain information, express opinions and exchange views. The development of mobile terminals has changed the way people communicate, enabling network users to receive and respond to network information anytime and anywhere [1,2]. Due to the rapidity, virtuality and divergence of the Internet, it is easy for any network topic to form online public opinions on a large or small scale. Different netizen emotions influence each other in the process of public opinion communication, and user emotions are amplified in the network and directly react on the physical society [3]. However, accurately grasping the evolutionary mechanism of netizen emotions and predicting their evolutionary trend is an important content of network public opinion governance in the context of big data. At the same time, the anonymity and randomness of users' interaction with the Internet, the heterogeneity and subjectivity of users' psychology, and the nonlinear effect between online public opinions and the real society make the evolution environment of users' psychological emotions more complex and more uncertain [4].

Xiong Xi et al. proposed a social network sentiment propagation analysis and prediction model based on temporal and spatial characteristics. The model includes three behavior sub-layers. The topological structure of each layer is different, which is determined by the interaction history of the behavior. The simulation analysis of the model on real data can obtain the process and law of emotion transmission in social networks. The experimental results show that the model has a good predictive effect on the spread of emotions in social networks, but because it needs to be carried out in layers, it will

1. WenZheng College of Soochow University, Suzhou, 215104, China
2. School of Education, Soochow University, Suzhou, 215123, China
*Correspondence Email: yb5863@163.com

consume more prediction time [5]. Sun Yueheng et al. proposed an event-driven online social group evolution behavior prediction method. Based on complex network theory, this method builds a social group behavior pattern analysis framework that integrates multi-dimensional features, mines the network's dynamic evolution mode of community groups, and compares and analyzes event-driven social groups To predict the evolution of community behavior. The experimental results show that the prediction model has strong robustness, especially for the evolving behavior of online social groups driven by emergencies, but this method has the problem of low prediction accuracy [6]. The traditional prediction model of the evolution trend of users' psychological emotions is not enough to accurately predict the evolution process of Internet users' psychological emotions, and it is difficult to understand and explain the phenomenon in the change process of users' psychological feelings under the background of online public opinions.

Therefore, on the basis of the above analysis, this paper combines cross-disciplinary research methods and means to study the evolution of Internet users' psychological mood and trend prediction method under the network public opinion, so as to provide a powerful tool for the supervision of Internet public opinion.

2. Research on the evolution and trend prediction of Internet users' psychological emotion under the network public opinion

2.1 Evolution characteristics of users' psychological emotion

Before making predictions, first use the principles of cognitive psychology to study the evolution characteristics of Internet users' psychological emotions. In the process of public opinion processing, individual users' information processing process successively includes understanding stage, knowledge acquisition stage and consciousness distribution stage. Social events are mapped in the network, and users will make preliminary judgments based on their own characteristics and experiences. Events that damage their own interests will arouse users' dissatisfaction and lead to anger or sadness, while events that benefit users will be satisfied, resulting in joyful emotions [7].

From the three levels of time, space and self processing, calculate the emotional impetus generated by the event. To calculate in time the temporal continuity of current events, whether temporary or permanent; Spatially calculate whether the impact of the event is isolated or widespread; Calculate on the self that the events facing you are not under your control. If the calculated user thinks that the influence of an event is long-term, extensive and uncontrollable, then the event has a great driving force on the user's emotion, and the user's emotion will fluctuate greatly [8].

The structural characteristics of Internet users determine the overall emotional characteristics of Internet users. The emotional state of Internet users is diversified and the ratio of negative and negative emotions is significant. The personal information of users can reflect the status of users in the virtual social network. Usually the authenticated user information is real and has high credibility. The number of users' followers and Weibo numbers can implicitly reflect the user's activity level, while the place of birth, birthday and education level of users can implicitly reflect the user's personality. Generally speaking, age and regional differences can subtly influence the user's reaction to things.

The classification of Internet users' emotions is the focus of the study on the characteristics of Internet users' emotions. The Internet users' emotions are divided into positive, neutral and negative emotions by emotion classification method, and the real-time monitoring network public opinion data are divided into positive, neutral and negative categories according to the Internet users' emotions. For netizens with positive emotions, negative emotions and neutral emotions, the number change rule of netizens with different emotions is the key to study the evolutionary mechanism of netizens' emotions. When a network public opinion, with the increase of three kinds of emotional Internet users, the network public opinion information also sharply increase, but in the cyber space can accommodate such public opinion information there is a cap, so the netizen emotions evolution is the essence of the three kinds of emotional netizens competition limited network space information resources, namely Internet users the main characteristic of three kinds of emotions, to compete against each other. According to the research on the evolution characteristics of users' psychological emotion, the evolution model of users' psychological emotion under the background of public opinion is established.

2.2 Establish the evolution model of user's

psychological emotion under the public opinion background

According to the analysis results of the evolution characteristics of users' psychological emotions, suppose that at a certain moment, the number of Internet users with positive, negative and neutral emotions is $x_1(t)$, $x_2(t)$ and $x_3(t)$ respectively. In the limited information resources of network space, the growth rates of the number of emotional users are r_1, r_2 and r_3 respectively. The upper limit of the growth of the number of users with the three emotions is K_1, K_2 and K_3 respectively, and the sum of the upper limit of the growth of the number of users with the three emotions is equal to the total amount of information resources in cyberspace. When there is only one emotion category of Internet users in the network information resource space, the relationship between the variation of the number of Internet users with a single emotion and the quantity base and the remaining network information resource space satisfies the following formula:

$$\begin{cases} \dfrac{dx_i(t)}{dt} = r_i x_i(t)\left(1-\dfrac{x_i(t)}{K_i}\right), i=1,2,3 \\ x_i(0) = x_{i0} \end{cases} \quad (1)$$

In formula (1), x_i is the number base of Internet users; $\left(1-\dfrac{x_i}{K_i}\right)$ is the remaining network information resource space. After the occurrence of online public opinions, three types of Internet users, namely, netizens with positive emotions, netizens with negative emotions and netizens with neutral emotions, coexist in the cyberspace. Therefore, it is necessary to expand the competition model of single-type emotional netizens to study the competition model of the three coexisting [9]. In order to describe in detail the degree of mutual influence and competition among different categories of emotional netizens, the competition mode of this paper is formulated as shown in the Figure 1.

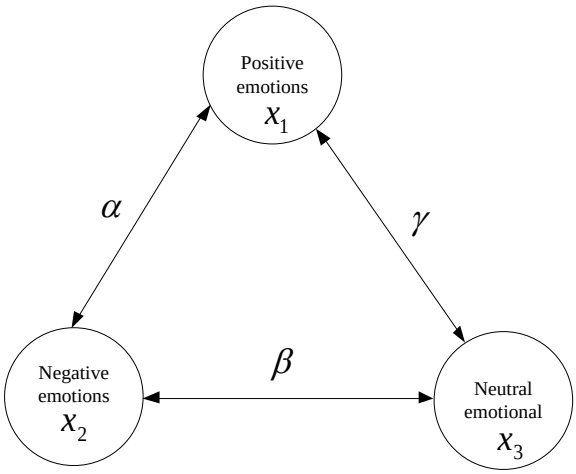

Figure 1 Competition patterns of different categories of emotional netizens

In the Figure 1, α, β and γ are the competitive coefficients of netizens with different emotions. Due to the competitive role of netizens with positive emotions, neutral emotions and negative emotions, the "surplus" space of the number of netizens with positive emotions changes, and the evolutionary mechanism model of the three emotions of netizens under online public opinions is obtained:

$$\begin{cases} \dfrac{dx_1}{dt} = r_1 x_1\left(1-\dfrac{x_1}{K_1}-\alpha\dfrac{x_2}{K_2}-\gamma\dfrac{x_3}{K_3}\right) \\ \dfrac{dx_2}{dt} = r_2 x_2\left(1-\alpha\dfrac{x_1}{K_1}-\dfrac{x_2}{K_2}-\beta\dfrac{x_3}{K_3}\right) \\ \dfrac{dx_3}{dt} = r_3 x_3\left(1-\gamma\dfrac{x_1}{K_1}-\beta\dfrac{x_2}{K_2}-\dfrac{x_3}{K_3}\right) \end{cases} \quad (2)$$

In formula (2), x_1 is the number of netizens with positive emotions; x_2 is the number of netizens with

negative emotions; x_3 is the number of netizens with neutral emotions. After establishing the evolution model of user's psychological emotion under the background of public opinion, the evolution trend of user's psychological evolution is predicted according to the influence of network public opinion on user's psychology.

2.3 Prediction of the evolution trend of user psychology

The prediction of the evolution trend of Internet users' emotions under the network public opinion can be divided into qualitative prediction and quantitative prediction. The evolution model of user's psychological emotion under the background of public opinion established above is taken as the prediction basis, the model is converted into difference form, and the prediction of user's psychological evolution trend is completed by calculating the non-zero equilibrium point of the model.

In the qualitative prediction of user psychological evolution trend, according to the data information of historical public opinion case base, cluster analysis is carried out through public opinion event attributes, and then the corresponding parameters of the evolution model of netizens' emotions in each category are calculated [10]. K-means clustering algorithm is used to cluster text vectors. Select K centroid randomly from the text vector, assign each point to the nearest centroid according to the distance index, and form K clusters to recalculate the centroid of each cluster. The center of mass no longer changes, ending the clustering algorithm. Cosine distance is selected to represent the distance between text vectors. The calculation formula of cosine distance, namely cosine similarity, is as follows:

$$\begin{cases} \cos(x,y)=\dfrac{x\bullet y}{\|x\|\|y\|} \\ x\bullet y=\sum_{k=1}^{n}x_k y_k \\ \|x\|=\sqrt{\sum_{k=1}^{n}x_k{}^2} \\ \|y\|=\sqrt{\sum_{k=1}^{n}y_k{}^2} \end{cases} \quad (3)$$

In formula (3), x and y represent two document vectors. $\|x\|$ and $\|y\|$ respectively represent the length of text vectors x and y. Cosine similarity is actually a measure of the Angle between two text vectors x and y. If cosine similarity is 1, the Angle between x and y is 0°, and x and y are the same except for the length. If cosine similarity is 0, the Angle between x and y is 90°, indicating that they do not contain any of the same words. After the occurrence of a certain public opinion event, the attribution is determined through discriminant analysis, and then such corresponding parameters are applied to predict the evolution trend of netizens' emotions in the initial stage of public opinion communication.

When the evolution trend of user psychology is quantitatively predicted, the evolution mechanism model of netizen emotion shown in formula (2) is transformed into its corresponding difference equations. In the public sentiment monitoring data collected by relevant departments, the number of netizens with corresponding emotions can be obtained. The regression coefficient can be obtained by using the quaternion linear regression analysis, so as to obtain all the parameters of the netizen emotion evolution mechanism model. The model with known parameters can predict the psychological and emotional evolution trend of Internet users.

Through the above steps, the research on the evolution of Internet users' psychological mood and the trend prediction method under the network public opinion is completed。

3. Experimental research and analysis

The prediction of the evolution trend of users' psychological emotions is conducive to the early-warning processing of user information on relevant platforms. This section will test the effectiveness and reliability of the prediction method of the evolution trend of Internet users' psychological emotions under the network public opinions studied above.

3.1 Experiment content

In order to ensure the authenticity and validity of the experimental results, this experiment adopts the form of comparative experiment. The method for predicting the evolution trend of Internet users' psychological emotion under the Internet public opinion studied in this paper is used as the experimental group, and the analysis and prediction model of social network sentiment propagation based on temporal and spatial characteristics (Method 1) and the event-driven online social group

evolution behavior prediction Method (Method 2) are as the comparison group. Choose the prediction accuracy of the prediction method, the recall rate of the prediction method, and the prediction time as the comparison indicators of the experiment, and compare the reliability of different prediction methods. Analyze the experimental data and draw the conclusion of this experiment.

3.2 Experimental process

Use Internet crawler tools to collect user data of Weibo, including post content, user information, user emotional tendency and other information. The user information crawled by Internet crawlers was taken as the experimental data set for the prediction of the experimental group and the comparison group, and 30% of the data set was selected as the training sample of the different groups of psychological and emotional evolution trend prediction methods. The remaining 70% data were predicted, and the real data crawled was taken as the standard data for experimental prediction. The experimental group and the contrast group were respectively used to predict the evolution trend of users' psychological emotions. The prediction accuracy of the prediction method is the ratio between the correct predicted data and the real total data. Recall rate is the proportion of correct data in the predicted results. Then use MATLAB software to process the experimental data, analyze the data and evaluate the performance of different prediction methods.

3.3 Experimental results and analysis

The prediction accuracy comparison data of different methods in predicting the evolution trend of Internet users' psychological emotions is shown in Table 1 below. The data in the table is analyzed and the ROC curves of the two prediction methods are drawn.

Table 1 Comparison of prediction accuracy of user psychological and emotional evolution trend

Scene number	Method		
	The method of this paper	Method 1	Method 2
1	0.88	0.78	0.70
2	0.85	0.72	0.63
3	0.83	0.68	0.60
4	0.82	0.65	0.56
5	0.82	0.66	0.51
6	0.79	0.57	0.47
7	0.78	0.52	0.41
8	0.77	0.51	0.38
9	0.77	0.44	0.32
10	0.75	0.40	0.29

Analysis of the data in Table 1 above shows that the prediction accuracy of the experimental group's prediction methods is higher than that of the comparison group's methods. The scene of this experiment is numbered according to the complexity of the scene. With the increase of the complexity of the experimental scene, the prediction accuracy of different prediction methods decreases continuously, but the prediction accuracy of the experimental group method decreases more slowly than that of the comparison group method. In this experiment, the average prediction accuracy of the experimental group method is 80.6%, which is much higher than that of the control group method. The above analysis shows that the experimental group prediction method is more accurate and effective in predicting the evolution trend of users' psychological emotions.

Figure 2 shows the ROC curve comparison results of different prediction methods.

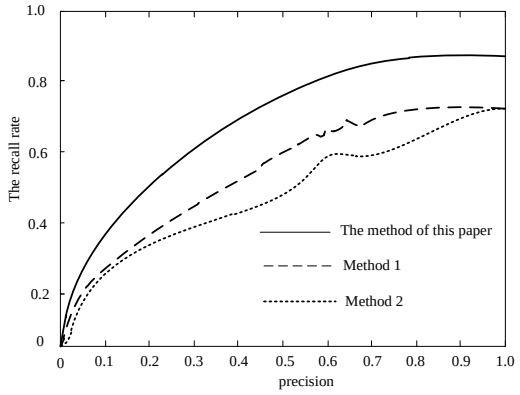

Figure 2 ROC curve of prediction method

According to the analysis of the curve in Figure 2 above, the area of the closed figure enclosed by the ROC curve and the two coordinate axes of the prediction method in the experimental group is larger than the area enclosed by the ROC curve and the coordinate axis of the method 1 and method 2 of the comparison group. The ROC curve of the experimental group is smooth and has no over fitting phenomenon. According to the definition of ROC curve, it can be judged that the prediction reliability of the experimental group method is higher than that of the contrast group method.

In order to further verify the effectiveness of the proposed method, the prediction time is taken as the experimental index to compare the prediction effect of different methods. The results are shown in Figure 3.

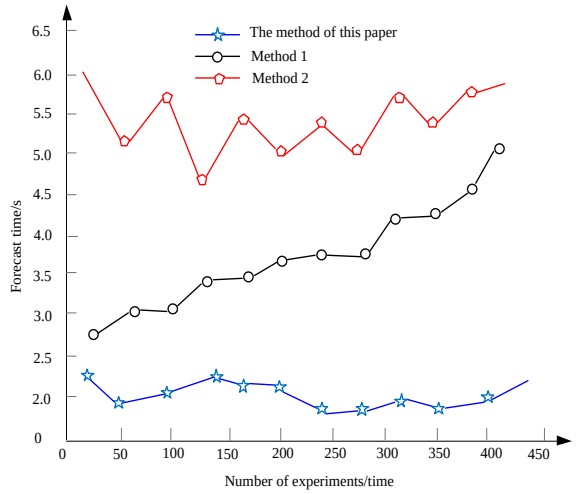

Figure 3 Comparison of prediction time of different methods

It can be seen from Figure 3 that when using this method to predict the evolution trend of Internet users' psychological emotions, the prediction time is always less than 2.5s, which is significantly lower than that of methods 1 and 2. The time gap between the method and the existing methods, especially method 2, is very obvious. It shows that the prediction efficiency of this method is higher, and it can accurately predict the user's emotional evolution trend in a shorter time.

In conclusion, the prediction method of Internet users' psychological emotion evolution trend under the network public opinion has high prediction accuracy, strong reliability, and high prediction efficiency, which can be applied in practice.

4. Conclusion

With the increasing number of Internet users, the study of users' psychological mood is very important for the monitoring of Internet public opinion. By studying the evolution characteristics of Internet users' emotions and aiming at the limitations of traditional emotion evolution trend prediction methods, this paper studies the evolution trend prediction method of Internet users' psychological emotions under the network public opinions. The experimental results show that the proposed method has the advantages of high accuracy and short time consumption, and can be applied to the actual prediction. In future studies, it is still necessary to further study the relationship between users' psychological emotions and the specific content and emotional tendency of online public opinions, as well as the extent to which online public opinions influence the evolution of users' emotions, so as to improve the accuracy and reliability of the prediction method.

Reference

[1] LI Wanlian, GAO Guanghan. An Analysis of the Research Progress and Trends of Emergency Network Public Opinion [J]. Journal of Chongqing University of Posts and Telecommunications (Social Science Edition),2019,31(05):60-68.

[2] ZHANG Ying, WANG Chao, GUO Wenya, et al. Multi-Source Emotion Tagging for Online News Comments Using Bi-Directional Hierarchical Semantic Representation Model [J]. Journal of Computer Research and Development, 2018, 055(005):933-944.

[3] XU Hao, TAN Deqing, ZHANG Jingqin, et al. Evolutionary Game Analysison Herding Behavior of Non-direct Stakeholders in Mass Emergencies [J]. Management Review,2019,31(05):254-266.

[4] YAO Cuiyou, CUI Yaqun. Simulation Research on Micro-blog Public Opinion Evolution Based on User Attributes [J]. Computer Simulation,2019,36(03):307-311.

[5] XIONG Xi, QIAO Shaojie, WU Tao, et al. Spatio-temporal Feature Based Emotional Contagion Analysis and Prediction Model for Online Social Networks[J]. Acta Automatica Sinica, 2018, 044(012):2290-2299.

[6] SUN Yueheng, LIU Xiaotong, WANG Wenjun, et al. Predicting the Event-driven Evolution Behavior of Online Social Groups[J]. Journal of Intelligence, 2019, 038(006):110-117.

[7] TIAN He，ZHAO Hai，WANG Jinfa, et al. Timing evolution and prediction of Internet transmission behavior [J]. Journal on Communications,2018,39(06):116-126.
[8] HE Jianjia, LIU Jusheng, WANG Xiangbing. Research on the Evolution Pattern and Countermeasures of Internet Public Opinion From the Perspective of Cognitive Disorder [J]. Modern Information,2018,38(03):58-65+78.
[9] QIN Feng, CHEN Zeng, ZHENG Xiao, et al. User Behavior Prediction Based on Emotion and Interest [J]. Computer Systems & Applications,2018,27(01):28-34.
[10] WU Lihua, WANG Zhaojun, CHI Qinghua, et al. Opportunistic link prediction based on user behavior in mobile Internet [J]. Engineering Journal of Wuhan University,2019,52(01):89-94.