

Construction and Verification of Network Public Emotion Entropy Flow Model

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Abstract:

This paper introduces the self-organization theory and entropy flow theory into the study of network public emotions. By using the literature research method and case analysis method, based on the analysis of the self-organization evolution characteristics of network public emotions, this paper proposes that positive entropy as a “disaster-causing factor” will lead to emotional contradictions and conflicts. As a 'stability factor', negative entropy can offset the negative effect of positive entropy and keep the network public emotion stable. Based on this, the dissipative structure theory in self-organization theory is used to establish the emotional entropy model composed of positive and negative entropy flow variables. According to the logic of positive entropy and negative entropy game, the state evolution model of network public emotion system in negative and positive public opinion events is constructed. This paper further selects the 'Jiangsu Xiangshui explosion' as a negative public opinion event to verify the model. The results show that the event is basically consistent with the entropy flow model of the negative public opinion event constructed in this paper, which proves that the emotional entropy flow model constructed in this paper has good applicability and effectiveness.

Keywords: *Network public emotion, Self-organizing evolution, Positive and negative entropy flow, Entropy flow model of emotion, Network public opinion.*

I. INTRODUCTION

Network public emotion is the 'hidden public opinion' state of network public opinion. It is the collection of cognition, attitude and emotion based on network public events, and also the hidden public opinion state of public emotion and opinion on specific events and social things [1]. Whether individual emotions or social emotions, once produced, it will enter the sequence of dynamic changes [2]. In the public field where everyone has a microphone, the Internet creates a typical 'public opinion field' behind public opinion events. Relying on the game mechanism of emotional entropy flow, it highlights the characteristics of self-organization evolution such as openness and imbalance. It is of great significance for the guidance of network public opinion and the improvement of social governance to comprehensively investigate and sort out the self-organizing evolution characteristics of network public emotion derivation, dissemination and diffusion, and to explore the mechanism of emotional entropy flow in public opinion

events.

II. LITERATURE REVIEW AND RESEARCH QUESTIONS

2.1 Literature Review

As a subsystem of the network public opinion system, the influence of network public emotion is becoming increasingly prominent, and the research in this field is getting more and more attention from all sides. The research of domestic and foreign scholars focuses on the expression and communication of network public emotion, realistic influence, modeling and prediction, and counseling countermeasures.

2.1.1 Research on the generation and dissemination of network public emotion

Fragmented expression and anonymous writing in cyberspace provide the best platform for public emotion expression and social communication. Li Chunlei, et al. found that there is a linkage mechanism between micro-media such as Weibo and Wechat and public emotions, which "awaken" and "catalyze" public emotions [3]. The communication of network public emotions generally goes through four stages: occurrence of emergencies, communication and mutual infection of emotions among users, generation of group polarized emotions, and leading to group polarized behaviors [4]. Its expression, transmission and evolution are more direct and intense, and show serious randomness, extreme and trend. Further studies by Sui Yan, et al. found that negative emotions become more and more prominent with the help of new media such as Weibo, resulting in an amplification effect [5].

2.1.2 Research on the realistic effect of network public emotion

The research mainly focuses on the expression of netizens' public opinion and the practical influence of positive and negative aspects. As an important "compensatory media", the Internet bears a variety of functions such as emotional venting, opinion expression and interest maintenance [6]. As a special dimension of netizens' public opinion expression, network public emotion has positive effects such as "thermometer" of social mentality [7] and "pressure relief valve" [8]. However, there are also new media events with opposing emotions that are repeatedly written and expressed, forming antagonistic discourse, group psychology and resentful interpretation of the event [9] and evolving into cyber violence under the group infection transmitted by the Internet, resulting in frequent occurrence of emotional crisis events and other negative effects [10].

2.1.3 Model construction and early warning research of network public emotion

The research mainly focuses on computer and other natural science fields, mostly taking public opinion events as research samples, using data mining and emotional computing methods. Construct Internet population model[11], social media users emotional convolution neural network model (Convolutional Neural Network)[12], the network public emotion evolution model, etc.[13]. Foreign scholars based on internationally recognized libraries and emotional words such as General Inquirer Linguistic Inquiry and Word Count (LIWC) mood measurement software, such as Facebook, Twitter, social media such as object,

through analyzing Internet words and tone of mood type, it is found that public emotion in social media can predict the fluctuation of stock market[14], voters' voting intention[15], political inclination[16], etc., and based on this, a neural network model of social media users' emotion is constructed[17] to investigate the relationship between network public emotion and social economic and political activities.

2.1.4 The dredging and countermeasure research of network public emotion

The research in this field is dominated by Chinese scholars, and it is proposed that the government, media and the public should be the three main bodies of governance. The government should attach importance to the expression of network public emotions, face up to the emotional demands of the public, establish an early warning mechanism, and take the initiative to disclose information to meet the public's information needs [18]. The media's input function system of network public emotion should keep channels unblocked, carry out intelligent interpretation of information, build an open and people-oriented mainstream public opinion field[19], strengthen the interaction and cooperation between forum opinion leaders and media, and screen, refine and amplify the rational views of "online opinion leaders"[20]. As the expression and communicator of network public emotion, the public also needs to constantly improve their media literacy ability in the face of emotional and irrational speech.

2.2 Research Questions

To sum up, the research on network public emotion is mainly concentrated in the field of information science, and a large number of achievements are based on case analysis of public opinion events. The research method is still relatively simple, mainly descriptive and intuitive theoretical deduction, which weakens the explanatory power of the research and the guidance to practice. As the diffusion product of social emotions in cyberspace, the derivation, dissemination and diffusion of network public emotions are not artificial organizational behaviors, but netizens spread and organize themselves by relying on spontaneous forwarding and comments, which highly coincides with and highlights the characteristics of self-organizing complex systems. Although some scholars have sorted out the self-organizing evolution mechanism of online public opinion [21] and self-organizing evolution modeling[22], there are still few research results from the perspective of latent state of public opinion -- network public emotion. Based on this, this paper intends to combine the self-organizing evolution characteristics, mechanism and entropy flow model of public emotions in network public opinion events with positive or negative different properties under the influence of spontaneous behaviors such as Internet users' comments and forwarding and multiple factors inside and outside the system.

Research question 1 (RQ1): What are the characteristics of online public sentiment in the evolution of self-organization?

Research question 2 (RQ2): What is the evolution mechanism and model of positive and negative entropy flow of network public sentiment?

Research question 3 (RQ3): Is there any difference in the evolution mechanism and model of network

public sentiment in public opinion events of different natures?

III. SELF-ORGANIZING CHARACTERISTICS AND CLOW CNALYSIS OF NETWORK PUBLIC EMOTION

3.1 Self-Organizing Characteristics of Network Public Emotion

"Self-organization theory" was born in the 1960s, which absorbed reasonable parts of dissipative structure, mutation theory, synergetics, hypercycle and other theories, and constructed a unique theoretical framework of system evolution. By self-organization, we mean that "a system is self-organized if there is no specific outside intervention in the process of acquiring its spatial, temporal or functional structure"[23]. Self-organization theory absorbs reasonable parts of dissipative structure, mutation theory, synergetics, hypercycle and other theories to construct a unique theoretical framework of system evolution. The change of entropy of network public emotion information is self-organizing in a kind of disorder and uncertainty, showing obvious self-organizing characteristics.

3.1.1 Openness

Openness is embodied in two aspects: field openness and discourse power openness. On the one hand, with the rise of social media, open network field become typical of the "public sphere", where people have the freedom of access network in the field of public, and it have to take off the mergence to rule out the limitations of real social life, emotional stimuli, emotional expression, group information transmission are found bearing in this space and transmission channel. On the other hand, the decentralized, equal and open characteristics of Internet media enable "everyone to have a microphone", which greatly improves the ability of ordinary people to exercise their right of discourse and participation and express their views on public affairs. The open field of the Internet environment and the relatively free opening of discourse power make the self-organizing evolution of network public emotion entropy flow have the basic conditions.

3.1.2 Unbalance

Unbalance refers to the fact that the distribution of matter and energy in each area of the system is different and extremely unbalanced [24]. "Discourse means a process in which a social group transmits its meaning to the society in accordance with certain rules, thus establishing its social status and being recognized by other groups"[25]. In the public opinion field of the Internet, although everyone can speak freely, the discourse power behind the discourse is quite different due to the different social capital owned by speech subjects. Such as big V as opinion leaders of the network and has the media power of mass media, to define things, this thing, explaining things, thus influence or shape the social cognitive value judgment to the events, and netizens spread its discourse power and influence compared with regular Internet users and fully, formed the obvious influence the imbalance of discourse power and media.

3.1.3 Nonlinear

Nonlinear means that the system meets the law of " $1+1>2$ ", that is, the system is not a simple superposition of various components, but through organic integration, some characteristics that the system has and some do not, and promote the overall evolution and development of the system[26]. network public emotion is not Internet product of emotion and its strength is simple to overlay, as a complex information system, stimulating information, ordinary Internet users, the media, opinion leaders and other influence factors in the interaction of nonlinear system, promote the evolution and development of the network public emotion, thus forming a kind of or several major expression of the emotions, And eventually move from a chaotic "cacophony" to a distinctly dominant mood. The system as a whole may exhibit certain characteristics that a system has but a small population does not. This is nonlinear, which shows different interaction modes and effects at different times, places and conditions [21].

3.1.4 Fluctuation

In the self-organization theory, fluctuation refers to the phenomenon of fluctuation of system parameters, which is a kind of imbalance of the system [27]. It is specifically divided into two types: slight fluctuation and huge fluctuation. Micro-rise and fall refers to the fluctuation mode in which the degree of its action cannot change the integrity of the system structure and its force is not enough to destroy the original stability of the system structure [28]. Giant fluctuation refers to the fluctuation mode in which the degree of its action can change the integrity of the system structure and its force is enough to destroy the system structure and the original stability [1]. In the process of the development of online public opinion, if there is no new stimulus information, the network public emotion system will basically be in a slight fluctuation, maintaining the structure and effect of the original network public emotion. If a major stimulating event occurs and approaches and reaches a certain "critical point", a "huge fluctuation" will be formed, rapidly advancing the unstable state to a new orderly and stable state, and forming a new structure and effect of network public emotion [26]. Compared with the slight fluctuation, the huge fluctuation has a strong interference effect on the network public emotion system, and even causes the destructive mutation.

Take the Case of "Luo Yixiao" in Shenzhen as an example. On November 25, 2016, Luo Er, former editor-in-chief of Shenzhen New Story magazine, published an article titled "Luo Yixiao, You Stop Me", claiming that his daughter Luo Yixiao was hospitalized in intensive care unit due to leukemia, and her medical expenses were more than RMB 10,000 yuan per day. An organization later claimed that the retweets could raise money for Luo, prompting sympathy, retweets and rewards from netizens. On November 30, it was revealed that Luo, who owns three houses, two cars and a company and is well-off, was a marketing stunt, and that the money he received was not used for his daughter's medical treatment, but for his son. For a time, public opinion was in an uproar, and the network public emotion showed a slight rise and fall trend from the positive emotions such as sympathy and support, which were relatively stable in the early stage. The abrupt reversal showed the overall instability of the emotional system structure, and evolved into the negative emotions of questioning and anger as the mainstream, and the position and direction of social public opinion also underwent a thorough reversal. This case shows the fluctuation of network public emotion entropy flow.

3.2 Entropy Flow Analysis of Network Public Emotion

Entropy was first proposed by Clausius, a German physicist, as a concept by which thermodynamics reveals the laws of motion in a thermodynamic system. Later, it has been used for reference and application by researchers in a wide range of disciplines. In 1908, Shen Nong, an American scholar, put forward a new concept of "information entropy" on this basis to reflect the disorder degree and uncertainty of the system quantitatively. The higher the entropy value is, the greater the disorder degree of the system is.

As a self-organizing system with dissipative structure, network public emotion can also be described from the perspective of entropy. As a special dimension of information entropy, "emotion entropy" quantifies the stability and self-organizing evolution trend of network public emotion system. In specific network public opinion events, "emotion entropy" (system state function DS) is the result of the evolution of network public emotion system, and is actually the product of the game between positive entropy flow and negative entropy flow of the system. Researchers can combine the internal and external information and energy input of the system to model the increase and decrease of the resulting emotional entropy, so as to obtain the analysis results.

In the dissipative system of network public emotion, positive entropy and negative entropy are the two main points of investigation, and also the key indexes to judge the self-organization evolution of the system. Confirm the specific factors affecting the generation of positive entropy flow and negative entropy flow, reduce the formation of positive entropy as much as possible, and continuously input negative entropy into the system, so as to reduce the emotional risk of network public opinion events, so as to ensure the orderly operation of the system.

3.2.1 Positive entropy

In specific public opinion events, positive entropy as a "disaster causing factor" will increase the disorder of the network public emotion system, and challenge the dissipative structure of the system. Specifically, positive entropy can be divided into two types: internal positive entropy of the first type and external positive entropy of the second type. Both of them are the root of the instability of the system self-organization and cause contradictions and conflicts.

The first type of positive entropy comes from within the system. As a subsystem of the network public opinion system, the reasons for the formation of its own positive entropy are complicated. In addition to the usual public opinion events of precipitation and accumulation of negative emotions in the system, the social vulnerable groups with the help of network discontent, netizens irrational cognition, negative emotion inside the system of large area quickly spread, group of emotional contagion, network big V extreme opinion and negative emotions towards, the negative public opinion events themselves and psychological stimulation for Internet users, Internet rumors, etc., Will cause the appearance and increase of positive entropy inside the system. Once these factors are combined and interacted with each other, the disorder of the system increases rapidly.

The second type of positive entropy comes from outside the system, including inaccurate or misleading media reports, instigation and malicious attacks by hostile forces, improper disposal and response of the parties involved, official information lag or information blockade, etc. The input and increase of positive entropy outside the system will further destroy the dissipative structure of the system, and as an external disturbance factor, further promote the increase of entropy inside the system, thus aggravating the unstable state of network public emotion in public opinion events. According to the social combustion theory, the positive entropy outside the system is equivalent to the "fuel" of public opinion events, which may lead to the further expansion of the situation and the escalation of the crisis.

On September 9, 2018, Hangzhou beaten pregnant woman @Stabbing Ytt complained through her microblog that she was beaten and abused by Internet celebrity Saya Chen when she was walking, resulting in premature labor, which attracted wide attention from netizens and started the positive entropy input of emotional entropy in the system of this public opinion event. With the participation and siding of famous big Vs such as @Wang Sicong, the anger has further spread. A large number of critical and emotional comments demanding "severe punishment" of Internet celebrities involved in the incident appeared in the public opinion field, which made the incident continue to ferment. In the name of "justice" and driven by the psychological motivation of self-proclaimed "justice", some netizens even took the group action of "violence against violence" to "sanction" the Internet celebrities involved. The above radical behaviors and negative emotions become the positive entropy flow outside the system and are further introduced into the system. In this case, the media gave timely guidance to public opinion, hangzhou police dealt with it correctly and disclosed information in a timely manner, and finally resolved the anger in the public opinion field without developing into an overall emotional polarization state. It can be seen from this case that it is urgent to reduce the positive entropy flow in order to ease and deal with the network public emotion crisis, and it is also crucial to accurately identify the positive entropy and trigger factors in the system.

3.2.2 Negative entropy

In 1944, Austrian physicist Schrodinger formally put forward the concept of "negative entropy". "A living organism is constantly producing entropy -- or increasing positive entropy -- and gradually approaching the dangerous state of maximum entropy, which is death. The only way to get rid of death, to live, is to constantly suck negative entropy from the environment." [29] Compared with positive entropy, negative entropy is a "stability factor", and the increase of negative entropy can offset the negative effect of positive entropy, thus effectively reducing the disorder of the system. The self-organizing evolution of a system is a continuous process of seeking maximum negative entropy. In the network public emotion system, the introduction of negative entropy can promote the generation of positive public opinion and reduce the damage to the stability of the emotional system. Similar to positive entropy, negative entropy also exists in many forms, which can be divided into two categories: internal negative entropy and external negative entropy.

The first type of negative entropy comes from the inside of the system, including the rational stance of netizens, the mentality of not being extreme or following blindly, the expression and dissemination of positive emotions of netizens, the correct guidance of public opinion by online media and opinion leaders,

and appropriate intervention measures of online public opinion, etc.

The second type of negative entropy comes from the outside of the system, including timely information disclosure by the government, correct emergency response to public opinion events, confirmation and remedy of the responsibility of the parties involved, and targeted public opinion guidance by traditional media.

On July 12, 2018, an explosion occurred in a chemical factory in Jiang 'an, Sichuan province, causing heavy casualties. After the photos and related videos of the accident were reposted and reported by netizens and other media such as @CCTV News, @Toutiao News and @Sichuan Daily on Weibo, the incident attracted a high level of attention. Many netizens linked it to the recent phuket ferry disaster in Thailand and the Tianjin bombing, and the accident was caused by illegal production, which further triggered negative emotions and doubts among netizens. After the accident, the government formed a rapid response mechanism, and actively promote the settlement of the aftermath of the problem. Major leaders of the Provincial Party Committee came to the scene to give guidance, major insurance companies promptly accepted the claims, and mainstream media promptly tracked and reported the handling of the aftermath, which added confidence to the public in the aftermath work. As the negative entropy outside the system, the above factors are introduced into the network public emotion system, which also plays a positive role of negative entropy inside the system, effectively reducing the negative emotions of netizens, and the system gradually tends to be stable.

Many public opinion cases have proved that in the response to online public opinion, if the negative entropy inside and outside the system can increase continuously, the positive entropy energy of the system can be offset or transformed, so that the order of the network public emotional system can be stabilized, and thus prevent the occurrence of emotional polarization.

IV. CONSTRUCTION OF NETWORK PUBLIC EMOTION ENTROPY FLOW MODEL

After the occurrence of online public opinion events, the state of network public emotion system will correspond to a mood entropy value at each time point. Based on this, emotional entropy provides a judgment basis for the evolution and running direction of the system. According to the logic of positive entropy and negative entropy game, the entropy flow formula of network public emotion system is as follows (1):

$$ds = d_e s + d_i s \quad (1)$$

In the formula: ds represents the total entropy of the network public emotion system; $d_e s$ represents the negative entropy flow of network public emotion system; $d_i s$ represents the positive entropy flow of network public emotion system.

When $ds < 0$, it indicates that the negative entropy in the system cancels the positive entropy, and the network public emotion system runs stably and evolves in an orderly direction.

When $ds = 0$, it indicates that the emotional entropy of the network public emotional system does not increase or decrease, and the system is in a stable equilibrium state, but with the change of various factors, the equilibrium state will be broken at any time.

When $ds > 0$, it indicates that the positive entropy in the system is greater than the negative entropy, the emotional entropy of the system keeps increasing, the disorder effect is obvious, and the system state starts to lose stability (see Fig 1).

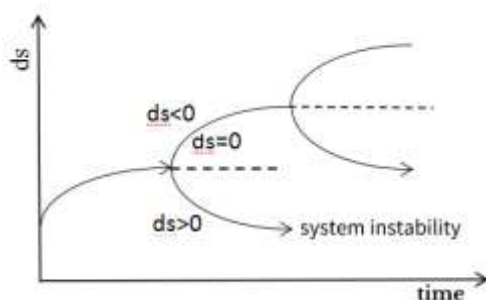


Fig 1: entropy flow state of network public emotion system

In order to further analyze the influence of entropy flow on the operation of network public emotion system, this paper uses the dissipative structure theory to establish a mood entropy model composed of positive and negative entropy flow variables (as shown in Fig 2), and the formula is as follows (2) (3) (4):

$$ds = d_e s + d_i s \quad (2)$$

$$d_e s = \sum s_e 1 + \sum s_e 2 + \sum s_e 3 + \dots + \sum s_e n \quad (3)$$

$$d_i s = \sum s_i 1 + \sum s_i 2 + \sum s_i 3 + \dots + \sum s_i n \quad (4)$$

In the above formula, $s_e 1$ is the first type of negative entropy flow, $s_e 2$ is the second type of negative entropy flow... $s_e n$ is the n type of negative entropy flow; $s_i 1$ is the first type of positive entropy flow, $s_i 2$ is the second type of positive entropy flow... $s_i n$ is the n type positive entropy flow.

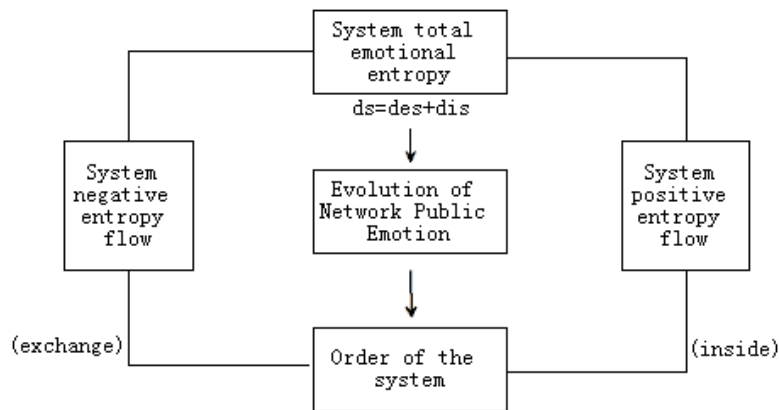


Fig 2: positive and negative entropy flow model of network public emotion system

Based on the analysis of entropy and self-organization theory, the state evolution model of network public emotion system in negative public opinion events is as follows, as shown in Fig 3.

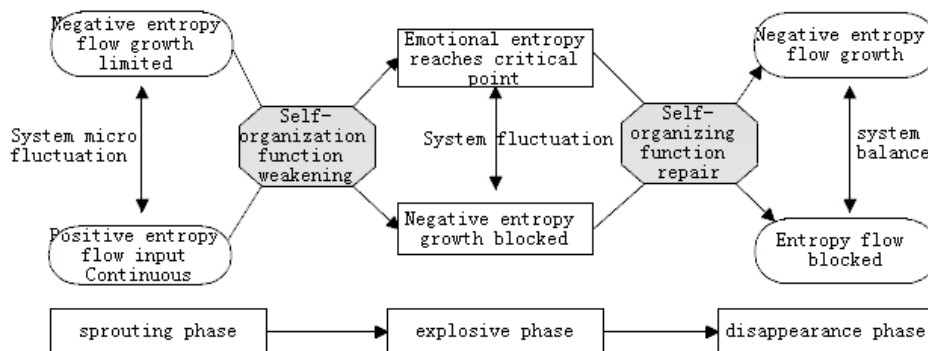


Fig 3: positive and negative entropy evolution model of network public emotion system in negative public opinion events

It must be pointed out that, if the increase of positive entropy flow in negative public opinion events can not be effectively reduced, the huge fluctuation of the system will show the differentiation of two paths: one is the polarization of negative emotions and even the burst of mass events, and then the system energy is seriously consumed and finally reaches the equilibrium state; The other is that due to the effective input of negative entropy flow, the disorder of entropy increase is suppressed, and the system enters into a stable and orderly stable state through repair. From this point of view, the evolution of the network public emotion system in negative public opinion events has diversity and some randomness (or uncertainty).

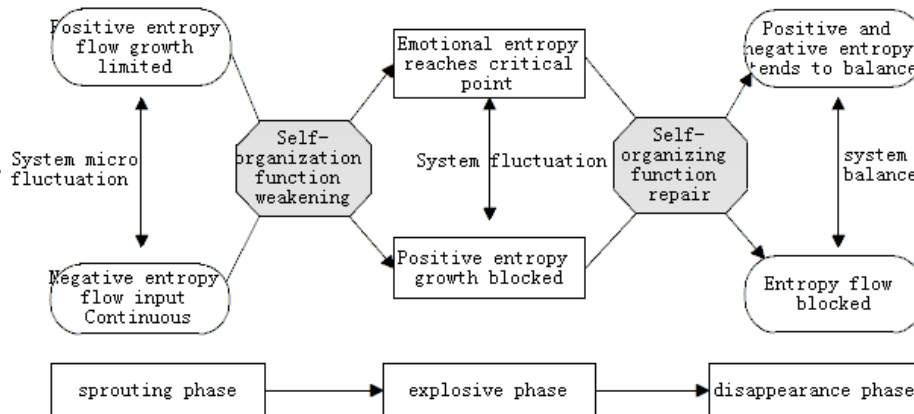


Fig 4: positive and negative entropy evolution model of network public emotion system in positive public opinion events

Due to the different nature of public opinion events, compared with negative public opinion events, positive public opinion events show different characteristics of netizens' emotional types and emotional entropy flow trend. The state evolution of the network public emotion system basically shows the following trend (see Fig 4), which eventually leads to the weakening or functional repair of the self-organizing function of the system. It must be pointed out that the weakening trend of the increase of systematic emotional entropy in positive public opinion events is often caused by the emergence of new issues in public opinion and the deviation of interest points of netizens.

V. VERIFICATION OF ENTROPY FLOW MODEL OF NETWORK PUBLIC EMOTION

As a special product of social emotion in the Internet era, network public emotion highlights the typical self-organization phenomenon [30]. In specific public opinion after the incident, in addition to exchange information, energy and other systems inside and outside, there is interaction between system elements of the nonlinear mechanism, in the evolution of the positive and negative entropy flows game to promote network public emotion forming dissipative structure, and in different stages of the process of public opinion transmission present diverse evolution trend.

5.1 Selection and Brief Introduction of Sample Cases

In order to select suitable online public opinion case samples, this paper determined three basic principles for case selection: first, public opinion cases should have significant social attention, and multiple subjects (Internet users, media, government) should have a large participation in the event, so as to ensure the representativeness and typicality of the study; Secondly, the network public emotion in the sample cases shows a trend of differentiable fluctuation, so the process and mechanism of its self-organization evolution can be clearly analyzed. Thirdly, the sample case has a certain timeliness, which is convenient for the research team to collect relevant data and text data scientifically. In view of this, the research team selected "Jiangsu Xiangshui Explosion Event" in 2019 as the research sample, and verified the entropy flow model of network public emotions in public opinion events.

The basic information of this public opinion case is as follows: On the afternoon of March 21, 2019, the chemical storage tank of Jiangsu Xiangshui Tianyi Chemical Co., Ltd. suddenly exploded. 78 people were killed in the explosion, and another 566 people were injured. As soon as the Xiangshui explosion was verified, it became a hot social issue of national concern. In this regard, The State Council set up an accident investigation team, and the relevant rescue progress and incident investigation also firmly affected people's hearts. After combing, it is found that as of 9 o'clock on March 30, 2019, there are 282,930 pieces of information about the explosion accident in Jiangsu province, including 42,983 pieces on Wechat, 130,621 pieces on Weibo and 66,851 pieces on website. The main communication fields of this public opinion are microblog, Wechat and web pages, among which mainstream media such as Xinhua News Agency official Weibo, People's Daily official Weibo, CCTV news official Weibo, and Global Times Wechat official account issued papers. Media reports and netizens' hot discussion pushed the public opinion to a climax. With the completion of the rescue work and the positive disclosure of relevant information, public opinion gradually subsided after March 27, 2019.

5.2 Evolution Analysis of Network Public Emotion Entropy Flow

Only the events that the public pays attention to will trigger the corresponding emotional aggregation and group communication phenomenon. The development of new events, the relaxation of people's emotions, the emergence of new issues and the lack of communication continuity in group communication on network media are the main reasons for the decay of issues [31]. Therefore, online public opinion events are bound to have a unique information life cycle, which goes through "Cradle to Grave" transformation. Yu Guoming, a scholar, pointed out that online public opinions generally follow a process of "event occurrence, netizens' disclosure, traditional media's follow-up, online heated speculation, formation of public opinion pressure, government departments' intervention and netizens' silence"[32]. scholars on new of the impact of network public opinion process can be divided into stage occurred, diffusion and stable period[33], xiang-hong xu in the process of public opinion in the study of introducing the theory of dissipative structure and fluctuation, think the opinion formation process from the information "beinart convection" to start, through the integration of cognition and psychological, final opinion through fluctuation, phase change, And that creates a new ordered structure[34]. In the classification of public opinion evolution stages, academic circles follow the following four common standards: first, the degree of development of issues of public concern; Second, the public scope to participate in discussion and debate; Third, the intervention opportunity of power organizations; Fourth, the actual results of the role of public opinion [35]. Based on the above point of reference and further thinking, from the network public opinion of the life cycle (bud, outbreak period, decline phase) of the analysis of the self-organizing evolution of the network public emotion, no doubt can build up a network public emotion on self-organization evolution of standards, and can also be based on this to scientific description and grasp the law of entropy, and explore the mechanism of public opinion in different stages of system transformation.

It must be added that jiangsu Xiangshui Explosion accident is a public security emergency, which is easy to provoke public tension, and the outbreak and spread of public opinion is relatively fast. Public opinion from the initial to the outbreak of the time process will be relatively short, so as to compress in a

short time to quickly break out. However, the formation and development of online public opinion events caused by non-sudden social problems are relatively gentle, which can stretch for months or even years, and may even stagnate and repeat between each stage, resulting in a wave trend of double or multiple peaks.

5.2.1 Initial stage of public opinion

Generally speaking, in the initial stage of public opinion, the internal energy storage of the system is small, the positive entropy flow dis and negative entropy flow des inside and outside the system are in a slow increase, and the increase of the system's emotional entropy ds is relatively stable. To be specific, the hot spots of public opinion emerged and began to spread in a small area, but with the characteristics of dispersion. The emotional comments of netizens began to appear in the form of "low level of public opinion", but did not attract widespread attention, and the phenomenon of small fluctuations began to appear.

The beginning of this public opinion event was a sudden explosion in Xiangshui Park at 14:48 on March 21, 2019. (Table I) The National Seismological Center released two official microblog posts at 14:50 and 15:00, respectively. Within 10 minutes of the explosion, "scene pictures" and "real videos" of the explosion appeared on Weibo and Wechat moments. Due to the lack of official information sources, the information sent by netizens is difficult to distinguish between true and false, and the public opinion field is in a state of chaos. In addition, the existing memory and emotional awakening of security events such as Tianjin explosion, worry, tension and other negative emotions began to rise, resulting in the increase of positive entropy flow dis of public opinion events.

At 16:42 on the same day, @Yancheng officially forwarded @Yancheng Evening News' Weibo account, confirming the real information of the explosion, and "reminding citizens not to go to watch and make way for rescue". The authorities clarified the facts publicly, the public security, fire, medical and other institutions rushed to the scene for rescue, and the government took emergency treatment of the incident. All the above factors appeared as negative entropy flow DES, which had a certain subtractive effect on the positive entropy flow DIS in the public opinion system. Since then, @People's Daily and @CCTV News have also issued the latest news about the incident. With the involvement of media reports, public opinion on the crisis has initially formed, and the "butterfly effect" of public opinion has also begun to appear.

TABLE I Initial stage of public opinion on "Jiangsu Roaring Water Event"

Time	Event process	Public opinion trends
2019/3/21 14:48	Explosion in Xiangshui Park	At 1450 and 15: 00, respectively, the National Seismic Station released two official micro-blog articles of the earthquake magnitude 2.0 (suspected explosion).
2019/3/21 14:48~14:58		Micro-blog, WeChat circle of friends have appeared water explosion ' s ' scene map ', ' live video ' and so on, public opinion is noisy, people appear negative emotions.
2019/3/21	Officials confirmed the	@ Yancheng officially forwarded the @ Yancheng Evening

16:42	authenticity of the incident and took emergency rescue measures	News microblogging, to clarify the facts. Since then, @ People 's Daily, @ CCTV News and others have issued updates on the incident
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5.2.2 Outbreak stage of public opinion

Generally speaking, different from the budding situation in the initial stage, the event information, netizens' opinions, emotional information and other information rapidly fission in the outbreak stage of public opinion, presenting an acceleration diffusion situation. With the increase of public opinion subjects' participation, scattered information dissemination has been intensively disclosed in large quantities, and netizens have paid more attention to it. The frequency of dissemination of relevant information and the number of comments have increased significantly. Due to the rapid increase of public opinion related information, there may be a complicated situation where truth and rumor coexist. In the outbreak stage, the internal energy of the system increases rapidly, the emotions of netizens are relatively high, the behavior of expressing emotions is more frequent, and the scope and influence of emotional communication are also expanding day by day. Therefore, the change of positive entropy flow DIS and negative entropy flow DES intensifies, and there is a more intense energy game between the two. The disorder degree of the system's emotional entropy DS increases and approaches or reaches a critical point, which provides the possibility for the emergence of huge fluctuations. At this stage, the government's role as the subject of public opinion management often affects the trend of public opinion and the change of the system's emotional entropy. Whether the government's response measures are appropriate or not will lead the online public opinion in different directions, and the public opinion will either enter the stage of extinction or evolve into a more serious crisis.

Public opinion broke out within a few hours after the Xiangshui Public security incident in Jiangsu province. Up to more than six hundred casualties and media reports recurring "earthquake" "flames" "mushroom cloud" and other words, to strengthen the public risk perception, and for fear of environment security threats against tension, fear and other negative emotions, including local water can not drink, air safety and so on a suspicious. There was even a rumor on the Internet that 18 firefighters died after inhaling carcinogenic gas. At this stage, "two micro" media become the main field of public opinion dissemination and the fermenting field of netizens' emotions. The emotional entropy flow of the network public emotion system increases very rapidly, which is manifested by the positive entropy flow climbing faster than the initial stage of public opinion and approaching the critical value of system qualitative change.

It is worth noting that due to the effective response of the local government and the correct guidance of public opinion by the media, the input of negative entropy flow of the system is also very obvious, which begins to effectively restrain the increase of system entropy. The relevant departments of Jiangsu Xiangshui do not shy away from facts, and firmly control the initiative in the field of online public opinion with intensive and open authoritative information release, which effectively inhibits the spread of rumors and rumors. @Jiangsu Fire Department, @Jiangsu Ecological Environment Department, @Ministry of Emergency Management, PRC, etc., all released rescue, environmental monitoring and emergency response information successively from 17:29 to 19:17 on the same day. (TABLE II) At 19:22,

@Yancheng published "Explosion report of Xiangshuitian Jiayi Chemical Co., LTD." on its microblog and Wechat official account. At 20:32, Yancheng posted a message: "There is no drinking water source downstream of the accident site, and the safety of drinking water is not affected." At 20:52, @Health China announced the progress of medical rescue. Earlier in the evening of the 21st, @Jiangsu Net police issued an appeal "netizens do not believe rumors, do not spread rumors." The above media on the explosion of the accident environment and health coverage, to dispel the doubts of part of the public.

At this stage, four press conferences continued to follow up and pointed to the key points of the incident, announcing the number of casualties caused by the accident, the critical search and rescue during the 72-hour golden rescue period, the surrounding sanitation investigation, the resumption of school classes, and the reconciliation work for the bereaved families. The above practices and information disclosure eased the public anxiety, and the emergence of a number of moving events and public reports in the rescue process further input the negative entropy flow outside the system.

As the network public emotion system in this event has been open and constantly exchanging information and energy with the outside world, a good dissipative structure has been formed. The huge fluctuation of the emotional system did not produce polarization mutation, but reduced the increase and disorder of the emotional entropy of the system, and prevented the occurrence of mass events and the outbreak of emotional crisis because of the subside of negative emotions.

TABLE II The outbreak stage of public opinion in “Jiangsu Resounding Water Event”

Time	Event process	Public opinion trends
2019/3/21 17:29- 19:17	The fire firefighters rescued 12 injured people, and the environmental department rushed to the scene for emergency monitoring, and the scene fire was preliminarily controlled.	@ Jiangsu Fire Protection, @ Jiangsu Ecological Environment, @ Ministry of Emergency Management of the People ' s Republic of China and others have successively released rescue, environmental monitoring, emergency disposal and other information
2019/3/21 19:22	The government carries out the work of accident rescue and order maintenance, the wounded are fully treated, and the environmental protection department carries out environmental monitoring.	Government Officer Wei @ Yancheng Published ' Explosion Briefing of Xiangshui Tianjiayi Chemical Co., Ltd. '
2019/3/21 20:32	The ecological environment department initiates an emergency plan for environmental accidents to monitor and deal with the surrounding environment.	Government official Wei @ Yancheng issued a message that there was no drinking water source downstream of the accident site and the safety of drinking water was not affected
2019/3/21 20:52	Many medical experts assisted the scene to carry out emergency treatment	@ Health China announces the progress of medical rescue
2019/3/22 22:09	Press conference on water explosions	Media follow-up reports and public anxiety eased

5.2.3 Fading stage of public opinion

In the stage of public opinion outbreak, the difference and mutual interference effect between public opinion elements are greatly highlighted, which will inevitably lead to the impact on the stability of macro structure and trigger the occurrence of fluctuation or even huge fluctuation. However, once the public opinion fades, the system energy is relatively weak, and the system gradually enters a relatively stable stage. Due to the corresponding disposal of the public opinion crisis, the government, media, netizens and other multiple subjects of public opinion have nonlinear coherent effect, and may even produce a certain synergistic effect. Thus, the entropy increase of the network public emotion system is further eliminated ($ds < 0$), the system evolves in an orderly direction, and the huge fluctuation phenomenon that brings system uncertainty will be completely ended at this stage.

Thanks to the successful treatment of Jiangsu Xiangshui Explosion event by all parties, the amount of information related to The Event has decreased since March 27, 2019, and the focus of netizens has shifted, and they tend to be rational in terms of emotional types. See Fig 5 for details.

Self-organization theory proposes that an open system continuously absorbs negative entropy from the external environment, and when the negative entropy is large enough to overcome the positive entropy inside the system, the system will form a dynamic stable ordered structure, which is manifested as entropy reduction mechanism [36]. In the waning stage of public opinion about The Jiangsu Flood incident, online Posting, media reports of the incident, netizens' comments and forwarding all showed an obvious downward trend. Therefore, the activity of both the negative entropy flow and the positive entropy flow of the system decreased significantly, and the positive and negative entropy flow began to recover to the state before the event.

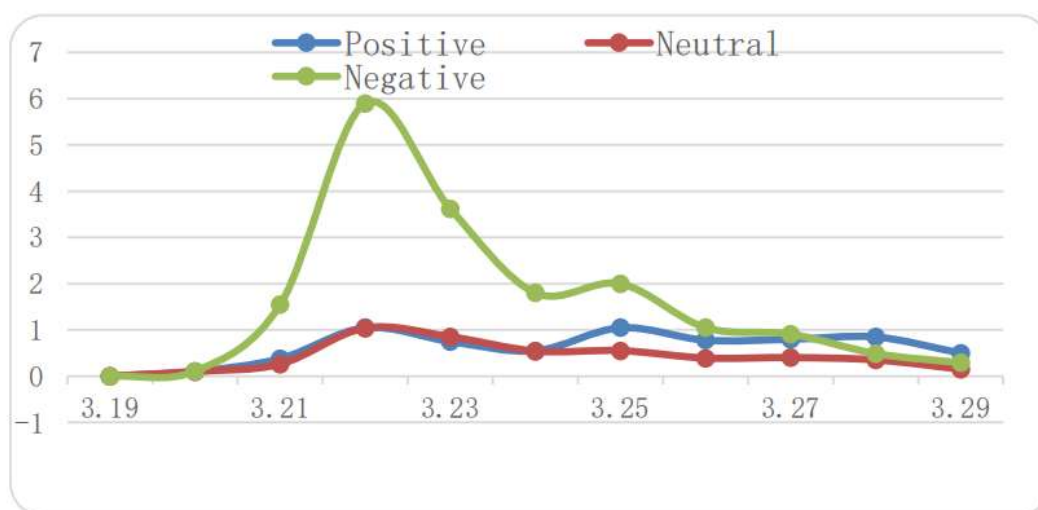


Fig 5: emotion trend of people in Jiangsu Xiangshui incident (data source: Research Center for New Media and Communication Ecology, Jinan University)

VI. CONCLUSIONS AND DISCUSSION

This paper introduces self-organization theory and entropy flow theory into the research on the occurrence and evolution mechanism of network public emotion, and it is proposed that network public emotion is a self-organization system with openness, non-balance, nonlinear and fluctuation, and its evolution is affected by the positive and negative entropy flow game of emotions. Positive entropy and negative entropy are the key indicators to judge the self-organization evolution of network public emotion system. They affect the stability and evolution structure and state of network public emotion from different directions. Among them, the positive entropy from the internal and external of the network common emotion system, as the "disaster causing factor", will increase the disorder of the network public emotion system, and cause contradictions and conflicts. The negative entropy from the internal and external of the network public emotion system, as a "stability factor", can offset the negative effect of the positive entropy, thus effectively reducing the disorder of the system. The self-organizing evolution of network public emotion system is a process of seeking maximum negative entropy. Based on this, the entropy flow formula and entropy flow evolution state graph of network public emotion system are proposed. In order to further analyze the influence of entropy flow on the operation of network public emotion system, this paper uses the dissipative structure theory to establish the emotional entropy model composed of positive and negative entropy flow variables and the positive and negative entropy evolution model of network public emotion system in positive and negative public opinion events.

In order to verify the applicability and effectiveness of the above models, this paper selected "Jiangsu Roaring water Explosion event", a negative public opinion event, to analyze the evolution stage of network public emotion entropy flow in the event. The analysis results show that the state variables of emotional entropy increase of network public emotion system in different stages of public opinion depend directly on the coordination of several order parameters such as government crisis handling measures, media public opinion guidance and linkage. The above order parameters promote the evolution of the system's fluctuation and ultimately determine the evolution direction of network public emotion. The overall evolution process of network public emotion is basically consistent with the entropy flow model of negative public opinion events. In the whole public opinion event, the network public emotion promoted and promoted by the event formed an open system highlighting the dissipative structure, showing distinct characteristics such as being away from equilibrium, nonlinear interaction and fluctuation. The self-organization characteristics of the system are fully highlighted in this case. The validation results strongly demonstrate the applicability and effectiveness of the network public emotion entropy flow model constructed in this paper.

It is worth noting that at the end of evolution of network public opinion events, the system entropy flow will form a new structure and return to the state before the occurrence of public opinion events. However, due to the cumulative nature of network public emotions, emotions in public opinion events often show some precipitation. The more similar events occur, the "stimulus-response" mode of emotion will start more quickly, and the negative emotions deposited in the previous similar events will be aroused again with the emergence of similar situations, and will be input into the system as the positive entropy flow of the next public opinion event.

Since this paper only selected one negative public opinion event as a validation case, the validation of

the network public emotion entropy flow model for positive public opinion events has not been carried out. Therefore, subsequent researchers can select a large number of different types of public opinion events to analyze on the basis of this study, so as to test, modify and improve the network public emotion entropy flow model constructed in this paper from multiple perspectives.

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