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Emotional contagion in the propagation of online rumors

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Abstract

This study explores the influence of emotion embedded in online rumors for its effect on viewers' intention to spread rumors. Based on the emotional contagion theory, we proposed an online rumor dissemination model and tested the model through a quasi-experiment. In particular, we investigated online rumors based on their positive, neutral, and negative emotion expressions. Multilevel linear regression was used to test the proposed mediation effect, moderating effect, and moderated mediation effect. Previous studies tended to focus on individuals' emotions and their associated behaviors while ignoring the influence of emotion expressions in text messages for their effects on the spread of online rumors. This study contributes to the field of rumor research in that it adds insight about how emotional expression text and individuals' emotions can influence the spread of online rumors, which is of great significance for further research in this field.

Keywords: online rumor, emotion expression, rumor spreading intention, emotional contagion theory, emotional susceptibility, misinformation, disinformation

Introduction

With the ease of use of modern technologies, emotions embedded in social media postings are more likely to arouse readers' inclination to feel the same way and thus further spread the information. This is a process referred to as "Emotional Contagion" – a phenomenon that one adopts the emotional state or feelings of another person (Singer & Tusche, 2014). When paired with unverified information or misinformation intentionally to misguide the public, the spiral dissemination of social media postings enlarges the impact of such postings, causing business, social and societal damages. Examples of such misinformation include China's KFC restaurants supplying mutated food to consumers¹, taking materials containing iodine could help ward off nuclear radiation². Certain political rumors may even pose a potential threat to national economic development and security, such as fake news during the 2016 U.S. Presidential Election, and North Korean saber rattling³. Unfortunately, the spread of rumors is common in today's social communications, and it has a huge impact on public affairs and political climate¹. Due to the complexity and unpredictability of information disseminated on social networks, the anonymity and openness of the Internet provide users with ample opportunities to comment on issues with little or no consequences¹. Therefore, users are free to exchange their opinions or express their emotions in their online social interactions. Emotion embedded messages spread easier and wider which could provoke a public response

at a faster rate than before⁴, but the more serious issue is when these provocative messages spread unverified information that becomes rumors, misinformation, or disinformation. So far, however, it is not well understood how emotion expressions can influence the spread of online rumors. It is imperative to study the influence of emotion expressions in online rumors on how they are spread.

Given the severity of the problem of online rumors, scholars have been exploring the patterns of how online rumors spread. However, there are three gaps in the current approaches. First, most of these studies viewed the spread of online rumors as the dissemination of information between rational people, and they lack of exploring the influence of emotions expressed through the text on rumor spread. Second, previous studies tended to focus on rational individuals' behaviors while ignoring the influence of viewers' emotions on the spread of online rumors, how the viewers' emotions play a part in the spread intentions of online rumors has not been investigated hitherto. Third, current works on emotional contagion are mainly carried out in a face-to-face situation, and its contagion channels are usually facial expressions, body movements, and voice language⁵, very little research has studied the emotional contagion mediated by the text. For these reasons, we are motivated to study the mechanism of emotional expressions of online rumors on viewers' intention to spread the rumor.

In the line of emotional contagion research, Shi et al. viewed emotional appeal as an important piece of information that influences networking behaviors, which could elicit individuals' cognitive and emotional responses, thereby affecting their intentions to participate in online collective behaviors⁶. People's emotions can be transmitted to each other through online social networks. Therefore, to understand how emotional expressions can trigger affective reactions that influence behaviors, we refer to the emotional contagion theory from social psychology⁷ to study online rumors.

This paper contributes to research in this area by developing and empirically validating an online rumor dissemination model. We also contribute to the literature by extending the emotional contagion theory into the field of online rumors, although prior relevant research is usually concerned primarily about people, little attention has been paid to understanding how online rumor text influence the viewers' emotions.

Literature review

Emotions have obvious explicitness, that is, individuals tend to express their emotions through emotional expression⁸. Early research defined emotional contagion as the process in which the receiver of emotional information automatically and continuously mimics the expression, language, and behavior of the exhibitor of an emotion⁷. This definition is also called primitive emotional contagion. With the development of emotion theory, some researchers believed that emotional contagion is a process in which individuals consciously participate, i.e., emotional contagion is a process of sensing, accepting, identifying, and imitating the emotions of others, and is regulated by the individual's advanced cognitive system⁹. A conscious emotional contagion can also be viewed as an individual collecting, perceiving, and imitating emotions by associating these emotions with certain social messages¹⁰. Thus, emotional contagion is the foundation of human interactions.

In recent years, based on the theory of emotional contagion⁷, scholars have started to study emotional messages on the Internet. For example, Tang and Lai showed that emotionalization is one of the salient features of online public opinion expression, and the effect of a communicator's emotion on the dissemination of public opinion was examined in their study through simulated scenario experiments. They

found that emotionalized public opinion from opinion leaders, rationalized public opinion from the general public, and new commentators were disseminated wider and easier¹¹.

Because of the similarity between the spread of rumors and the dissemination of infectious diseases, epidemic models (such as the Susceptible, Infected, and Refractory model or SIR) are often used as the basis of simulating the rumor-spreading process and have also been frequently borrowed to build rumor spread models. For example, Zanette used the SIR model to simulate the dynamic process of rumor propagation in small-world networks and empirically confirmed that the spreading process of online rumors can be explained by the SIR model¹². Zhao et al. extended the classic SIR rumor dissemination model by adding a forgetting mechanism, which makes the rumor-spreading process more realistic and apparent². Considering various realistic factors, Wang et al. proposed the SIRAIU model and investigated cases where two or more rumors were spread at the same time¹³.

In fact, rumor spreading is similar to the corresponding propagation behavior in the real world¹⁴. Researchers have begun to investigate more factors related to human behavior to explain online rumor-forwarding behavior. From this perspective, scholars have studied issues such as the influence of users' hesitation behavior and network heterogeneity on the spread of online rumors¹⁵; different control and debunking strategies on online rumor diffusion^{16,17}; individual differences in the intention to spread online rumors¹⁸.

In general, previous studies have mostly focused on model simulation and optimization, as well as the control strategy of online rumor propagation. There is a lack of studies on the influence of emotion expression of online rumors on viewers' intentions to further spread rumors. In fact, the emotion expressions in online rumors will affect users' judgment on rumors and their decision whether to spread rumors or not, which plays an important role in the spread process. Therefore, the emotion expression in online rumors associated with individuals' likelihood to spread the rumors needs to be uncovered. To fill the gap, we examine the impact of emotion expression in online rumors on people's rumor spread intention and the associated psychological mechanisms based on emotional contagion theory and the current state of online rumor research.

Research model and hypothesis development

We propose a research model and several hypotheses based on the emotional contagion theory and moderated mediation models (see Figure 1).

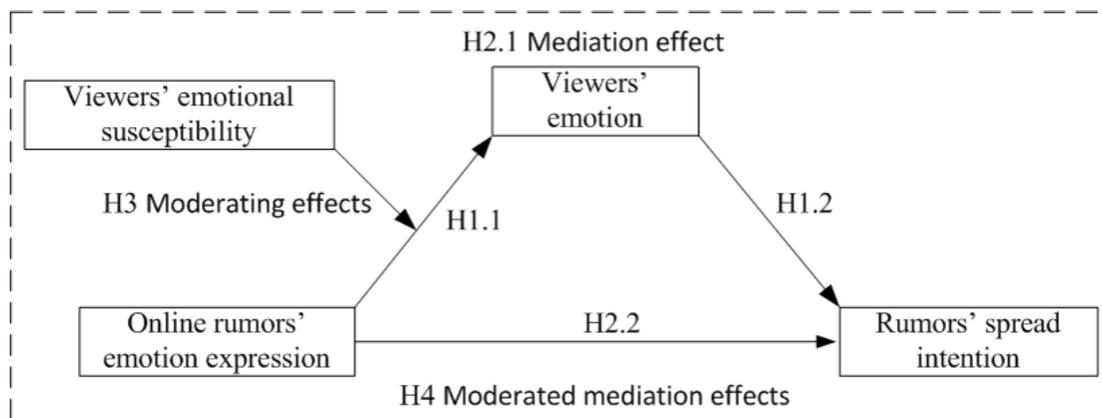


Figure 1 Proposed research model

Emotional contagion and behavioral intention

Emotion plays a critical role in social cognition and behavior¹⁹. According to the emotional contagion theory, emotions can be passed to other people through facial expressions, verbal language, and physical actions. In 1995, Moore et al. were among the first to study the role of written texts in emotional contagion²⁰. They found that texts can stimulate individuals to imagine the described situations and produce similar emotional feelings accordingly. Scholars defined this as emotional infection under the regulation mechanism of language association⁵. Compared with traditional communication media, individual text expressions on social networks are closer to the daily spoken expressions. Individuals can not only express their emotions through texts, but they also use non-text cues (such as emoticons or other symbols) to embed their emotions in the messages. Therefore, emotions can spread on social networks²¹. Emotional contagion could arise when Internet users browse rumors with emotion expressions. Based on this, the following hypothesis is proposed:

H1.1: Emotion expression in online rumors affects viewers' emotions.

In the field of behavioral psychology, the effect of emotions on decision-making has been supported in many experimental studies²². Bechara et al. described its impact process as "emotions represent the brain's coding of the overall outcome of a particular behavior, and intervene in behavioral decisions in a way that can be perceived"²³. When emotions arise, related behavioral intentions also occur²⁴. Some scholars even believed that emotions play a decisive role in behavioral intentions, and it has a greater impact on behavioral intentions than cognition²⁵. When emotions embedded in text resonate with the viewer, it consequently results in intentions to repost, like, and share. If the information read by the viewer is a network rumor, the behavior of liking, reposting, and sharing screenshots contribute to further spreading the rumor. Based on the above inferences, the following hypotheses are proposed:

H1.2: Viewers' emotions affect their intentions to spread rumors.

Mediation effects of viewer emotions

In the field of psychology, an individual's emotions can mediate the relationship between psychological elasticity and stress adaptation, between self-efficacy and happiness, and between events and life satisfaction²⁶. Combining H1.1 and H1.2, we argue that the emotion embedded in online rumors can affect a viewer's emotions, which, in turn, affect the viewer's intention to spread the rumors. This is an indirect effect of emotion expressions in online rumors. Based on this, we propose the following hypothesis:

H2.1: The viewers' emotion mediates the relationship between emotion expressions in online rumors and viewers' intentions to spread rumors.

In addition, the influence of emotion on behavioral intention is also reflected in the mediating effect. Positive emotions and negative emotions can act as "partial intermediaries" or "complete intermediaries" to influence behavioral intention⁵. Emotions embedded in online rumors can directly affect spreading intentions. Therefore, we propose the direct effect between the two as follows:

H2.2: Emotion expressions in online rumors affect viewers' intentions to spread rumors.

Moderating effects of viewers' susceptibility

In the process of emotional contagion, some people are easily affected by others' emotions, while others are not, individuals with varying personality traits may react differently to the same events. Doherty's study showed that there are gender differences in the process of emotional contagion²⁷. Female participants' emotional susceptibility is higher²⁸. Emotional susceptibility refers to the degree to which an individual's emotions are easily affected in emotional contagion. Besides gender, factors such as previous experience, personality traits, and genetics can also affect susceptibility²⁹. Internet users with high susceptibility are more likely to be affected by emotion expressions in online information. Therefore, we propose:

H3: The viewers' emotional susceptibility moderates the relationship between the emotion expressions in online rumors and the viewers' emotions.

Moderated mediation effects

Taken together, we have proposed three sets of hypotheses (H2.1, H2.2, and H3), they are all about the mediating effect and the moderating effect. Specifically, H2.1 illustrated the mediating role between rumors' emotion expression and intention to spread, while H3 described the moderating role of emotional susceptibility between rumors' emotion expression and viewers' emotions. Therefore, this paper follows the above logical assumptions and proposes a moderated intermediary model, which suggests that emotional susceptibility also plays a moderating role in the mediating effect of the viewers' emotion on online rumors' expression- spread intention relationship. Specifically, based on the emotional contagion theory, viewers with high emotional susceptibility are more likely to have a greater effect of emotional contagion³⁰, thus increasing the possibility of spreading the intention of rumors. Emotional susceptibility as a personality trait may play a moderating effect in the indirect effect of views' emotions. As depicted in Figure 1, we formulate the following moderated mediation relationships:

H4: The viewers' emotional susceptibility moderates the relationship between online rumors' emotion expression and the spreading intention of rumors.

Research design

Measures

Based on the research model, this paper mainly involves four variables, including the emotion expressions in online rumors, viewers' susceptibility to emotions, viewers' emotions, and intention to spread rumors. Each item in the questionnaire was measured using a five-point Likert scale.

Emotion expression of online rumors

According to the Differential Emotion Scale (DES) proposed by Izard³¹, emotions can be divided into three categories: positive emotions, neutral emotions, and negative emotions. The present paper manipulates the emotion expressions in online rumors through the texts used in spreading the rumors. To avoid any potential bias from the participants, we removed any information indicating that the questionnaire was about online rumors. We selected food safety rumors as our focus because this topic is closely related to our daily lives and is a topic of interest in other related studies³². The selection criteria are the number of likes, shares, or reposting, the scope of rumor spread, and the availability duration of the original text. By referring to the sentiment corpus of microblog texts³³, the original raw text was processed using mood words, punctuation, word order, and rhetoric to obtain their emotional tendency (positive, negative, or neutral). Examples of

texts with rumors are illustrated in Table 1. In the questionnaire, "the above information expresses positive (neutral, negative) emotions" is used to test the effect of emotion expression.

Table 1 Three types of motions expressed in rumor content

Emotion Type	Rumor Content
Positive emotion	Good News! A new vegetable has been identified 80% anticancer. Here it comes a new era of anticancer!
Neutral emotion	Shock! Eating like this causes cancer easily. See if this applies to you!
Negative emotion	Sad! Applying banned fertilizer to vegetables to yield more. Vegetable farmers are afraid to eat their own produce!

Viewers' susceptibility

The measurement of susceptibility in the field of psychology generally adopts the "Emotional contagion Questionnaire" (ECQ) compiled by Doherty in 1997. Some scholars have seen variations in validity and reliability when administering it to Asian cultures³⁴. Therefore, we adopted the adapted version of ECQ by Zhang et al. and comprehensively considered the applicability of research scenarios and expert opinions³⁴. The finalized version contains 10 items that measure viewers' susceptibility, which examined a person's tendency to mimic five basic emotions—sadness, fear, anger, happiness, and love.

Viewers' emotions

In terms of the measurement of emotion, there are four popular methods currently used in the literature: self-reported measurement, autonomic nervous system (ANS) and electroencephalogram (EEG) measurement, behavioral measurement and startle response measurement³⁵. Existing research often uses self-reports to measure emotions, an approach subject to biases in experimental environments and other factors. This paper considers quasi-experimental timeliness and questionnaire situations and refers to the Positive-Negative Emotional Scale (PANAS) commonly used in the academic community to quantify the emotional state³⁶.

Viewers' intention to spread rumors

The Theory of Planned Behavior (TPB) believes that behavioral intention is the most direct factor affecting behavior and has been widely used in scientific research in many fields. We considered the impact of word-of-mouth intentions³⁷ and information dissemination intentions during communication³⁸. We also considered the differences between WeChat and Weibo's network environments and the characteristics of Internet users' dissemination on the two platforms. Eventually, we designed the following three scenarios.

Scenario 1: Suppose you read this post in your WeChat moment page or group, or you read the post because someone forwarded it to you personally on WeChat.

Scenario 2: Suppose you read this post on Weibo's home page or hot page, or you read the post because someone tagged you under the post.

Scenario 3: Suppose you hear this information during online or offline chatting with others.

Questionnaire design and data collection

This study used data from a situational questionnaire. The questionnaire was disseminated through a post within the campus community website of a local public university in China. Based on our research objectives, the designed fictitious rumors were the stimuli introduced to participants, followed by a survey that measures participants' intention to spread the rumors. Informed by prior studies^{39,40}, spread intention was captured using items such as "I will share this information with other WeChat friends", "I'll cover this information in a similar topic", "I will forward this tweet" and so on.

In the experimental phase, because participants' emotions could affect the validity of the data collected for the observation variables⁴¹, we designed items to measure initial emotions at the beginning of the questionnaire before the experiment started. Based on the scale proposed by Du et al., four questions were used to measure the respondents' initial emotions. When performing data analysis, samples with extreme scores and far deviations from the mean were eliminated to ensure that the initial emotion of each sample is stable and the emotional state is at a similar level. In addition, respondents' familiarity with the experimental context could have an impact on the experimental results. If the respondent has had the same or similar real experience in the experimental setting, the experimental results are likely to be more effective⁴². This study uses two items, (e.g., "I have seen similar information in Weibo followers or hot topics") to measure the respondents' familiarity with the experimental situation. During data analysis, samples with lower scores and large deviations from the mean were excluded to ensure that the sampled participants were more familiar with the experimental situation and that there was little difference in familiarity.

We designed three groups of questionnaires in this experiment. In order to ensure the scientificity of the final experimental results and to take into account the feasibility of the experiment, a sample of 120 was set for each group, and 360 situational questionnaires were provided. A total of 327 copies were received with a response rate of 91%. This resulted in a final sample of 266 valid questionnaires after excluding responses with extreme initial sentiment scores and low familiarity with online rumors.

Data Analysis and Results

Descriptive statistics

The demographic characteristics of the sample are shown in Table 2.

Table 2 Descriptive statistics of the sample

Question	Option	Frequency	Percentage
Gender	Male	97	36.5%
	Female	169	63.5%
Age (year)	<= 18	6	2.3%
	19~28	183	68.8%
	29~38	36	13.5%
	39~48	18	6.8%
	>= 49	23	8.6%
Education level	Middle school	5	1.9%
	Two-year or three-year college	33	12.4%
	Bachelor's	134	50.4%
	Master's or Ph.D.	94	35.3%
Number of years using social media (year)	<= 2	11	4.1%
	3~4	51	19.2%
	5~6	99	37.2%
	7~8	71	26.7%
	>= 9	34	12.8%
Time spent on social media per day (minute)	<= 30	18	6.8%
	31~60	64	24.1%
	61~120	83	31.2%
	121~180	40	15.0%
	>= 181	61	22.9%

As can be seen from Table 2, the gender distribution is slightly uneven. The reason may be that some questionnaires were administered at universities with a focus on economics and finance. The proportion of female students at these colleges is generally large, resulting in a 27% higher sample size for women than for men. Because females tend to use social networks more frequently and are more susceptible to emotions, this difference is acceptable. In terms of age, more than 68% of the samples were in the 19-28-year-old category. This age range covers most college students and newcomers to the workplace and is the main group of the population who used social networking most often. In terms of education level, 85.7% of the sample size is a bachelor's degree or above. In terms of the age and frequency of use of social media platforms, 95.9% of the samples have more than 2 years of experience, and 93.2% of the samples used social media for more than half an hour per day, reflecting that the sample is generally familiar with social networking platforms.

Reliability and Validity

The results are shown in Table 3. The Cronbach's α coefficients of all variables are above 0.7, indicating that each scale has an acceptable level of reliability. The overall Cronbach's α coefficient of the questionnaire is 0.884, which can be tested for validity.

Table 3 Reliability results of the variables

variables or questionnaire	Number of items	Cronbach's α
online rumor emotion expression (ED)	1	/
viewer susceptibility (ES)	10	0.788
viewer emotional self-report (SR)	8	0.840
viewer intention to spread rumors (SI)	11	0.929
questionnaire overall	30	0.884

The situational questionnaire used in this study refers to the Differential Emotional Scale (DES), the "Emotional contagion Questionnaire" and the Positive-Negative Emotional Scale (PANAS). The above scales are classic scales in the field of emotion research and have been widely adopted by the academic community. In addition, during the pilot study, through the discussion with experts and scholars, the text and structure of the original questionnaire were improved to ensure content validity. The items in this questionnaire about emotional contagion are divided into "positive emotional situation, neutral emotional situation, and negative emotional situation"; self-report on emotions is divided into "positive emotion, neutral emotion, and negative emotion"; and the items on the context environment were divided into "WeChat, Weibo, and chatting". The analysis results are shown in Table 4. The model fit of the nine-factor model is the best compared with other alternative models, the fit of this model reached the standard for research ($X^2/df=2.295<5$, $RMSEA = 0.061 < 0.08$, $IFI = 0.922 > 0.9$, $TLI = 0.906 > 0.9$, $CFI = 0.921 > 0.9$). Therefore, this questionnaire has good discriminative validity.

Table 4 AMOS confirmatory factor analysis results (N = 266)

Model	Factors	X^2/df	RMSEA	IFI	TLI	CFI
Nine factors	WCE, W BE, CE, Pos, Neu, Neg, PosE, NeuE, NegE	2.295	0.061	0.922	0.906	0.921
Eight factors	WCE, W BE, CE, Pos, Neu+Neg, PosE, NeuE, NegE	2.331	0.062	0.918	0.904	0.917
Seven factors	WCE+WBE, CE, Pos, Neu+Neg, PosE, NeuE, NegE	2.725	0.07	0.892	0.875	0.891
Six factors	WCE+WBE+CE, Pos, Neu+Neg, PosE, NeuE, NegE	3.28	0.08	0.854	0.835	0.853
Five factors	WCE+WBE+CE, Pos+Neu+Neg, PosE, NeuE, NegE	3.64	0.087	0.829	0.809	0.828
Four factors	WCE+WBE+CE, Pos+Neu+Neg, PosE+NeuE, NegE	3.855	0.09	0.813	0.794	0.812
Three factors	WCE+WBE+CE, Pos+Neu+Neg, PosE+NeuE+NegE	4.423	0.099	0.774	0.753	0.772
Two factors	WCE+WBE+CE, Pos+Neu+Neg+PosE+NeuE+NegE	6.148	0.121	0.657	0.628	0.656
Single factor	WCE+WBE+CE+Pos+Neu+Neg+PosE+NeuE+NegE	9.03	0.151	0.464	0.42	0.461

Note: WCE – WeChat; WBE – Weibo; CE – Chatting; PosE – positive emotional situation; NeuE – neutral emotional situation; NegE – negative emotional situation; Pos – positive emotions; Neu – neutral emotions; Neg – negative emotions.

Common Method Bias

Since each questionnaire is filled out by the same subject, there might be a possibility for common method bias. We used Harman single factor analysis to check common method bias. All variables were analyzed using unrotated principal component analysis, and the results show that the common factor variance interpretation of the first eigenvalue greater than 1 was 27.097%, which was less than the recommended value of 50%. Therefore, the common method bias was not a significant issue in this study. Multi-level linear regression was used to test the proposed direct effects, mediating effect, and moderating effect. The eight viewers' self-reported emotions were classified into positive emotions, negative emotions, and neutral

emotions according to the DES (Differential Emotion Scale). Among them, the average of pleasant (SR1) and relaxed (SR5) ratings is used as the positive emotion score; the average of surprise (SR2) and nervous (SR7) ratings are used as the neutral emotional score; the remaining average of the reported values score as negative emotions.

The direct effects

Regression results for control variables are shown in Table 5. Since no statistically significant linear regression exists in each model, gender, age, education level, age of use, and length of use have not significantly affected positive, neutral, and negative emotions. Emotion expression (ED) was added as the independent variable. The regression results are shown in Table 6. Compared with the above model without the independent variable ED, variance explained by the model increased by 33.2% (Positive), 31.8% (Neutral), and 44.7% (Negative) respectively. It showed that the model fits well, and the p-value of each regression model is less than 0.001. Thus, there is a significant linear regression relationship between the independent variable ED and the positive, neutral, and negative emotion expression of the dependent variable, emotion expressions in online rumors. Therefore, H1.1 is supported.

Table 5 Regression Results with Control Variables Only

Variable type	Online Rumor Emotional Expression		
	positive	neutral	negative
Intercept (constant)	2.662	3.114	3.096
Control			
Gender	0.147	-0.002	0.022
Age	-0.067	-0.104	0.068
Education	0.043	-0.117	-0.034
Years	0.092	0.025	-0.206
Duration	0.011	-0.113	-0.004
R ²	0.044	0.060	0.082
Adjusted R ²	-0.014	0.003	0.026
Significance	0.580	0.397	0.206

Similar to the above analysis, H1.2 is tested, and the results of multilevel linear regression are shown in Table 7. The regression results showed that whether the emotions are expressed as positive, neutral, or negative, the amount of explanation of variance has significantly increased compared with the regression with only the control variables ($P < 0.05, 0.001, 0.001$). Therefore, the viewers' emotions significantly affect the intention to spread rumors, which supports H1.2.

Table 6 Regression Results with Rumor Emotion expression

Variable type	Online Rumor Emotional Expression			
	positive	neutral	negative	
Intercept (constant)	1.476	0.954	0.421	
Gender	-0.069	-0.082	0.077	
Age	-0.023	-0.085	-0.053	
Control	Education	0.035	-0.025	-0.068
Years	0.018	0.025	-0.132	
Duration	-0.013	-0.124	0.062	
Independent variable	ED	0.463	0.511	0.767
R ²	0.364***	0.375***	0.537***	
ΔR ²	0.320	0.315	0.455	
Adjusted R ²	0.318	0.321	0.503	

Table 7 Regression Results with Reviewers' Emotions

Variable type	Online Rumor Emotional Expression						
	positive		neutral		negative		
Whether include SR	No	Yes	No	Yes	No	Yes	
intercept (constant)	1.863	1.453	1.951	0.855	2.905	1.657	
Gender	0.093	0.078	-0.053	0.058	0.357	0.250	
Age	0.208	0.180	0.126	0.179	0.120	0.047	
control	Education	0.015	0.032	0.086	0.065	-0.162	-0.169
variables	Years	-0.071	-0.090	-0.070	-0.073	-0.079	0.031
Duration	0.043	0.049	0.077	0.081	-0.089	-0.074	
Independent variable	SI	/	0.212	/	0.363	/	0.501
R ²	0.103	0.144*	0.036	0.197***	0.133*	0.389***	
ΔR ²	0.103	0.041	0.036	0.161	0.133	0.256	
Adjusted R ²	0.049	0.082	-0.022	0.138	0.081	0.345	

Test of mediating effect and moderating effect

Regarding the of mediating effect, the R² of model 2 in Table 8 is increased from 0.056 to 0.062 compared with model 1, and the regression result is significant at the level of 0.01, indicating that the emotion expressions in rumors on the Internet significantly affected viewers' emotions. Therefore, H2.2 is supported. Compared with model 4, model 5 has an increased amount of variance explained by 9%, and it is significant at the level of 0.001, which showed that the online rumor's emotion expression has a significant positive impact on viewers' emotions. This again verified H1.1. Compared with model 2, the coefficient of ED in model 3 has a significant decrease, and R² has increased significantly to 0.216. From the above data, it can be inferred that the model has a higher degree of fit, and there is a statistically significant linear regression relation at the level of 0.001.

Table 8 Results of the Mediation and Moderating Effects

Variable	Intentions (SI)			Viewers' Emotion (SR)				
	model 1	model 2	model 3	model 4	model 5	model 6	model 7	
Intercept (constant)	2.128	1.886	1.335	2.408	1.411	0.862	0.815	
Control variables	Gender	0.113	0.095	0.127	-0.006	-0.082	-0.084	-0.073
	Age	0.171	0.171	0.152	0.048	0.049	0.054	0.064
	Educated	-0.012	-0.008	-0.016	0.006	0.021	0.025	0.032
	Years	-0.045	-0.043	-0.031	-0.038	-0.031	-0.030	-0.021
	Duration	0.000	-0.001	0.008	-0.020	-0.023	-0.027	-0.029
Independent variable	ED	/	0.068	-0.041	/	0.281	0.252	0.255
Mediating variable	SR	/	/	0.390	/	/	/	/
Moderator	ES	/	/	/	/	/	0.170	0.149
Interaction	ED*ES	/	/	/	/	/	/	0.228
R ²	0.056*	0.062**	0.216***	0.007	0.097***	0.107***	0.121***	
ΔR ²	0.056	0.006	0.154	0.007	0.090	0.010	0.015	
F	3.103	2.865	10.177	0.365	4.617	4.398	4.434	

To sum up, there is a mediating effect in this regression model, that is, emotion embedded in online rumors has a positive effect on viewers' intentions to spread the rumors by affecting their emotions. Thus, H2.1 is supported. In addition, the significance of the independent variable ED in Model 3 is $p=0.419$. Therefore, the mediation effect is a partial mediation.

Regarding the test of the moderating effect, we centralized the rumor sentiment in ED and the mood susceptibility (ES) as moderating variables, and constructed the interaction terms between the two variables. From models 5 to 7 in Table 8, it can be seen that emotion expressions in online rumors (ED), viewer's susceptibility (ES), and interaction term ED * ES all had a significant linear regression relationship on the viewer's mood at the level of 0.001. After adding the interaction term, the adjusted R² in Model 7 increased to 0.121, the coefficient for ED was 0.255, and the coefficient for the interaction term was 0.228 ($P < 0.001$). This shows that the viewer's susceptibility significantly moderated the relations between rumors' emotion expression and the viewer's emotion at the level of 0.001. Because the coefficients of the interaction term and independent variable are both positive, it shows that the moderating effect in this model is a positive enhancement. The viewer's susceptibility enhances the influence of online rumors' emotion expression on viewers' emotions, and H3 is supported.

In order to visually and intuitively show the moderating effects in the model, this paper uses the average plus or minus one standard deviation as a benchmark to distinguish the high and low groupings of online rumors' emotion expression scores and viewers' susceptibility and uses the ED, ES and the ED * ES coefficients in the moderating effect equation. Figure 2 shows the moderating effect of the viewer's high susceptibility ($M + 1SD$) and low susceptibility ($M-1SD$) on the influence of online rumor emotion expression on viewers' emotions in a plot. It can be seen from the figure that regardless of the level of viewers' emotional susceptibility, emotional susceptibility has a positive moderating effect on the model. Thus, H3 is supported. The slope of the high susceptibility group is larger, indicating that compared with the viewers with low susceptibility, the viewers with high susceptibility were more likely to be affected when viewing emotional online rumors.



Figure 2 Effect of viewers' emotional susceptibility on the relationship between online rumor emotion expression and viewers' emotions

The moderated mediation effect test

With a 95% confidence interval and 5000 bootstrapping, emotion expressions in online rumor (ED), viewer's rumor spread intention (SI), viewers' emotion (SR), and viewers' emotional susceptibility (ES) were set as independent, dependent, mediating, and moderating variables, respectively. We calculated the test results of the moderated mediating effect through a macro command in SPSS. See Table 9 for a summary of the moderated mediating effect model, and Table 10 for the moderating effects and interval parameters of the viewer's emotional susceptibility group.

Table 9 Results of the Moderated Mediation Effect

		Coefficient	standard error	t
intercept (constant)		-0.0277	0.0460	-0.6027
Independent variable	ED	0.1786**	0.0564	3.1642
Moderator	ES	0.2097*	0.0962	2.1825
Interaction	ED*ES	0.2445*	0.1158	2.1112
R ²		0.2739***		
F		7.7984		

As can be seen from Table 9, the model R² is 0.2739 (P <0.001), which indicates that the model has a moderate mediating effect. As shown in Table 10, the model effect value is 0.0193 in the low emotional susceptibility group, and the confidence interval contains 0, which indicates that the moderating effect within this group is not statistically significant. In the high susceptibility group, the model effect value is 0.1069, which is significantly larger than the low susceptibility group, and the confidence interval does not contain 0. This shows that the moderated mediating effect is significant in the high susceptibility group. And the effect is positive, that is, the high emotional susceptibility enhances the mediating effect of viewers' emotions on the emotion expressions in online rumors and viewers' intentions to spread rumors. H4 is partially supported.

Table 10 Parameters of the moderating effect of viewers' emotions

	ES	effect	standard error	Lower confidence limit	Upper confidence limit
M-1SD	-0.5047	0.0193	0.0291	-0.0348	0.0799
M	0	0.0629	0.0226	0.0234	0.1126
M+1SD	0.5047	0.1069	0.0413	0.0382	0.2048

Discussion

There are several key findings from this study. First, emotion expression of online rumors positively affects viewers' emotions. All the hypotheses in the present study are based on the emotional contagion theory. Previous research studied individuals⁴³ or groups⁴⁴ as subjects for emotional contagion, but these subjects are also affected by the media that use. This study extended this theory to the impact of texts on individuals. Our quasi-experiment and linear regression verified that online rumor emotion expression has a positive impact on viewers' emotions. Our research results are consistent with the extant research.

Second, viewers' emotions affect their intentions to spread rumors. Specifically, the higher the individual's emotional score, the stronger the intention to spread rumors. When online rumors spread negative emotions such as panic and anxiety, people tend to believe rather than disregard the content, which accelerates the rumor spread. In this paper, emotion expression group changed much larger than those in the other two groups, indicating that when viewers have negative emotions such as disgust, sadness, anger, and fear, it is more likely to energize their intentions to spread rumors.

Third, viewers' emotions played a partial mediation effect on the positive influence of online rumors' emotion expression on viewers' intention to spread rumors. When applying emotional contagion theory in different contexts, some researchers focused on the mediating role of emotions. For example, Yi and Liang discussed the mediation effect of Internet users' emotions in tourism and showed that online travel blogs could increase people's intention to travel by affecting their emotions⁵. We found similar conclusions.

Fourth, viewers' emotional susceptibility played a moderating role in the positive influence of emotion expressions in online rumors on viewers' emotions. When Zhang et al. demonstrated the mechanism of emotional contagion from the perspective of biological feedback, they observed that due to the difference in emotional observation ability and imitation ability between individuals³⁰, some individuals were easily affected by others, while others were difficult to be affected. This study echoes the above points through an empirical analysis in the field of online rumors. When facing emotionally expressed online information, viewers with high emotional susceptibility will significantly enhance the positive impact of rumor's emotion expression on their emotions.

Fifth, there is a moderated mediation effect in the online rumor-spreading model based on the theory of emotional contagion. The indirect effect of emotion expression on the viewer's emotion is stronger when the viewer's susceptibility is high than when it is low. However, when susceptibility is low, it did not show any significance. For those who are not easily affected by others, their emotions are less affected by the emotion expressions in online rumors, which may weaken the moderated mediation effect in this model. Therefore, by referring to Wang et al.'s research conclusions on "The probability of fear emotion infection"⁴⁵, we suggest that when the reliability of the online information is unknown, suppressing one's emotions may help decrease the spread of the rumor.

Conclusion

Contributions to theory

The results of our study contribute to a better understanding of the factors that influence the spread of online rumors. In particular, we provided novel insights into the effects of individuals' psychological processes and the emotion expressions in online rumors, which so far have not been studied in detail.

First, rooted in the emotional contagion theory, we proposed a rich theoretical lens that can explain the influence of emotion expressions in online rumors and individuals' psychological emotions in relation to the context of rumors' spread. Therefore, we extended the theory of emotional contagion into the research stream of online rumors. So far, extant research usually considers only human factors when it comes to the context of emotional contagion. Motivated by the research of Tang and Lai¹¹, we applied emotional contagion theory to explain individuals' emotions and the emotion expressions in online rumors, a non-human factor. Second, we established and verified an online rumor dissemination model based on emotional contagion theory. In particular, we explored mediating, moderating, and moderated mediation effects in the model, and further enriched the rumor spread model system under a social network environment. Third, when applying the emotional contagion theory to analyze the relationship between various variables in the spread of online rumors, previous studies tended to focus on rational individuals' behaviors while ignoring the influence of viewers' emotions on the spread of online rumors. We revealed the important mechanism of emotion expressions in online rumors, which is of great significance for further research in this field.

Contributions to practice

The practical contributions of this research are as follows. First, with the frequent changes in how people spread online rumors, online rumor detection engines should update more frequently for emotionally affected words, punctuation, short phrases, and techniques associated with rumor detection. Second, social platforms should spend more effort on monitoring opinion leaders or anyone who can generate faster and wider online impact for the purpose of containing rumor spread. Opinion leaders play an important role in the process of online emotional contagions, and platforms should quickly limit or block emotional rumors when necessary. Third, media channels should strengthen their morality and sense of responsibility, decreasing the negative impact of emotionalized rumors on public emotions. In the early stage of dissemination of information, the media should report the news with caution and not gain public attention with emotion expression. Before citing information from other sources, media channels should first judge the reliability and authenticity of the information to reduce the possibility of rumors. Fourth, the government should strengthen legislations to protect citizens from online rumors. Although it depends on cultural and societal norms, a government may step as far as regulating, controlling, and fact-checking online rumors in a timely manner. Moreover, the government should also strengthen the cultivation of the literacy of citizens, encourage users to actively spread positive public opinion, and encourage a culture of fact-checking by citing legitimate evidence. Fifth, Internet users should treat online information rationally and be alert to emotional information. Most Internet users, as the audience and disseminator of information, neglect the identification of authentic evidence and unknowingly spread rumors. Internet users must be more vigilant about emotional information and avoid becoming rumor spreaders due to emotional contagion.

Limitations

This paper also has certain limitations: First, the cross-sectional design of the data in the situational questionnaire does not consider the effect of time on the variables, and it cannot completely rule out the

interference of the common method on the verification results. In the future, field experiments or vertical designs may be used in experiments and quasi-experiments, and multiple points of data can be collected to analyze changes in variables over time. Second, the source of quasi-experimental data is relatively single, which may cause the conclusion of the experiment to be not universal. Future research can expand the coverage of the sample, geographic representations, demographic differences, and even how the rumor text is formatted. Third, the moderator variable only considers the viewer's susceptibility. Future studies may consider the rumor's emotional appeal, individual differences among viewers, and the original emotional state to adjust the mechanism of emotional contagion to simulate the changes in viewers' emotions. Fourth, no consideration is given to the influence of emotional contagion on secondary dissemination, in the secondary dissemination of online rumors, the viewer has changed from the receiver of the information to a secondary source. Future research can focus on the influence of emotional contagion among the audience on the spread of online rumors.

References

- Agnes, M. & Maja, F. (2018). Demystifying the role of emotion in behavior: toward a goal-directed account. *Cognition and Emotion*, 33, 94-100. doi: 10.1080/02699931.2018.1510381
- Al-Garadi M.A., Varathan, K.D., Ravana, S.D., Ahmed, E., Chang, V., Lv, Z. (2016). Identifying the influential spreaders in multilayer interactions of online social networks. *Journal of Intelligent and Fuzzy Systems*, 31(4): 2721-2735. doi: 10.3233/JIFS-169112
- Bakker, A.B. & Schaufeli, W.B. (2010). Burnout contagion processes among teachers. *Journal of Applied Social Psychology*, 30(11): 2289-2308. doi:10.1111/j.1559-1816.2000.tb02437.x
- Bechara, A, Damasio, H, Tranel, D. et al. (1997). Deciding advantageously before knowing the advantageous strategy. *Science*. 275(5304):1293-1295. doi: 10.1126/science.275.5304.1293
- Bispo, L., Paiva, A. (2009). A model for emotional contagion based on the emotional contagion scale. *In: 3rd international conference on affective computing and intelligent interaction and workshops*, 1-6. doi:10.1109/ACII.2009.5349396
- Churchill, G.A & Peter, P.J. (1984). Research design effects on the reliability of rating scales: a meta-analysis. *Journal of Marketing Research*. 21(4): 360-375. doi:10.2307/3151463
- Doherty, R.W. (1997). The emotional contagion scale: a measure of individual differences. *Journal of Nonverbal Behavior*. 21(2):131-154. doi:10.1023/A:1024956003661
- Hampson, E, Anders SMV & Mullin LI. (2006). A female advantage in the recognition of emotional facial expressions: test of an evolutionary hypothesis. *Evolution and Human Behavior*. 27(6), 401-416. doi:10.1016/j.evolhumbehav.2006.05.002
- Hatfield, E. & Cacioppo, J.T. (1994). Emotional contagion. Cambridge University Press. doi:10.1111/1467-8721.ep10770953
- Izard, CE. (1984). Emotion-cognition relationships and human development. *Emotion, Cognition and Behavior*. New York: Cambridge University Press. 17-37

- Jiang, M, Gao Q. & Zhuang, J. (2021). Reciprocal spreading and debunking processes of online misinformation: A new rumor spreading–debunking model with a case study. *Physica A: Statistical Mechanics and Its Applications*, 565. doi:10.1016/j.physa.2020.125572
- Lee, CS (2012). Long M. News sharing in social media: the effect of gratifications and prior experience. *Computers in Human Behavior*, 28(2), 331-339. doi:10.1016/j.chb.2011.10.002
- Lee, H & Oh, H..J. (2017). Normative mechanism of rumor dissemination on twitter. *Cyber psychology Behavior and Social Networking*. 20(3):164. doi:10.1089/cyber.2016.0447
- Li, J, Jiang, H, Yu, Z. & Hu, C. (2019). Dynamical analysis of rumor spreading model in homogeneous complex networks. *Applied Mathematics and Computation*. 359:374–385. doi:10.1016/j.amc.2019.04.076
- Loewenstein, G, Weber E, Hsee, C & Welch, N. (2001). Risk as feelings. *Psychological Bulletin*, 127(2): 267-286. doi:10.1037/0033-2909.127.2.267
- Lorenzo, C, Yunkyu, S, Kramer, A, Cameron, M., Massimo, F., Christakis N.A. et al. (2014). Detecting emotional contagion in massive social networks. *Plos One*, 9(3), 1-6. doi:10.1371/journal.pone.0090315
- Lewis, M & Todd, RM. (2005). Getting emotional: a neural perspective on emotion, intention, and consciousness. *Journal of Consciousness Studies*. 12(8), 210-235. doi:10.1007/s10806-005-2851-0
- Martin, D, O'Neill, M, Hubbard, S & Palmer A. (2008). The role of emotion in explaining consumer satisfaction and future behavioural intention. *Journal of Services Marketing*. 22(3), 224-236. doi: 10.1108/08876040810871183
- Moore, D.J., Harris, W.D. & Chen, H.C. (1995). Affect intensity: an individual difference response to advertising appeals. *Journal of Consumer research*. 273(8), 154-164. doi:10.1086/209442
- Ong, A.D., Bergeman, C.S., Bisconti, T.L. et al. (2006). Psychological resilience, positive emotions, and successful adaptation to stress in later life. *Journal of Personality and Social Psychology*. 91(4), 730-749 · doi:10.1037/0022-3514.91.4.730
- Pal, A., Chu, a A.Y. & Goh, D.H. (2020). How do users respond to online rumor rebuttals. *Computers in Human Behavior*. 106, 1-11. doi:10.1016/j.chb.2019.106243
- Kelle, R.P.A, Lipkus, I.M. & Remer, B.K. (2003). Affect, framing, and persuasion. *Journal of Marketing Research*. 40(1), 54-64. doi:10.2307/30038835
- Kirchler, E. & Davis, J.H. (1986). The influence of member status differences and task type on group consensus and member position change. *Journal of Personality and Social Psychology*. 51(1), 83-91. doi:10.1037/0022-3514.51.1.83
- Pei, L., Zhang, Z., Li, C., Guo, Y., & Xu, M. (2019). Crowd behavior evolution with emotional contagion in political rallies. *IEEE Transactions on Computational Social Systems*. 6(2), 377-386. doi:10.1109/TCSS.2018.2878461

- Raab, M., Schlauderer, S., Overhage, S. et al. (2020). More than a feeling: Investigating the contagious effect of facial emotional expressions on investment decisions in reward-based crowdfunding. *Decision Support Systems*. 135, 1-11. doi:10.1016/j.dss.2020.113326
- Schmitt, B.H., Dubé, L. & Leclerc, F. (1992). Intrusions into waiting lines: does the queue constitute a social system? *Journal of Personality & Social Psychology*. 63(5), 806-815. doi:10.1037/0022-3514.63.5.806
- Shen, Y.C., Lee, L.Y., Pan, L.Y. & Lee, C.Y. (2021). Why people spread rumors on social media: developing and validating a multi-attribute model of online rumor dissemination. *Online Information Review*. 45(7), 1227-1246. doi:10.1108/OIR-08-2020-0374
- Shi, M., Liu, C., Shi, K. et al. (2018). The path of online collective behavioral intention being affected by emotional contagion: a study based on the emotion-information theory. *Journal of Intelligence*. 37(11), 103-109. doi:10.3969/j.issn.1002-1965.2018.11.016.
- Singer, T. & Tusche, A. (2014). Understanding Others: Brain Mechanisms of Theory of Mind and Empathy, In Paul W. Glimcher and Ernst Fehr (Eds.), *Neuroeconomics*, 2nd edition, 513-532.
- Steinert, S. (2020). Corona and value change. the role of social media and emotional contagion. *Ethics and Information Technology*. 1-10. doi:10.1007/s10676-020-09545-z
- Tang, X.M. & Lai, S.Q. (2018). The influence of emotional information on the spread of public opinion events. *Journal of Intelligence*. 37(12), 124-129. doi:10.3969/j.issn.1002-1965.2018.12.019.
- Vijayalakshmi, V. & Bhattacharyya, S. (2012). Emotional contagion and its relevance to individual behavior and organizational processes: A position paper. *Journal of Business and Psychology*. 27(3), 363-374. doi:10.1007/s10869-011-9243-4
- Wan, J.H, Sui, J. & Yu, H. (2014). Research on evacuation in the subway station in China based on the Combined Social Force Model. *Physical A: Statistical Mechanics and its Applications*. 394, 33-46. doi: 10.1016/j.physa.2013.09.060
- Wang, Q., Yang, X. & Xi W. (2018). Effects of group arguments on rumor belief and transmission in online communities: an information cascade and group polarization perspective *Information and Management*. 55(4), 441-449. doi:10.1016/j.im.2017.10.004
- Wang, J., Zhao, L. & Huang, R. (2014). SIRaRu rumor spreading model in complex networks. *Physica A: Statistical Mechanics and Its Applications*. 398, 43-55. doi:10.1016/j.physa.2013.12.004
- Wang, X.W., Li, Y.Q., Liu, Y.T., & Qiu, C. (2021). A rumor reversal model of online health information during the covid-19 epidemic. *Information Processing & Management*. 58: 1-19. doi: 10.1016/J.IPM.2021.102731
- Watson, D. & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological Bulletin*. 98, 219-235. doi:10.1037/0033-2909.98.2.219
- Wang, C.X., Lv, S.R. & Yang, K.. (2015). Research on probability of fear contagion in emergency. *China Safety Science Journal*. 25(9), 14-19. doi: 10.16265/j.cnki.issn1003—3033.2015.09.003

- Wu, F., Huang, Y., Song, Y. & Liu, S. (2016). Towards building a high-quality microblog-specific Chinese sentiment lexicon. *Decision Support Systems*. 87, 39-49. doi:10.1016/j.dss.2016.04.007
- Xie, J., Fang, P. & Jiang, Y.(2018). Advances in emotion measuring methods. *Journal of Psychological Science*. 2, 488-493. doi: 10.16719/j.cnki.1671-6981.2011.02.048
- Xu, H., Li, T., Liu, X., Liu, W., & Dong, J. (2019). Spreading dynamics of an online social rumor model with psychological factors on scale-free networks. *Physica A: Statistical Mechanics and its Applications*. 525, 234–246. doi:10.1016/j.physa.2019.03.037
- Yi, T. & Liang, M.Z. (2019). The effect of emotion expression in travel blogs on tourists' intention: an empirical analysis based on emotional contagion theory. *Tourism Research*. 11(1), 1-15. doi:10.3969 /j.issn.1674-5841.2019.01.001
- Zanette, D.H. (2001). Critical behavior of propagation on small-world networks. *Physical Review E*. 64(5), 1-4. doi:10.1103/PhysRevE.64.050901
- Zhang, Q.Y., Lu, J.M., Yan, Z.Y. et al. (2016). The mechanism of emotional contagion. *Acta Psychologica Sinica*. 48(11), 1423-1433. doi:10.3724/SP.J.1041.2016.01423
- Zhang, L. (2016). Positive group affective tone and employees' work engagement: Based on emotional contagion theory. *Journal of International Psychology*. 51, 809. doi:10.2224/sbp.6751
- Zhao L., Cui, H, Qiu, X., Wang, X. & Wang, J. (2013). SIR rumor spreading model in the new media age. *Physica A: Statistical Mechanics and its Applications*. 392(4), 995–1003. doi: 10.1016/j.physa.2012.09.030