Factors affecting individual online rumor sharing behavior in the COVID-19 pandemic

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A B S T R A C T

With the outbreak of COVID-19, online sharing of rumors about the disease is of growing concern worldwide. Drawing on the stimulus–organism–response (S–O-R) framework, this study aims to explore the impacts of peer condition and peer communication on fear of COVID-19, and the impact of fear of COVID-19 on online rumor sharing behavior, by considering the contingency effect of health self-efficacy. Data from 1167 respondents to an online survey in China were adopted to test our research model. The results indicate that peer communication and peer condition induce fear of COVID-19, and fear of COVID-19 results in online rumor sharing. Fear of COVID-19 mediates the effects of peer communication and peer condition on online rumor sharing. Health self-efficacy alleviates the positive effect of peer communication on fear of COVID-19, and the positive effect of fear of COVID-19 on online rumor sharing. This study advances the literature on online rumor sharing and S–O-R, and provides practical implications to social media users and governments.

1. Introduction

Since the beginning of 2020, coronavirus disease (COVID-19) has become a global pandemic, which has not only caused significant challenges for health systems but also resulted in economic recession. Simultaneously, numerous rumors and pieces of misinformation, relating to the etiology, prevention, and cure of the disease, have spread on social media (Tasnim et al., 2020). The World Health Organization (WHO) became promptly aware of the importance of these rumors, referring to this phenomenon as the first global *infodemic* (Cinelli et al., 2020; Zarocostas, 2020) because it spreads more rapidly than news with reliable sources and has great influence during the virus outbreaks. For example, rumors about the national lockdown fueled panic purchasing of groceries and paper products in the United States, resulting in the disruption of the supply chain and food insecurity in the public domain.[1] Similar phenomena have been observed in the rumors relating to the diagnosis and treatment of COVID-19; this confuses the general population as well as the healthcare providers. For instance, in China on January 31, 2020, it was widely spread in social media that the Shuanghuanglian oral solution could inhibit COVID-19, resulting in the exhaustion of stock of Shuanghuanglian-related products and market

confusion. In addition, the rumor led to reduced compliance with home quarantine and social isolation, which was of particular concern with individuals infected with the disease. In China in February 2020, when there was a rapid increase in COVID-19 cases, people lived in quarantine and isolation and at risk of infection, and experienced psychosocial stress. Thus, people turned to social media to learn more about the disease, where rumors are rampant even with the presence of anti-rumor platforms. Thus, this motivates us to explore the mechanisms by which online rumors are spread.

In the existing literature on rumors in the COVID-19 outbreak, scholars mainly focus on the diffusion of rumors related to COVID-19 on social media platforms (Cinelli et al., 2020; Ding et al., 2020; Mourad et al., 2020). Cinelli et al. (2020) collected rumor data on five social media platforms and analyzed the rumor amplification among the different platforms. Song et al. (2020) provided a large COVID-19 rumor dataset and adopted a neural topic model to label the topic classification. Other studies include the research on disinformation propagation (Huang & Carley, 2020; Li et al., 2020); examining the social, cultural, and political entanglements (Leng et al., 2020); and identifying disinformation campaigns (Vargas et al., 2020). Moreover, Hui et al. (2020) adopted the epidemic-like model and considered education as the

control measure in analyzing the mechanism of spread. However, prior research contributes little on the individual aspects and exploring the social and psychological factors in rumor sharing in the COVID-19 outbreak. A similar research was presented by Long et al. (2020) focusing on the impacts of individuals' basic characteristics (e.g., age, gender, education, and house type) on rumor beliefs, and these basic factors were set as control variables in our research.

Prior studies on online rumor sharing have mainly focused on the processes of online rumor sharing (Chen, 2019; Lee et al., 2015; Zhao et al., 2013) and the reasons for online rumor sharing (Kwon & Rao, 2017; Oh et al., 2018; Zhao et al., 2016) independently. For example, the SIR (susceptible, infected, and recovered) model was applied to explore the process of rumor spreading by Zhao et al. (2013). With regard to the reasons for rumor sharing, Zhao et al. (2016) mainly focused on social media in the context of social crisis, whereas Kwon and Rao (2017) chose the context of government internet surveillance. However, studies combining the processes of and the reasons for online rumor sharing are rare and insufficient, and have not considered the context of crisis/disaster and health contexts. This study focuses on the processes of and the reasons for online rumor sharing in the context of COVID-19.

Our study focuses on some social and psychological factors which consist of peer communication, peer condition, and fear. Peer communication indicates the peer interactions and can affect the individual's perception (Geber et al., 2019). Peer condition reflects the health conditions of an individual (Hogue & Mills, 2019). Under the spread of COVID-19, the peer condition and peer communication can trigger negative attitudes and impacts of the disease, and the fear of COVID-19 emerges. Fear reflects a situation judged as dangerous, and fear of the virus is detrimental to thinking carefully about rumors and leads to irrational decisions based on incomplete or incorrect information (Boss et al., 2015). With the impacts of factors, individual tend to believe and share the rumor. Thus, we argue that these social and psychological factors (peer communication, peer condition, and fear) may strongly affect online rumor sharing. Our first research question is *to investigate the effects of social and psychological factors (including peer communication, peer condition, and fear) on rumor sharing behavior among individuals in the COVID-19 outbreak.*

Then, to understand the boundary conditions, it is necessary to explore the possible contingencies determining the relationship between the factors and rumor sharing behavior. Health self-efficacy represents the individuals' beliefs about their capability to manage their health (Lee et al., 2008; Oh, Lauckner, et al., 2013), which greatly influences how they respond to effectively manage situations (Bandura, 1997). Thus, under the outbreak of COVID-19, health self-efficacy may act as a context to moderate the processes of online rumor sharing. Accordingly, our second research question is *to explore the moderating effect of health self-efficacy on the relationships between fear, peer condition, peer communication, and rumor sharing behavior.*

To address the research questions, an integrative model was constructed on the basis of the stimulus–organism–response (S–O-R) framework. We adopted the survey method, collected empirical data, and tested our research hypotheses. Our study contributes to the existing literature in several ways. First, this study extends the S–O-R literature by introducing the S–O-R framework to track the mechanism of online rumor sharing. Second, this study extends the understanding of the process of online rumor sharing by identifying the important mediator of fear. Finally, this study enriches the health self-efficacy and rumor sharing literature by uncovering the contingent effect of health self-efficacy in the process of online rumor sharing about COVID-19.

2. Theory background

2.1. Online rumor sharing

Rumor refers to unverified information that can be deemed later to be true or false (Alkhodair et al., 2020). Rumor sharing is increasing

because of the proliferation of social media platforms. Unlike traditional rumor sharing through only word-of-mouth, online rumor sharing on social media is faster and more widespread (Lee & Hong, 2016; Pal et al., 2019; Zhao et al., 2013). Online rumor sharing can be accessed by anyone with social media at any time from any place. As rumor sharing on social media is so manifold and prevalent, many scholars have paid attention to online rumor sharing (Kim et al., 2018; Pal et al., 2020; Zhao et al., 2013).

Prior studies on online rumor sharing mainly focus on simulation models to explore the spread of rumors on social media (Pal et al., 2020). Zhao et al. (2013) applied the SIR (susceptible, infected, and recovered) model to explore rumor sharing in new media and make the rumor spread process more realistic and apparent. Chen (2019) investigated the rumor sharing process in an emergency by proposing a novel rumor spreading model. These works apply the simulation approach to reveal the dynamic process of rumor sharing on social media. Other studies explore why people share rumors on social media (Pal et al., 2020). Zhao et al. (2016) integrated the theory of planned behavior and norm activation model to investigate the reason of rumor sharing on social media in the context of social crises. Kwon and Rao (2017) focused on online rumor sharing in the context of government Internet surveillance, and the empirical results indicated that brief, anxiety, threat situation, and government Internet surveillance concerns are closely related to citizens' willingness for cyber rumor sharing.

Although past studies explore the processes of online rumor sharing and the reasons of online rumor sharing independently, studies that combine the two aspects to explore online rumor sharing behaviors are rare and insufficient. Combining the processes and the reasons of online rumor sharing is beneficial to better understand the mechanisms of online rumor sharing behaviors.

2.2. Stimulus–organism–response framework

Developed from environmental psychology, the S–O-R framework conveys that an organism responds according to various external states after being stimulated, which affects individuals' behavior (Cao & Sun, 2018; Mehrabian & Russell, 1974). The S–O-R framework comprises three related factors: stimulus (S), organism (O), and response (R). Stimulus refers to the environmental or psychological stimulus to individuals (Mehrabian & Russell, 1974). Organism refers to the cognitive and affective states of the individuals (Wang et al., 2019; Wu & Li, 2018). Response refers to the individuals' actions in response to the related stimulus, including approach or avoidance behaviors (Eroglu et al., 2001; Kim & Johnson, 2016). The S–O-R framework explains how a stimulus affects an organism's internal states, and then causes the individuals' action response, which can clearly reveal the intrinsic mechanism of the individuals' action response (Eroglu et al., 2003; Mehrabian & Russell, 1974; Tseng & Wang, 2016).

The S–O-R framework has been widely applied in information systems (IS) research to explain individuals' behaviors online. Prior studies successfully adopted the S–O-R framework to explain customers' patronage intention and social commerce intention (Jeong et al., 2009; Zhang et al., 2014). The framework also has been used to explore how psychological language words contained in microblogs influence dissemination behavior in emergency situations (Lu et al., 2021). Recently, Pal et al. (2020) applied the S–O-R framework to investigate how perceived message properties affect perceived utilitarian and hedonic values, and then determine online rumor rebuttal acceptance.

The framework of S–O-R provides a visualized framework for us to investigate the reasons and processes of online rumor sharing behaviors in COVID-19. When individuals communicate with their peers (peer communication) and know the condition of their peers (peer condition) in COVID-19, these stimuli will influence the individuals' cognitive and affective states (e.g., fear), and finally result in online behaviors (e.g., online rumor sharing). In other words, peers' communication and peers' condition in COVID-19 as the stimulus (S) affect individuals' cognition

and affect (fear) as the organism (O), and then influence individuals' online rumor sharing as the response (R).

2.3. Peer communication and peer condition

Peer communication and peer condition as important factors of peer influence impact individuals' affections and behaviors (Bexkens et al., 2019; Harrigan et al., 2021; Youn & Shin, 2019). Peer communication refers to obvious peer interactions among publics, which is regarded as an important component of public social media engagement (Ai et al., 2016; Qin & Men, 2019). Peer condition reflects the health status of peer (Bexkens et al., 2019; Yan et al., 2019).

Peer communication and peer condition have been verified to affect the affections, cognitions and behaviors of individuals. The study of Davis (2013) showed that peer communication directly and indirectly influenced the self-concept clarity. Qin and Men (2019) explored the relationship between peer communication and organization-public relationships and found that negative peer communication was detrimental to trust, satisfaction and commitment. Harrigan et al. (2021) uncovered that peer communication on social media drove trust in the social media and, ultimately, purchase intention. In terms of peer condition, peer condition was associated with risk-taking behaviors in male adolescents (Bexkens et al., 2019). Yan et al. (2019) also indicated that peer condition contributed to form intimate relationships and exchange emotional support on social media.

Peer communication and peer condition are vital in public crises and crisis communication relies on peer-generated information. Due to that peer information sources during nation-wide disasters have provided consistent support for their high credibility (Lachlan et al., 2014; Lin et al., 2016; Rahmi et al., 2019). For instance, the study of Lin et al. (2016) revealed that peer communication was assigned to tweeted risk information with higher levels of credibility compared to strangers. However, the studies about peer communication and peer condition effect on affections and behaviors in the contexts of crisis/disaster are rare and insufficient.

2.4. Health self-efficacy

Health self-efficacy refers to the beliefs of individuals about their capabilities to manage their health (Lee et al., 2008; Oh, Lauckner, et al., 2013). Health self-efficacy is based on the theoretical work of Bandura (1977), who introduced and defined the concept of self-efficacy. Self-efficacy refers to individuals' beliefs about their capabilities to manage particular difficulties that they encounter (Bandura, 1977, 1997). The idea behind self-efficacy is the principle that individuals' beliefs about their capabilities influence the way in which they react to a given situation (Oh, Lauckner, et al., 2013).

Self-efficacy in health has been demonstrated to play an important role in various results. The study of Clark and Dodge (1999) indicates that self-efficacy in health influences disease management behaviors, including stress management. Jackson et al. (2007) found that people with high health self-efficacy tend to engage in health-promoting lifestyles. Self-efficacy in health has been found to have a significant effect on prevention behavioral intentions in coping with public crises via social media (Kim & Hawkins, 2020; Yoo et al., 2016). Prior studies also indicate that health self-efficacy may play a moderating role or interacting role in influencing outcomes. Health self-efficacy has been found to have a joint effect on health information search behaviors with negative emotions (Lee et al., 2008). The research of Deng and Liu (2017) shows that health self-efficacy negatively moderates the relationship between perceived risk and health information-seeking behavior intention in social media. Self-efficacy in health is also found to moderate the effects of perceived usefulness on continuance usage intention in health protection (Huang & Ren, 2020).

Past studies on health self-efficacy have achieved fruitful results, and health self-efficacy may act as an important contingency factor to influence individuals' behaviors on social media (Deng & Liu, 2017; Oh, Lauckner, et al., 2013). The rumor sharing process (S–O-R) may also be contingent on health self-efficacy; however, the studies on rumor sharing seemingly ignore this issue.

3. Research model and hypotheses

The research model is presented in Fig. 1. Adapted from the S–O-R framework, this model was proposed to investigate the process of and reasons for online rumor sharing about COVID-19. In the context of COVID-19, peer communication and peer condition as important factors of peer influence affect individuals' affections and emotions (Bexkens et al., 2019; Harrigan et al., 2021; Youn & Shin, 2019); they act as stimuli to influence the cognitive and affective states (e.g., fear) of individuals (the organism), and the fear of COVID-19 will result in a related response (e.g., online rumor sharing). Health self-efficacy reflects individuals' beliefs about their ability to manage their health and influences their decisions on how to effectively manage situations (Bandura, 1997; Lee et al., 2008; Oh, Lauckner, et al., 2013). When facing COVID-19, individuals' decision-making in the process of rumor sharing tends to be affected by health self-efficacy, and health self-efficacy may act as an important contingency factor. In this vein, the research model was formed and the hypotheses are presented in the following.

3.1. Peer communication and fear of COVID-19

Peer communication refers to obvious peer interactions among publics, which is regarded as an important component of public social media engagement (Ai et al., 2016; Qin & Men, 2019). Peer communication about COVID-19 can affect individuals' perception of the disease. The outbreak of COVID-19 in China has made it difficult for people to function as they did before because of the stress and uncertainty induced by the public health crisis (Pan & Zhang, 2020; Zhong et al., 2021). During this period, people have often talked about the shortage of such items as masks, ventilators, vaccines, or medication (Zhong et al., 2021). In the process of peer interaction related to COVID-19, people tend to believe the information that they acquire from their peers and to do little critical thinking (Qin & Men, 2019; Youn & Shin, 2019). The more they communicate about the disease, the more severe they perceive the virus to be. The severity of COVID-19 influences people's perceptions of the seriousness and unpleasantness of the virus, and finally results in affect of fear (Wang et al., 2021; Zhong et al., 2021). In addition, in the process of exchanging information about COVID-19, their peers' anxiety and uncertainty about the virus influence peoples' attitudes and decision-making about the disease (Geber et al., 2019; Youn & Shin, 2019). For instance, if peers convey negative attitudes and affects toward COVID-19, their fellow peers develop unpleasant perceptions. Thus, fear of COVID-19 is triggered. On the basis of the above
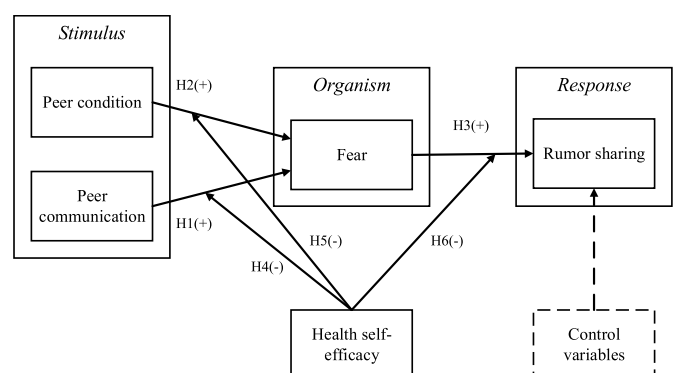

Fig. 1. Research framework.

arguments, we propose the following hypothesis:

H1: Peer communication is positively related to fear of COVID-19.

3.2. Peer condition and fear of COVID-19

Peer condition reflects the health status of an individual in COVID-19 (Bexkens et al., 2019; Yan et al., 2019). Peer condition acting as an important factor affects individuals' attitudes and cognitions (Hogue & Mills, 2019; Yan et al., 2019). If peers are infected with COVID-19, they induce a negative attitude and affect (e.g., anxiety) toward the virus. This negative attitude is adopted by others, who then harbor a negative affect toward COVID-19 (Chu & Sung, 2015; Shi & Dai, 2020); thus, the fear emotion is triggered. Peers with a poor health condition because of COVID-19 may go through a bad experience with the disease, and this experience is likely to affect their peers, who then develop fear of COVID-19. From the above arguments, we propose the following hypothesis:

H2: Peer condition is positively related to fear of COVID-19.

3.3. Fear of COVID-19 and online rumor sharing

Fear refers to a situation judged as dangerous and toward which protective action is taken (Boss et al., 2015; Rogers, 1975). The feeling of fear can result in individuals' protective behaviors to alleviate the situation (Zhang & Zhou, 2020). When an individual encounters rumors about COVID-19, the person with fear does not carefully read and think about the rumor and makes irrational decisions based on incomplete or incorrect information (Boss et al., 2015); thus, the individual tends to believe and share the rumor online. Meanwhile, rumoring is a process to alleviate one's emotional tension by elaborating a story to obtain acceptance and support from the audience (Oh, Agrawal, & Rao, 2013). In this vein, fear of COVID-19 tends to induce a person to share the acquired rumor information about COVID-19 to procure comfort and relieve anxiety, which results in rumor sharing behaviors online (Walker & Beckerle, 1987; Wang et al., 2018). On the basis of the above arguments, we propose the following hypothesis:

H3: Fear of COVID-19 is positively related to online rumor sharing.

3.4. Mediating effect of fear of COVID-19

We argue that the effects of peer communication and peer condition on online rumor sharing are mediated by fear of COVID-19. Following the suggestion of Kiss et al. (2020), two perspectives that support our arguments are as follows. On the one hand, according to the S–O–R framework, external stimuli (S) tend to affect the internal states of an organism (O), and then the internal states of the organism (O) are likely to induce the individuals' action responses (R) (Cao & Sun, 2018; Mehrabian & Russell, 1974). In other words, external stimuli (peer communication and peer condition) affect individuals' action responses (online rumor sharing) via the internal states of the organism (fear of COVID-19). In this vein, fear of COVID-19 mediates the effects of peer communication and peer condition on online rumor sharing. On the other hand, peer communication about COVID-19 will induce individuals to believe information about the severity of the disease and convey negative attitudes and affects toward the disease (Youn & Shin, 2019; Zhong et al., 2021), and their peers' condition (e.g., infected with COVID-19) tends to trigger negative attitudes and affects (e.g., anxiety) toward the virus (Chu & Sung, 2015; Shi & Dai, 2020); thus, the fear of COVID-19 emerges. Fear of the virus is detrimental to thinking carefully about rumors and leads to irrational decisions based on incomplete or incorrect information (Boss et al., 2015); moreover, people will share rumors online to alleviate their emotional tension (Oh, Agrawal, & Rao, 2013). Thus, peer communication and peer condition affect fear of COVID-19 and finally affect online rumor sharing; that is, fear of COVID-19 mediates the effects of peer communication and peer condition on online rumor sharing. According to the above arguments, we

propose the following hypothesis:

H4: Fear of COVID-19 mediates the relationship between peer communication and online rumor sharing.

H5: Fear of COVID-19 mediates the relationship between peer condition and online rumor sharing.

3.5. Moderating effect of health self-efficacy

Health self-efficacy denotes individuals' beliefs about their ability to manage their health (Lee et al., 2008; Oh, Lauckner, et al., 2013). Individuals' belief in their capabilities influences how they make decisions and respond to effectively manage situations (Bandura, 1997). When individuals communicate with their peers about COVID-19, they acquire information about an unpleasant virus and tend to believe the information (Qin & Men, 2019). People with health self-efficacy believe that they can protect themselves from public health events (Bandura, 1990; Yoo et al., 2016). In this context, even though individuals may exchange information with their peers about COVID-19, the fear of COVID-19 tends to decrease. Meanwhile, people with health self-efficacy have confidence that they can manage the situation and fight the disease (Deng & Liu, 2017; Lee et al., 2008). In this situation, when people communicate with their peers about the virus, the negative emotions and attitudes transferred by their peers are not as severe as before; thus, the positive effect of peer communication on fear of COVID-19 is weakened. From above arguments, we propose the following hypothesis:

H6: Health self-efficacy negatively moderates the relationship between peer communication and fear of COVID-19.

Peers with poor condition (e.g., infected with the virus) send a signal that the disease is very bad, and these negative emotions are transferred to peers without poor condition (Chu & Sung, 2015; Shi & Dai, 2020). People with high health self-efficacy believe that they can react to public health events and their health can be well protected (Lee et al., 2008; Oh, Lauckner, et al., 2013). Thus, the negative emotions acquired from the peers with poor condition do not affect them severely, and the negative effect of peer condition on fear of COVID-19 tends to be alleviated. Further, people with high health self-efficacy believe that they can survive the disease and take action to prevent the virus (Cheng & Ng, 2006; Kim & Niederdeppe, 2013). In this context, their peers' painful experience of being infected with COVID-19 is less likely to influence them, thereby reducing the effect of peer condition on fear of COVID-19. From the above arguments, we propose the following hypothesis:

H7: Health self-efficacy negatively moderates the relationship between peer condition and fear of COVID-19.

Health self-efficacy also moderates the effect of fear of COVID-19 on online rumor sharing. People with health self-efficacy have the confidence that they can overcome the negative outcomes of the disease (Deng & Liu, 2017; Zhang & Zhou, 2020). Even though they feel fear about the disease, when receiving rumors about COVID-19, people with high health self-efficacy tend to cope with health information more effectively and make relatively rational decisions to decrease the rumor sharing (Weaver III et al., 2009), thereby reducing the positive effect of fear on online rumor sharing. In addition, people with high health self-efficacy tend to engage in health behavior (e.g., exercise) to protect themselves (Aalto & Uutela, 1997; Huang & Ren, 2020). Individuals engaging in the health behavior (e.g., exercise) can achieve happiness and entertainment (Brailovskaia et al., 2020; Huang & Ren, 2020); the happiness and enjoyment accompanied by the health behavior may alleviate the need for comfort obtained via online rumor sharing due to fear of COVID-19. Therefore, the detrimental effect of fear of COVID-19 on online rumor sharing is relieved. On the basis of the above arguments, we propose the following hypothesis:

H8: Health self-efficacy negatively moderates the relationship between fear of COVID-19 and online rumor sharing.

4. Research methodology

4.1. Data collection

To test our proposed hypotheses, we conducted an online survey to collect data in February 2020, when COVID-19 was very serious in China and many different rumors were spread on social media. An online survey was conducted by adopting a large sample pool provided by Sojump (http://www.sojump.com/) in China (Li et al., 2021; Sun et al., 2017). We mainly adopted the snowball sampling technique, and a link directing the users to the questionnaire was distributed via referrals on WeChat. The respondents were provided with a small amount of money (2–5 CNY) to encourage participation. A total of 4000 questionnaires were distributed, and we received 1989 respondents. We deleted invalid questionnaires, where all answers were the same, some answers were missing, or answers were obviously contradictory. Finally, 1167 valid responses were prepared for the data analysis. The sample demographics are presented in Table 1; 53.81 % of the respondents were male, 69.24 % were under the age of 30, and 58.95 % had a bachelor's degree or higher.

4.2. Measures

The measurements for most constructs have been introduced in prior research (see Appendix A). Activities influenced by the rumor were adapted from the studies of Suki and Suki (2019). The items of rumor sharing behavior were adapted from Venkatesh et al. (2003). The items of peer communication were adapted from Suki and Suki (2019). Peer condition was adapted from Yan et al. (2019). The items of fear were adapted from Boss et al. (2015). The items of health self-efficacy were adapted from Oh, Lauckner, et al. (2013).

We adopted a 5-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The English version of the questionnaire was first developed, which the authors translated into Chinese independently to ensure no differences between the Chinese and the English versions of constructs. Then, we asked a group of IS scholars to review and check the content validity before dissemination of the questionnaire. Last, we collected and controlled the respondents' information, including the gender (GE), age group (AG), education background (ED), work (WO), and living condition (LC).

5. Data analysis

5.1. Measurement model

The measurement model was tested for the reliability and validity of constructs, and the results are presented in Tables 2 and 3. The composite reliability (CR) of all constructs was greater than 0.7, and the Cronbach's alpha values were above 0.7, indicating good construct reliability (Fornell & Larcker, 1981). Moreover, most of the factor

Table 1
Sample demographics.

Characteristics	Levels	Frequency	Percentage (%)
Gender (GE)	Male	628	53.81
	Female	539	46.19
Age group (AG)	<18	63	5.40
	18–25	411	35.22
	26–30	334	28.62
	31–40	242	20.74
	>41	117	10.02
Education (ED)	≤Junior college	479	41.05
	Undergraduate	515	44.13
	Postgraduate	173	14.82
living condition (LC)	live alone	614	52.61
	live with relatives	376	32.22
	live with others	177	15.17

Table 2
Scale properties.

	Items	Cronbach's alpha	CR	Factor loading	AVE
Activities influenced by the rumor (RA)	RA1	0.93	0.93	0.92	0.81
	RA2			0.91	
	RA3			0.86	
Rumor sharing (RS)	RS1	0.95	0.95	0.92	0.85
	RS2			0.93	
	RS3			0.93	
Peer communication (PO)	PO1	0.89	0.89	0.88	0.73
	PO2			0.82	
	PO3			0.86	
Peers conditions (PC)	PC1	0.93	0.93	0.92	0.87
	PC2			0.95	
Fear (FR)	FR1	0.92	0.92	0.87	0.80
	FR2			0.92	
	FR3			0.89	
Health self-efficacy (HSE)	HSE1	0.79	0.80	0.72	0.67
	HSE2			0.91	

loadings of items were above 0.7, and the average variance extracted (AVE) values exceeded 0.6, indicating good convergent validity of constructs.

Table 3 presents the results of discriminant validities by comparing the square root of the AVE of a construct with the correlations related to the construct. It can be seen that the square roots of the AVE of all constructs are larger than the correlation coefficients with other constructs in the model. The details are provided in Table 3, indicating good discriminant validity. However, because of the high correlations of some variables, we adopted the variance inflation factor (VIF) to test for multicollinearity issues. We found that the VIF values of the main variables were less than 2, some VIF values of the control variables were approximately 7, and the mean value of the VIF was approximately 3. Thus, the results indicated that multicollinearity was not a significant concern in our study according to the existing literature (Cohen et al., 2013; Zhang et al., 2021).

Moreover, because we adopted self-reported data, we analyzed for common method bias. We first adopted Harman's single factor approach (Podsakoff and Organ, 1986) to check for common method bias, and the first unrotated factor explained only 28.40 % of the covariance of the main factors in our model. This result indicated the non-existence of a single factor that could explain the majority of the covariance. Second, we followed Podsakoff et al. (2003) and Liang et al. (2007) to check for common method bias by comparing the variance explained by the trait factors and method factor. The results showed that the average percentage of variance explained by the constructs (68.54 %) was relatively large compared with the average percentage of variance explained by the common method factor (11.20 %). Thus, we concluded that common method bias was unlikely to be a threat for our study.

5.2. Structural model

We adopted the STATA to estimate the coefficients in the regressions, and the results are presented in Table 4. First, as to the direct impacts of social influence and peer condition in Model 1, we found that both peer communication (PO) and peer condition (PC) were positively and significantly related to fear ($\beta = 0.53$, $p < 0.001$ and $\beta = 0.15$, $p < 0.001$, respectively). The results indicated that with other factors controlled, the degree of the individuals' feeling of fear would increase by approximately 52.67 % or 15.26 % units when the peer communication or peer condition increased by one unit. These results indicated that H1 and H2 are supported. Then, we found that a strong and positive relationship existed between fear and rumor sharing in Model 5. The coefficient of fear was positive and significant ($\beta = 0.40$, $p < 0.001$). This result showed that fear strongly increased the individuals' online rumor sharing. Accordingly, H3 is strongly supported.

Table 3
Correlations and discriminant validity.

	RA	RS	PO	PC	FR	HSE	GE	AG	ED	WO	LC
RA	**0.90**										
RS	0.77	**0.92**									
PO	0.26	0.22	**0.85**								
PC	0.57	0.60	0.15	**0.93**							
FR	0.37	0.32	0.47	0.25	**0.89**						
HSE	0.03	−0.02	0.49	0.02	0.35	**0.82**					
GE	−0.08	−0.09	−0.00	−0.11	0.01	0.05	–				
AG	−0.01	0.02	0.03	−0.00	0.02	0.08	0.10	–			
ED	−0.11	−0.12	0.12	−0.20	0.05	0.10	0.03	0.02	–		
WO	−0.11	−0.12	−0.06	−0.11	−0.04	0.10	0.06	0.34	−0.02	–	
LC	0.12	0.10	−0.04	0.13	−0.01	−0.11	−0.07	−0.11	−0.17	−0.04	–

Note: 1. RA: activities influenced by the rumor; RS: rumor sharing; PO: peer communication; PC: peers conditions; FR: fear; HSE: health self-efficacy; GE: gender; AG: age group; ED: education; WO: work; LC: living condition.
2. The diagonally arranged data is the square roots of AVEs.

Table 4
Estimation results (N = 1167).

	FR				RS	
	Model 1 Coefficient (standard error)	Model 2 Coefficient (standard error)	Model 3 Coefficient (standard error)	Model 4 Coefficient (standard error)	Model 5 Coefficient (standard error)	Model 6 Coefficient (standard error)
PO	0.53***	0.68***	0.43***	0.73***		
	(0.04)	(0.12)	(0.04)	(0.12)		
PC	0.15***	0.15***	0.03	−0.04		
	(0.02)	(0.02)	(0.11)	(0.11)		
FR					0.40***	0.84***
					(0.03)	(0.14)
HSE		0.40***	0.13*	0.34***		0.19
		(0.10)	(0.07)	(0.10)		(0.10)
Moderator						
HSE*PO		−0.06*		−0.072**		
		(0.03)		(0.03)		
HSE*PC			0.03	0.04		
			(0.02)	(0.02)		
HSE*FR						−0.10**
						(0.03)
Constant	1.12***	−0.06	0.98**	0.21	1.29***	0.42
	(0.06)	(0.41)	(0.32)	0.44	(0.25)	(0.46)
Control variables	controlled	controlled	controlled	controlled	controlled	controlled
F	13.83	14.38	14.21	14.07	15.63	15.32
Adj-R²	0.25	0.28	0.27	0.28	0.27	0.28
RMSE	0.89	0.88	0.88	0.88	1.11	1.11

Note: 1. FR: fear; RS: rumor sharing; PO: peer communication; PC: peers conditions; HSE: health self-efficacy.
2. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Table 5
Estimation results of mediation effect of fear (N = 1167).

	RS	RS	FR	RS
	Model 7 Coefficient (standard error)	Model 8 Coefficient (standard error)	Model 9 Coefficient (standard error)	Model 10 Coefficient (standard error)
PO	0.21***		0.53***	0.09*
	(0.04)		(0.03)	(0.04)
PC	0.42***		0.15***	0.39***
	(0.02)		(0.02)	(0.02)
FR		0.40***		0.22***
		(0.03)		(0.03)
Constant	0.84***	1.29***	1.11***	0.60*
	(0.24)	(0.24)	(0.21)	(0.24)
Control variables	controlled	controlled	controlled	controlled
F	26.60	15.63	13.83	28.15
Adj-R²	0.41	0.27	0.25	0.43
RMSE	1.01	1.11	0.89	0.99

Note: 1. RS: rumor sharing; FR: fear; PO: peer communication; PC: peers conditions; HSE: health self-efficacy.
2. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

We tested the mediation effect of fear by following Luo et al. (2018) in adopting the following steps, and the results are shown in Table 5. We first checked the effects of peer communication and peer condition on rumor sharing behavior in Model 7, and the impacts were positive and significant (PO: β = 0.21, *p* < 0.001; PC: β = 0.42, *p* < 0.001). Second, we explored the impacts of the mediator (fear) on rumor sharing behavior in Model 8, and found a strong and positive influence (β = 0.40, *p* < 0.001). Third, the relationships of peer communication and peer condition to fear were examined in Model 9, and we found significant and positive relationships (PO: β = 0.53, *p* < 0.001; PC: β = 0.15, *p* < 0.001). Last, we adopted peer communication, peer condition, and fear in one regression to investigate its effects on rumor sharing behavior in Model 10. We found that the coefficients of the three variables were significant and positive, and the coefficients of peer communication and peer condition were smaller than in the first step (PO: 0.09 < 0.21; PC: 0.39 < 0.42). Thus, fear partially mediated the relationships between social influence, peer condition, and rumor sharing behavior. Accordingly, H4 and H5 are supported.

Further, we tested the moderation effect of health self-efficacy (H6, H7, and H8). First, Model 2 showed that health self-efficacy (HSE) significantly and negatively moderated the relationship between peer communication and the individuals' feeling of fear (HSE*PO: β = −0.06, *p* < 0.05). When the health self-efficacy of an individual was high, it strongly weakened the impact of peer communication on fear. According to Meyer et al. (2017), we plotted the marginal effect of peer communication on fear at different levels of health self-efficacy in Fig. 2. The result indicated that as the value of health self-efficacy increased, the effect of peer communication on fear became significantly weaker. Thus, H6 is supported. However, Model 3 indicated that the moderation effect of health self-efficacy was not significant in the relationship between peer condition and fear (HSE*PC: β = 0.03, *p* > 0.05); thus, H7 is not supported. Last, Model 6 showed that health self-efficacy strongly weakened the influence of fear (FR) on the individuals' online rumor sharing (HSE*FR: β = −0.10, *p* < 0.01). These results revealed that when individuals had a high degree of health self-efficacy, the positive impacts of fear on rumor sharing were significantly weakened. We also plotted the marginal effect of fear on rumor sharing at different levels of health self-efficacy in Fig. 3. The results showed that as the value of health self-efficacy increased, the effect of fear on rumor sharing became significantly weaker. Accordingly, H8 is supported.

5.3. Robustness check

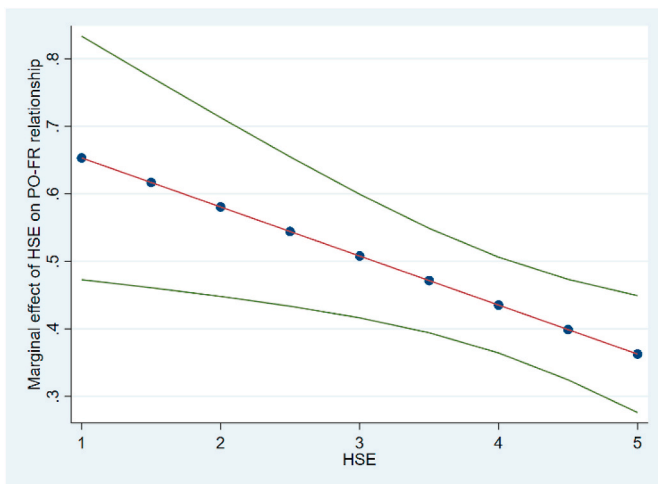To check the robustness of our empirical results, we first adopted

Fig. 2. Moderation effect of health self-efficacy (HSE) on the relationship between peer communication (PO) and fear (FR).
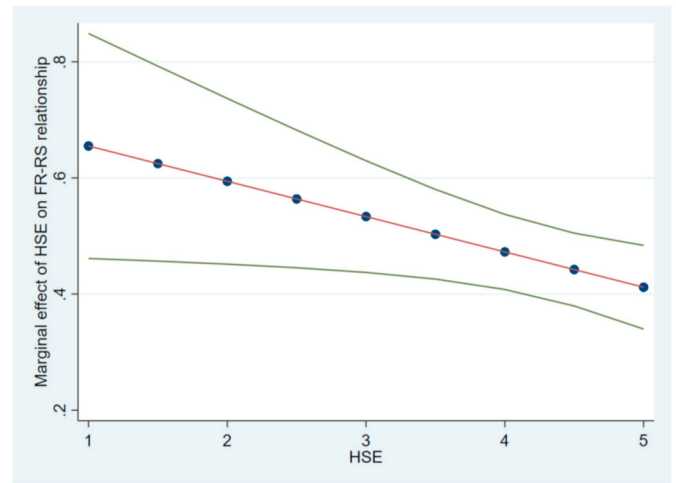

Fig. 3. Moderation effect of health self-efficacy (HSE) on the relationship between fear (FR) and rumor sharing (RS).
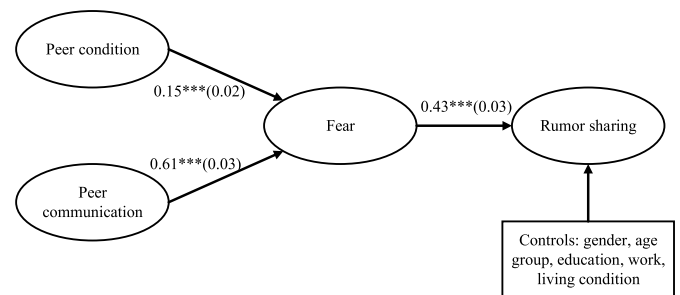

Fig. 4. Path coefficient (standard error) in structural equation model (Note: *p < 0.05, **p < 0.01, ***p < 0.001).

AMOS to run the structural equation model. The results are shown in Figs. 4 and 5. With respect to the direct influence in Fig. 4, we can see that peer condition and peer communication both significantly affected fear (PO: β = 0.61, *p* < 0.001; PC: β = 0.15, *p* < 0.001). Fear also strongly influences rumor sharing behavior (β = 0.43, *p* < 0.001).

Regarding the mediating effect of fear, we followed MacKinnon et al. (2002) and Cui et al. (2018) in adopting the joint significance test approach. As presented in Fig. 4, both peer condition and peer communication significantly affected fear (PO: β = 0.61, *p* < 0.001; PC: β = 0.15, *p* < 0.001). Fear had a positive and significant association with rumor sharing behavior (β = 0.43, *p* < 0.001). These results suggest that fear positively mediates the positive relationship between peer communication and peer condition and rumor sharing behavior. We also estimated the size of indirect effects from peer communication and peer condition on rumor sharing behavior through fear using the bootstrap technique in the structural equation model (Cui et al., 2018; Shrout & Bolger, 2002). Regarding the mediation effect of fear on the relationship between peer communication and rumor sharing behavior, the estimated indirect effects were 0.168 (PO: *p* < 0.001) with a 95 % confidence interval from 0.133 to 0.210. Regarding the mediation effect of fear on the relationship between peer condition and rumor sharing behavior, the estimated indirect effects were 0.077 (PO: *p* < 0.001) with a 95 % confidence interval from 0.049 to 0.113. Overall, the mediation effects of fear are supported.

Lastly, with regard to the moderation effect of healthy self-efficacy, the results are presented in Fig. 5. We can see that the healthy self-efficacy significantly weakened the impacts of peer communication on fear (β = −0.16, *p* < 0.001) and of fear on rumor sharing behavior (β = −0.01, *p* < 0.01). However, the moderating effect of healthy self-

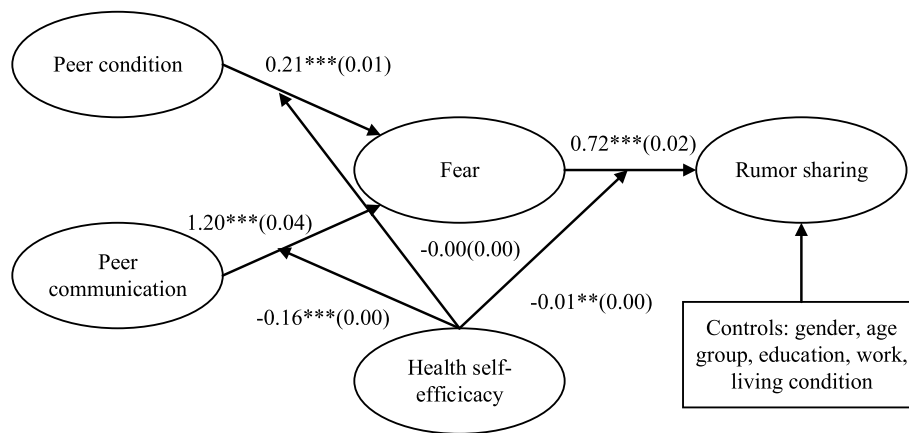**Fig. 5.** Path coefficient (standard error) in structural equation model with moderators (Note: *p < 0.05, **p < 0.01, ***p < 0.001).

efficacy was not significant in the relationship between peer condition and fear. In conclusion, the results are consistent with our main results.

We checked the robustness of our main results by replacing the rumor sharing behavior with activities influenced by the rumor. We present the results in Table 6, which shows the consistency of most of our results. The direct influence of fear was significant and positive to the individuals' activities influenced by the rumor ($\beta = 0.44$, $p < 0.001$). As to the mediation effect of fear, Model 11 showed that peer communication and peer condition significantly affected activities influenced by the rumor (PO: $\beta = 0.27$, $p < 0.001$; PC: $\beta = 0.38$, $p < 0.001$); in Model 12, peer communication and peer condition strongly affected fear (PO: $\beta = 0.53$, $p < 0.001$; PC: $\beta = 0.15$, $p < 0.001$); in Model 13, fear strongly affected the activities influenced by the rumor ($\beta = 0.44$, $p < 0.001$); in Model 14, the coefficients of peer communication, peer condition, and fear were significant, and the coefficients of peer communication and peer condition decreased compared with the first step (PO: 0.12 < 0.27; PC: 0.33 < 0.38). Regarding the moderation effect, Model 15 indicated that health self-efficacy significantly and negatively moderated the impacts of fear on the activities influenced by the rumor (HSE*FR: $\beta = -0.06$, $p < 0.05$). These results showed the consistency of our main results.

6. Discussion and conclusion

6.1. Key findings

The outbreak of COVID-19 has severely threatened people's lives and well-being, and online sharing of rumors about the disease is of growing concern worldwide (Pan & Zhang, 2020; Shin et al., 2018). This study based on the S–O–R framework investigated the reasons for and processes of rumor sharing about COVID-19 on social media and has resulted in some key findings.

First, support for the stimulus-organism hypotheses was found. Peer communication and peer condition are positively related to fear of COVID-19. As we know, peer communication and peer condition as important factors of peer influence affect individuals' affections and emotions, and previous studies have indicated that peer influence produces more negative than positive effects (Bexkens et al., 2019; Harrigan et al., 2021; Youn & Shin, 2019). This study verifies the previous results and finds that both peer communication and peer condition about COVID-19 tend to produce negative effects, namely, fear of COVID-19.

Second, this study found support for the organism-response hypothesis. According to our empirical results, fear of COVID-19 is positively associated with online rumor sharing. Individuals with fear tend to make irrational decisions based on incomplete or incorrect information (Boss et al., 2015) and to alleviate their emotional tension by

Table 6
Estimation results of robustness check (N = 1167).

	RA	FR	RA	RA	RA
	Model 11 Coefficient (standard error)	Model 12 Coefficient (standard error)	Model 13 Coefficient (standard error)	Model 14 Coefficient (standard error)	Model 15 Coefficient (standard error)
PO	0.27*** (0.03)	0.53*** (0.03)		0.12*** (0.04)	
PC	0.38*** (0.02)	0.15*** (0.02)		0.33*** (0.02)	
FR			0.44*** (0.03)	0.27*** (0.03)	0.72*** (0.13)
HSE					0.14 (0.09)
Moderator HSE*FR					−0.06* (0.03)
Constant	0.75*** (0.23)	1.11*** (0.21)	1.14*** (0.23)	0.44* (0.22)	0.52 (0.42)
Control variables	controlled	controlled	controlled	controlled	controlled
F	24.95	13.83	17.34	28.22	16.49
Adj-R^2	0.39	0.25	0.30	0.43	0.30
RMSE	0.96	0.89	1.03	0.93	1.03

Note: 1. RA: activities influenced by the rumor; FR: fear; PO: peer communication; PC: peers conditions; HSE: health self-efficacy. 2. *p < 0.05, **p < 0.01, ***p < 0.001.

sharing rumors on social media to obtain acceptance and support from the audience (Oh, Agrawal, & Rao, 2013). Previous studies have also confirmed that the feeling of fear tends to induce related responses and actions, for example, economic resilient behavior and problematic internet use (Hua et al., 2018; Sela et al., 2020).

In addition, this study found that fear mediated the effects of peer communication and peer condition on online rumor sharing. Fear is the key mediator in the relationship between peer communication, peer condition, and online rumor sharing. That fear has an important role as mediator has also been identified in previous IS-related studies (Boss et al., 2015; Sela et al., 2020; Vranjes et al., 2017). The results of this study are consistent with those previous studies.

Finally, the moderating effects of health self-efficacy were identified in this study. Health self-efficacy reflects individuals' beliefs about their ability to manage their health and influence their decisions on how to effectively manage situations (Bandura, 1997; Lee et al., 2008; Oh, Lauckner, et al., 2013). This study found that health self-efficacy has important contingency effects on individuals' decisions to manage COVID-19. Health self-efficacy alleviates the positive effect of peer communication on fear of COVID-19, and the positive effect of fear of COVID-19 on online rumor sharing. However, the hypothesis that health self-efficacy alleviates the effect of peer condition on fear of COVID-19 is not supported. A possible explanation is that although health self-efficacy creates the condition of improving confidence in dealing with the disease, peers' infection with COVID-19 makes people believe that the disease is too difficult to defeat, and this unpleasant situation results in the collapse of confidence (Beaunoyer et al., 2020; Braquehais et al., 2020). Thus, the effect of peer condition on fear of COVID-19 is not relieved by health self-efficacy.

6.2. Conclusion

The global pandemic of COVID-19 not only causes significant challenges for health systems and economic recession, but also results in online rumor sharing. This study investigates online rumor sharing about COVID-19 by applying the S–O–R model and considering the contingency effect of health self-efficacy. Based on 1167 social media users' samples, this study uncovers that peer communication and peer condition contribute to fear of COVID-19, and fear of COVID-19 induces online rumor sharing. Meanwhile, fear of COVID-19 plays a mediating role in the effects of peer communication and peer condition on online rumor sharing. In addion, health self-efficacy weakens the effect of peer communication on fear, and the effect of fear on online rumor sharing. Our study provides theoretical contributions to the literature on online rumor sharing and S–O–R, and practical implications for social media users and governments.

6.3. Theoretical contributions

This study makes several important theoretical contributions. First, the study contributes to the literature on S–O–R by extending the S–O–R framework in online rumor sharing. Originating from environmental psychology, the S–O–R framework indicates that environmental factors act as stimuli to influence internal cognitions and affections, and finally compel behavioral responses (Cao & Sun, 2018; Mehrabian & Russell, 1974). The S–O–R framework has been widely applied in social media to explore individual online behaviors, for example, social commerce intention and discontinuous intention of social media users (Cao & Sun, 2018; Lu et al., 2021; Zhang et al., 2014). In addition, Pal et al. (2020) investigated online rumor rebuttals by using the S–O–R framework. However, few studies have applied the S–O–R framework to track the mechanism of online rumor sharing. This study applies the S–O–R framework to explore online rumor sharing about COVID-19 by identifying three related factors: stimulus (peer communication and peer condition), organism (fear), and response (online rumor sharing). In other words, this study extends the applicability of the S–O–R framework

to a new and important phenomenon—online rumor sharing—and reveals the process of and reasons for rumor sharing about COVID-19 on social media.

Second, this study contributes to our understanding regarding the process of online rumor sharing by uncovering the mediating effects of fear. Previous studies have indicated that fear plays an important mediating role in IS-related research (Boss et al., 2015; Sela et al., 2020; Vranjes et al., 2017). However, the mediating effect of fear in online rumor sharing seems to have been ignored. This study indicates the impacts of peer communication and peer condition to online rumor sharing via fear of COVID-19 and the mediation effect of fear on the influence from peer communication and peer condition to online rumor sharing. In other words, this study opens up the black box of the effect of peer communication and peer condition on online rumor sharing and uncovers the rumor sharing mechanism of COVID-19 on social media, thus extending the literature on online rumor sharing.

Finally, this study contributes to the literature on online rumor sharing by revealing the contingency effects of health self-efficacy. Health self-efficacy has been identified to influence individual behaviors to deal with public crises via social media and to act as a contingency factor in online behaviors (Deng & Liu, 2017; Kim & Hawkins, 2020; Yoo et al., 2016). The rumor sharing process may also be contingent on health self-efficacy; however, the studies of rumor sharing seemingly ignore this issue. This study explores the moderation effect of health self-efficacy on the influence from peer communication and peer condition to fear of COVID-19, and the influence from fear of COVID-19 to online rumor sharing. In other words, this paper reveals the moderating effects of health self-efficacy on the process of online rumor sharing about COVID-19, which enriches the studies of online rumor sharing and health self-efficacy.

6.4. Practical implications

This study also has practical implications for both social media users and governments. Users should hold a rational perspective on COVID-19 and make an accurate assessment of the epidemic. As we know, fear of COVID-19 acts as an important driving factor in rumor sharing on social media. If social media users can hold a rational perspective on COVID-19 and acquire accurate information about the disease (e.g., obtaining information from official channels), they will not be afraid of the disease as before and will reduce rumor sharing on the Internet. Meanwhile, users should reduce the frequency of exchanging information about the virus and contacting friends and relatives with COVID-19. Our findings indicate that peer communication and peer condition tend to induce fear. Therefore, although people obviously have a need to communicate and have contact with their peers, to reduce the generation of fear, the frequency of communication and contact should be controlled. Finally, users need to have self-efficacy to cope with COVID-19. The empirical results show that health self-efficacy is beneficial to alleviate the negative effect of peer communication on fear of COVID-19, and the detrimental effect of fear on online rumor sharing. If social media users improve their health self-efficacy, for example, by having confidence to defeat the virus, fear emotions may not be so severe and online rumor sharing behaviors will likely decrease.

Governments and society should prioritize the control of the spread of COVID-19. If the virus is well controlled, people's peers (e.g., friends) are less likely to become infected with the disease and the health condition of peers will be good. According to our empirical results, peers' good health conditions are conducive to reducing the fear of COVID-19, and finally alleviating online rumor sharing. In this vein, good disease control facilitates the reduction of rumor sharing on social media. Thus, governments and society need to take effective measures to control COVID-19, for example, by conducting home quarantine and distributing protective goods. In addition, governments and society should nurture people's self-efficacy to deal with the virus. As we know, health self-efficacy is conducive to alleviating the harmful effects of peer

communication on fear, and of fear on online rumor sharing. People's self-efficacy not only needs to improve, but also needs to be nurtured and cultivated by governments and society by, for example, transferring information to the public that the disease can be well controlled and many people successfully defeat the virus. In this way, peoples' health self-efficacy can be improved, and fear of COVID-19 and online rumor sharing can be eliminated.

6.5. Limitations and future studies

In addition to its theoretical contributions and practical implications, there are some limitations in this study. First, the survey data were collected in China and our study focuses on the context of COVID-19, so the generalization of the results to other countries is constrained. Future studies may conduct research in other countries in other contexts to test whether the results can extend to those countries in a more general context. In addition, the data sample consists mainly of young people, which also limits the generalization of our study. Future studies may try to collect data from different age groups. Further, the data collected in this study are single-sourced survey data. While most quantitative studies collect data from surveys with one source (Choi et al., 2017; Oh et al., 2018; Pal et al., 2020), multiple data sources (e.g., survey data combined with objective data) will enhance the results' validity, which is a new direction for future studies. Finally, this study only considers

fear as a mediator and health self-efficacy as a moderator. Other factors, such as rumor believing, empathy, confirmation of prior belief, source credibility, distrust of official sources, attention-seeking, social media engagement, and attitude toward spreading online rumors may act as mediators and moderators, which is another avenue for future research.

Credit author statement

Peng Luo: Conceptualization, Methodology, Writing - original draft. Chenxiao Wang: Data curation, Investigation, Writing - original draft. Feng Guo: Conceptualization, Writing - review & editing. Li Luo: Writing - review & editing, Supervision.

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Appendix A. Measurement scales

Construct	Items	Source
Activities influenced by the rumor (RA)	RA1: Because of these epidemic rumors, I bought some unnecessary protective items. RA2: Because of these epidemic rumors, I took some unnecessary actions. RA3: Because of these epidemic rumors, my life has become chaotic.	Suki and Suki (2019)
Rumor Sharing (RS)	RS1: I have shared some virus-related rumors on my Weibo or WeChat when I did not know they were rumors. RS2: I have shared some virus-related rumors to my family and friends when I did not know they were rumors. RS3: I have shared some virus-related rumors unconsciously when I did not know they were rumors.	Venkatesh et al. (2003)
Peer communication (PO)	PO1: I often discuss the virus with my friends/relatives. PO2: I often learn about the virus information from my friends/relatives. PO3: I often share with my friends/relatives about virus information.	Suki and Suki (2019)
Peer condition (PC)	PC1: My friends/family members are under compulsory isolation, suspected cases, or confirmed cases. PC2: In the past 14 days, my friends/family have had close contact with confirmed cases, suspected cases, or people in severely affected areas such as Wuhan.	Yan et al. (2019)
Fear (FR)	FR1: I was worried about the prospect of virus infection from others. FR2: I was frightened about the prospect of virus infection from others. FR3: I was anxious about the prospect of virus infection from others.	Boss et al. (2015)
Health self-efficacy (HSE)	HSE1: I am confident that I can keep my health in the outbreaks. HSE2: I have set clear goals for not being infected by the virus. (drop) HSE3: I am actively taking measures to not be infected.	Oh, Lauckner, et al. (2013)

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