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Factors influencing users' rumour spreading intention during public health emergencies: based on protection motivation theory

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Abstract: With the development of social media and information technology, dealing with the infodemic in public health emergencies has become particularly important. Existing research on exploring the primary rumour-spreading motivation and process under the COVID-19 context is limited. This study aims to explore the factors influencing rumour spreading and reveals its mediation process and boundary condition. Based on protection motivation theory and using structural equation modelling analysing data from 423 users, the results showed that: 1) issue involvement has a positive effect on both threat appraisal (perceived severity and perceived vulnerability) and coping appraisal (self-efficacy and response efficacy), however, the effect of issue involvement on response cost is not significant; 2) perceived vulnerability and coping appraisal positively influence the intention to spread rumour by forming the attitude to spread rumour (protection motivation); 3) when the tie strength between the user and the information receivers is at a high level, the user's attitude to spread rumour has a more positive effect on intention to spread rumour.

Keywords: rumour spreading; protection motivation theory; issue involvement; intention to spread rumour.

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1 Introduction

In recent years, the outbreak of various health emergencies, such as COVID-19, has led to social unrest and threatened people's health and lives. In addition, with the development of information and communication technology, various social media provide a platform for people to access and share information, which is mixed with many rumours (Xue and Taylor, 2022). In health emergencies, we not only face the challenges posed by the severity and emergencies of the event itself but also by the infodemic that develops on social media. Rumours convey inaccurate and incorrect information about health prevention and treatment, leading people to engage in wrong behaviours that adversely affect individuals and society (Pal and Banerjee, 2020). For example, rumours of food shortages have caused panic buying, leading to social disorder; rumours of disease prevention measures, such as drinking alcohol and injecting disinfectants, leading to life-threatening situations. Therefore, scholars began to pay attention to rumour spreading on social media.

During public health emergencies, people are concerned about their health status but have limited knowledge about preventing and treating diseases (Zhou et al., 2021). Therefore, searching for health-related information has become a preventive strategy for people dealing with health crises (Zheng et al., 2022). Due to the lack of official information about disease prevention, people use social media to get more unverified health information (Mukherjee and Bawden, 2012). This health information often seems potentially valuable to be widely disseminated because its informational and emotional support provides preventative measures and alleviates fears. Ning et al. (2021) found that the most widely circulated theme of the rumour was about health protection during COVID-19. Moreover, Tan and Hsu (2023) found that people were willing to share COVID-19-related news with others, whether true or false, because it could serve as advice and a warning. Therefore, this study argues that people view rumour spreading as a protective measure in public health emergencies to protect themselves and acquaintances from health threats.

A review of prior literature, prior rumour spreading studies have focused on using computer technology methods to analyse rumour themes on social media, simulated rumour spreading processes, and proposed rumour detection methods (Cinelli et al., 2020; Jiang et al., 2022; Zheng et al., 2022). In fact, rumour spreading is a problem-solving activity driven by people's motivation (Zhang et al., 2022). Therefore, exploring people's psychological motivation for spreading rumours is particularly important. Current research on rumour-spreading motivation has focused on finding the

motivation that influences rumour spreading and how information characteristics motivate rumour spreading (Shen et al., 2021; Marett and Joshi, 2009; Tan and Hsu, 2023; Zhang et al., 2022). Lin et al. (2022) have analysed the effects of socialising, status-seeking, entertainment, and information-seeking motivation on everyday rumour spreading. Sudhir and Unnithan (2019) found that rumours cause anxiety and arousal, which stimulates the effect of emotion management motivation on rumour spreading. Studying the motivation that drives people's behaviour requires considering the context in which it occurs (Turner, 2001). However, existing research on rumour spreading motivation has paid little attention to the impact of individual characteristics, such as the level of issue involvement. Given that the level of issue involvement represents the importance individual places on public health information, exploring its relationships is particularly important. Unlike prior studies, this study explores how issue involvement affects users' threat appraisal and coping appraisal, which further affect attitude and intention to spread in the COVID-19 context.

Another important question is the boundary condition investigation during the rumour spreading process. When considering rumour spreading, tie strength is one of the most important factors that cannot be ignored. In fact, the relationship between attitude to spread rumour and intention to spread rumour depends on tie strength with information receivers. For example, under low tie strength context, users may not generate rumour-spreading intention because they may feel that they are not familiar with the information receivers, so it is not their own business and they will not spread rumour. However, under high tie strength context, users may generate rumour-spreading intention because the information receivers have a close relationship with themselves, and users want to protect them from harm, so they spread rumour to remind information receivers to pay attention to protection. Furthermore, prior research showed that tie strength with information senders affects rumour credibility (Garrett, 2011); however, it is still unclear how tie strength with information receivers affects rumour spreading. To fill this gap, this study explored the moderating role of tie strength with information receivers in the relationship between attitude and intention to spread.

Based on the protective motivation theory (PMT), this study constructed a theoretical model to explore the specific mechanisms of rumour spreading and explored the theoretical and practical implications of the conclusions drawn. First, this study enriches the literature on rumour spreading by investigating how issue involvement affects threat appraisal and coping appraisal, which further affect users' attitude and intention to spread, and describing the process through which this occurs. Second, this study contributes to PMT and involvement theory by applying them to study rumour spreading within the context of public health emergencies. Third, this study contributes to the research on rumour spreading by revealing the moderating effects of tie strength on attitude and intention to spread. Finally, this study provides practical implications for the suppression or prevention of rumour spreading from the perspective of protection motivation.

2 Theoretical background and hypotheses

2.1 Protection motivation theory

PMT is initially used in the health domain to explain how individuals are persuaded by fear appeals to produce changes in attitudes and behaviours (Floyd et al., 2000). Nowadays, PMT is widely applied to analyse the process of forming protective motivation and the intention to adopt protective behaviours when facing threats (Yoo et al., 2021). Numerous studies based on PMT have analysed people's adoption of health protection measures such as self-isolation and wearing masks during COVID-19 (Farooq et al., 2020). However, social media conveyed wrong protective messages to people, which led people to take wrong protective measures (Cato et al., 2021). Naeem and Ozuem (2022) have qualitatively analysed why people make panic buying as protective measures in response to the threat based on PMT. Therefore, this study intends to use PMT to explain why people wrongly adopt rumour spreading as a protective behaviour.

PMT can explain protective behaviour through three sequential processes: information sources, cognitive mediation processes, and coping styles (Floyd et al., 2000). First, people obtain relevant information from environmental and interpersonal sources to input the model. Second, people develop protective motivation through cognitive mediating processes, including threat appraisal and coping appraisal. Some studies have ignored the mediating role of protective motivation in the relationship between cognitive appraisal and protective behaviour (Bhati et al., 2021), while some studies have conceptualised protective motivation as attitude to protective behaviour (Wang, 2023). Finally, people decide whether to take protective measures in response to threats. Drawing on PMT literature, this study constructs a theoretical framework to explain how people develop protective motivation and regard rumour spreading as a protective measure during public health emergencies. This study argues that the prior knowledge about health crises and motivation to deal with the problem provided by issue involvement affects cognitive appraisal. People appraised the threat of the event through perceived severity (the severity of the health crisis) and perceived vulnerability (the likelihood that they will be affected); they appraised the ability to respond event through self-efficacy (assessing their ability to convey valuable information through the shared rumour), response efficacy (whether the shared rumour will be effective in preventing the event), and response cost (the cost of time, energy to spread the rumour). This study conceptualised protection motivation as attitude to spread rumour and analysed whether tie strength with the information receiver moderated the relationship between attitude and intention to spread rumour.

2.2 Relationship between issue involvement and cognitive appraisal

PMT argues that people are motivated by information sources to respond to threats (Tanner et al., 1989). In public health emergencies, people worried about diseases causing harm to themselves actively seek measures to protect themselves (Zhou et al., 2021). People respond more strongly emotionally to highly correlated events (Tan and Hsu, 2023). Therefore, this study argues that issue involvement in public health emergencies affects people's threat appraisal and coping appraisal processes. Issue involvement represents the degree to which people are concerned about the event and its consequences, which influences an individual's motivation and ability to deal with the

problem, and provides prior knowledge. People with high issue involvement actively search for information to cope with the uncertainty of crisis events. However, people pay more attention to information about negative consequences based on the negative bias theory, so they perceive the event as more threatening (Chua and Banerjee, 2018). Those with prior knowledge about a crisis event believe they know more about it than others (Chen and Fu, 2022). This increased knowledge increases the individual's perceived ability to control events (Liao et al., 2020), so they are confident that they can take protective measures and achieve effective results. Based on the above, this paper puts forth the following hypotheses:

- H1 Issue involvement has a positive effect on perceived severity.
- H2 Issue involvement has a positive impact on perceived vulnerability.
- H3 Issue involvement has a positive effect on self-efficacy.
- H4 Issue involvement has a positive effect on response efficacy.
- H5 Issue involvement has a negative effect on response cost.

2.3 Relationship between threat appraisal and attitude to spread

Perceived severity refers to an individual's perception of the severity of the public health emergency. In health behaviour research, perceived severity is closely related to protective motivation (Yildirim and Guler, 2022). The event's severity can lead to fear, which causes people to search for measures to respond to threats and affects people's ability to deal with problems (Luo et al., 2021). In public health emergencies, rumours are considered useful because they convey information related to health protection, and content ambiguity influences judgments about the credibility of rumours (Oh et al., 2013). Moreover, people adopt the better-safe-than-sorry approach, believing that the rumour content can help reduce the threat of the event to them (Qi et al., 2017). Based on the above, this paper puts forth the following hypothesis:

- H6 Perceived severity has a positive effect on attitude to spread.

Perceived vulnerability refers to the appraisal of the likelihood of being affected by the event. The closer people perceive themselves in danger, the more likely they are to take protective action in response to the threat (Laato et al., 2020). During public health emergencies, people are concerned about their health status. Yildirim and Guler (2022) found that perceived vulnerability triggers protective behaviours such as wearing masks during COVID-19. Research has shown that spreading rumours during crisis events can alleviate anxiety and provide health precautions (Zhou et al., 2021). Therefore, rumour spreading is considered to positively affect emotion and health management when the event is potentially threatening to people (Sudhir and Unnithan, 2019), and people develop positive attitudes to spread rumour. Based on the above, this paper puts forth the following hypothesis:

- H7 Perceived vulnerability has a positive effect on attitude to spread.

2.4 *Relationship between coping appraisal and attitude to spread*

Self-efficacy refers to the appraisal of the ability to take measures to respond to threats, which has been shown to have a positive impact on attitudes to protective behaviours (Martens et al., 2019). In this study, self-efficacy refers to the perceived ability to convey valuable information in response to a health crisis. Myrick (2017) found that self-efficacy positively impacts health information search. In public health emergencies, people are easily exposed to rumours through social media, which offer informational and emotional support (Zhou et al., 2021). However, people lacking relevant expertise will make incorrect judgments, and health self-efficacy is positively associated with the perceived persuasiveness of rumours (Xue and Taylor, 2022). Based on the above, this paper puts forth the following hypothesis:

H8 Self-efficacy has a positive effect on attitude to spread.

Response efficacy refers to the appraisal of the effectiveness of measures to respond to the threat. This study argues that people spread rumour when rumour content can help protect themselves and acquaintances from the effects of a crisis event. During COVID-19, Tan and Hsu (2023) found that people share fake news because it can serve as a warning or advice. Rumours are instrumental relevant information statements that help people understand and manage risk (DiFonzo and Bordia, 2007). At the same time, the uncertainty of public health emergencies and people's psychological panic reduce the ability to judge, which makes it easy for people to believe that rumour content can help them and acquaintances cope with the threat. Based on the above, this paper puts forth the following hypothesis:

H9 Response efficacy has a positive effect on attitude to spread.

Response cost refers to the resources required to take protective measures, such as time, energy, and money. Response cost can dampen positive attitudes to protective behaviours and make people hesitant to take protective actions (Farooq et al., 2020). Hew and Hara (2007) found that lack of time and unfamiliarity with content are significant barriers preventing people from sharing information online. This study argues that when people feel that spreading rumour requires considerable response cost, they develop negative attitudes to spread rumour. Based on the above, this paper puts forth the following hypothesis:

H10 Response cost has a negative effect on attitude to spread.

2.5 *Relationship between attitude to spread and intention to spread*

Attitude refers to positive or negative feelings toward protective behaviour, which is an important factor influencing intention to behave (Wang, 2023). PMT argues that the formation of protective motivation through threat and coping appraisal impacts protective behaviour. Many studies have conceptualised protective motivation as attitudes to protective behaviour to explain how protective motivation generated by threat and coping appraisal influences protective behaviour (Martens et al., 2019). Guo et al. (2015) found that protective motivational factors increase acceptance intentions by stimulating positive attitudes toward mobile health devices. This study argues that positive attitudes to rumour

spreading formed through cognitive appraisal promote the intention to spread rumour. Based on the above, this paper puts forth the following hypothesis:

H11 Attitude to spread has a positive effect on intention to spread.

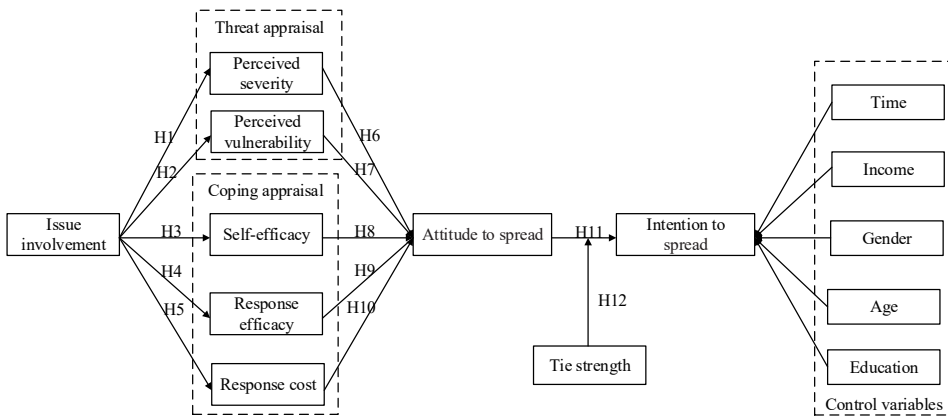
2.6 The moderating role of tie strength

Tie strength refers to the degree of intimacy between the information sender and receiver in exchanging information (Brown and Reingen, 1987). Previous research has found that tie strength negatively influences recipients' judgments of message credibility and quality (Koo, 2016; Kim and Chung, 2018). This study argues that tie strength moderates the relationship between attitude and intention to spread rumour. First, tie strength is a relationship characterised by frequent contact and emotional involvement (Lin et al., 2019); in a public health emergency, people are more concerned about the health of acquaintances and therefore will share information that provides disease prevention (Tan and Hsu, 2023). Second, people have a more specific understanding of solid tie strength information receivers, which can reduce the implementation cost of sharing messages (Ma et al., 2020a). Based on the above, this paper puts forth the following hypothesis:

H12 Tie strength plays a positively moderating role between attitude and intention to spread.

Based on PMT, this study constructs a research model to explore the factors affecting people's intention to spread rumour during public health emergencies. The research model for this study is shown in Figure 1.

Figure 1 Research model



3 Research methodology

3.1 Instrument development

To test the hypotheses proposed in this study, we conducted a quantitative study through an experimental design. Since COVID-19 was still unstable in 2020, we used an online questionnaire to collect data. We selected rumours from the official Chinese

rumours-refuting platform (<http://www.piyao.org.cn>) that had been verified to be false as the experimental stimuli for this study. Before formally responding to the questionnaire, we asked subjects to read the rumour selected in advance and informed them that the authenticity of the rumour was uncertain. Then, in the questionnaire, we tested the subjects' evaluation of the effect and cost that sharing this rumour could produce, as well as their attitude and intention to spread this rumour. Also, to avoid the influence of prior experience on the experiment, we chose subjects who saw the rumour for the first time as data collection subjects. Rumour is defined as unverified information, so people are unsure whether a rumour is officially identified as true or false when they first see it. However, 'rumour' is considered fake news in China, and to avoid the additional impact of word misunderstanding on the study, we used the word 'information' instead of 'rumour' in the questionnaire.

Table 1 Measurement items

<i>Constructs</i>		<i>Measure items</i>
Issue involvement	II1	I am concerned about the development of COVID-19
	II2	I think the development of COVID-19 is important to me
	II3	I often think about the consequences of COVID-19
Perceived severity	PS1	Infection with COVID-19 is very bad
	PS2	Infection with COVID-19 will make everyone very miserable
	PS3	If I/my family is infected with COVID-19, it is terrifying
Perceived vulnerability	PV1	I may be infected with COVID-19
	PV2	I am at risk of catching COVID-19
	PV3	I may be infected with COVID-19 in the future
Self-efficacy	SE1	I am sure to share valuable information with others
	SE2	It is easy for me to share valuable information with others
	SE3	I am always aware of the latest news on COVID-19 (drop)
Response efficacy	RE1	The information I shared can help others prevent COVID-19
	RE2	The information I shared can help others understand COVID-19
	RE3	The information I shared can help others protect their safety
Response cost	RC1	Sharing this information will waste my time
	RC2	Sharing this information will waste my energy
	RC3	Sharing this information can be troublesome
Attitude to spread	AS1	It is wise to share this information
	AS2	It is correct to share this information
	AS3	It is valuable to share this information
Intention to spread	IS1	I plan to share this information
	IS2	I am willing to share this information
	IS3	I will share this information immediately
Tie strength	TS1	I plan to share this information with people I know
	TS2	I plan to share this information with my relatives and friends
	TS3	I plan to share this information with people I have close contact with

In this study, drawing on previous studies and with the modification due to this research context, we obtained all the measurement items, as seen in Table 1. This study was conducted in China, so we first translated the English-language scale into Chinese, revised it in response to the research situation, and then translated Chinese into English for comparison, to be reviewed by five English-speaking experts. Before distributing the questionnaire, we sought out 30 management graduate students and teachers for pre-testing. These actions ensured the appraisal questionnaire's clarity, accuracy, logical consistency, and validity. We collected and controlled for demographic characteristics (gender, age, education, income) and time on the internet.

In particular, the measurement items of issue involvement were adapted from Nekmat and Kong (2019). Threat appraisal includes two dimensions, including perceived vulnerability and perceived severity; coping appraisal includes three dimensions, including self-efficacy, response efficacy, and response cost; these scales were derived from Lee (2011). The scales of attitude and intention to spread were derived from Bock et al. (2005). The scale of tie strength, including three items, was taken from Sun et al. (2014). All items were measured using the Likert seven-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

3.2 Data collection

This study used the paid sample service of a professional online questionnaire platform (<http://www.Sojump.com>) to distribute the questionnaires, a platform widely used in information management research (Ma et al., 2020b, 2021a). In this study, a total of 526 papers were collected. We removed 103 invalid questionnaires based on criteria such as trap items and the same scoring. Finally, 423 questionnaires were retained, and the effective rate of the questionnaire was 80.41%. The demographic statistics of participants are recorded in the Appendix.

4 Data analysis

4.1 Measurement model

Before analysing the structural model, the reliability and validity of the model need to be measured. The method of Hair et al. (2009) can be used to evaluate the measurement model through three aspects: reliability, convergence validity, and discriminative validity. The construct self-efficacy (SE) originally contained three items; however, one item (SE3) did not load properly and therefore was eliminated from the analysis. As shown in Table 2, the minimum Cronbach's alpha is 0.717, which is larger than the threshold value of 0.7, the minimum CR is 0.848, which is larger than the threshold value of 0.7, and the minimum AVE is 0.650, which is larger than the threshold value of 0.5, so the measurement items have high reliability. Simultaneously, AVE's square roots are larger than their correlation coefficients with other factors, which indicate that the model has good discrimination validity. According to Table 3, all the factor loading is between 0.784–0.952 at the significance level of $p < 0.01$, which exceeds the threshold value of 0.7, so the model has high convergence effectiveness.

Table 2 Descriptive statistics and inter-construct correlations

Item	Alpha	AVE	II	PS	PV	SE	RE	RC	AS	IS	TS
II	0.730	0.650	0.806								
PS	0.758	0.674	0.525	0.821							
PV	0.924	0.952	0.125	-0.011	0.932						
SE	0.717	0.876	0.478	0.326	0.192	0.883					
RE	0.802	0.883	0.593	0.346	0.221	0.663	0.846				
RC	0.934	0.958	-0.101	-0.141	0.373	0.034	0.017	0.940			
AS	0.907	0.942	0.389	0.240	0.204	0.462	0.468	-0.160	0.918		
IS	0.930	0.955	0.350	0.132	0.280	0.440	0.444	-0.137	0.866	0.937	
TS	0.913	0.945	0.525	0.277	0.191	0.423	0.464	-0.209	0.765	0.755	0.923

Notes: Issue involvement (II); Perceived vulnerability (PV); Perceived severity (PS); Self-efficacy (SE); Response efficacy (RE); Response cost (RC); Attitude to spread (AS); Intention to spread (IS); Tie strength (TS).

Table 3 Cross loadings

<i>Item</i>	<i>II</i>	<i>PS</i>	<i>PV</i>	<i>SE</i>	<i>RE</i>	<i>RC</i>	<i>AS</i>	<i>IS</i>	<i>TS</i>
II1	0.820	0.434	0.057	0.386	0.460	-0.093	0.290	0.255	0.405
II2	0.810	0.426	0.029	0.400	0.482	-0.130	0.312	0.261	0.412
II3	0.788	0.409	0.217	0.368	0.492	-0.019	0.339	0.329	0.451
PS1	0.408	0.821	-0.040	0.273	0.233	-0.117	0.192	0.104	0.218
PS2	0.492	0.856	0.016	0.290	0.350	-0.088	0.208	0.107	0.270
PS3	0.382	0.784	-0.007	0.237	0.258	-0.150	0.191	0.117	0.185
PV1	0.112	-0.012	0.938	0.170	0.216	0.342	0.212	0.291	0.211
PV2	0.110	0.002	0.927	0.185	0.183	0.346	0.175	0.241	0.145
PV3	0.128	-0.019	0.930	0.183	0.217	0.355	0.181	0.247	0.174
SE1	0.442	0.288	0.132	0.889	0.580	0.007	0.409	0.391	0.400
SE2	0.401	0.288	0.209	0.876	0.592	0.054	0.406	0.386	0.345
RE1	0.503	0.256	0.226	0.550	0.851	0.030	0.406	0.407	0.398
RE2	0.532	0.343	0.181	0.574	0.831	0.007	0.348	0.349	0.409
RE3	0.471	0.281	0.154	0.561	0.856	0.007	0.433	0.369	0.370
RC1	-0.104	-0.147	0.351	0.059	0.026	0.949	-0.151	-0.112	-0.188
RC2	-0.097	-0.134	0.392	0.049	0.015	0.941	-0.144	-0.114	-0.206
RC3	-0.081	-0.115	0.308	-0.013	0.008	0.928	-0.156	-0.161	-0.195
AS1	0.357	0.222	0.202	0.442	0.425	-0.123	0.919	0.796	0.681
AS2	0.363	0.207	0.187	0.431	0.440	-0.140	0.926	0.806	0.732
AS3	0.352	0.233	0.172	0.398	0.423	-0.178	0.910	0.786	0.693
IS1	0.329	0.111	0.256	0.407	0.394	-0.164	0.822	0.952	0.727
IS2	0.341	0.179	0.233	0.407	0.414	-0.173	0.831	0.929	0.709
IS3	0.312	0.079	0.300	0.423	0.439	-0.043	0.781	0.928	0.684
TS1	0.487	0.254	0.186	0.403	0.424	-0.151	0.695	0.675	0.918
TS2	0.449	0.222	0.174	0.381	0.398	-0.193	0.710	0.708	0.919
TS3	0.517	0.290	0.170	0.386	0.462	-0.233	0.712	0.705	0.931

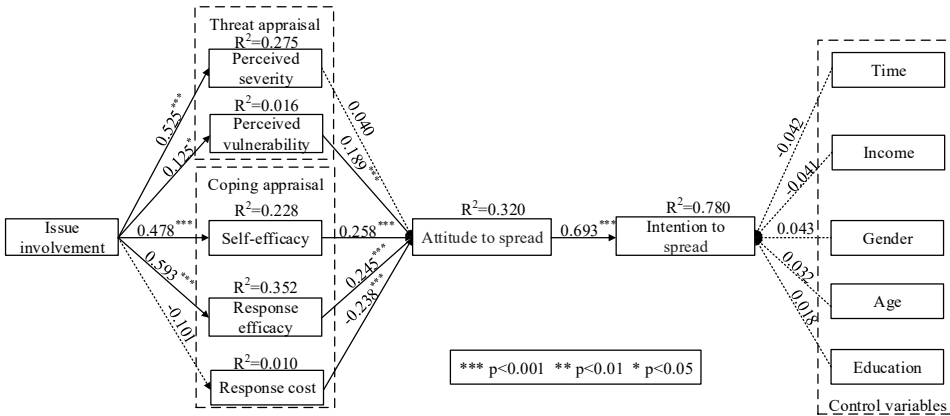
This study used Harman's single-factor approach to test all the constructs in the proposed model. The results showed that there is no single factor, and the covariance explained for each factor is less than 29.670%, so this study did not need to consider the common method bias.

4.2 Structural model

Smart PLS 3.0 was used for analysis of the structural model. Figure 2 shows the result of the structural question model. Except for H5 and H6, all hypotheses are supported. Specifically, issue involvement has a significant impact on perceived severity, perceived vulnerability, self-efficacy, and response efficacy, but it has no significant impact on response cost. Therefore, H1 ($\beta = 0.525$, $t = 8.683$), H2 ($\beta = 0.125$, $t = 2.411$),

H3 ($\beta = 0.478$, $t = 8.619$), and H4 ($\beta = 0.593$, $t = 11.864$) are supported, while H5 ($\beta = -0.101$, $t = 1.796$) is not supported. Then, for threat appraisal, perceived vulnerability has a positive effect on the attitude to spread. However, perceived severity has no significant effect on attitude to spread. Therefore, H7 ($\beta = 0.189$, $t = 3.734$) is supported, while H6 ($\beta = 0.040$, $t = 0.870$) is not supported. For coping appraisal, self-efficacy and response efficacy have a positive effect on attitude to spread, but response cost has a negative effect on attitude to spread; therefore, H8 ($\beta = 0.258$, $t = 4.039$) and H9 ($\beta = 0.245$, $t = 3.786$), and H10 ($\beta = -0.238$, $t = 4.921$) are supported. Finally, attitude to spread has a significant positive impact on intention to spread; thus, H11 ($\beta = 0.693$, $t = 18.516$) is supported.

Figure 2 Results of the structural model analysis



4.3 Mediating effect

This study tested the mediating role of perceived severity, perceived vulnerability, self-efficacy, response efficacy, response cost, and attitude to spread. For measurement, we adopted the bootstrap method. Specifically, we use the PROCESS SPSS macro developed by Hayes to test mediation (Ma et al., 2019), use the bias-corrected method and the percentile method to test the mediating effect and measure the confidence level for the 95% confidence intervals. The results are shown in Table 4.

According to the criteria for mediating effects proposed by previous research (Prebensen and Xie, 2017; Ma et al., 2021b), when the confidence interval of the indirect effect does not include zero, the mediating effect is significant. Furthermore, if the confidence interval of the direct effect also does not contain zero, then it is fully mediated, else it is partially mediated. Therefore, perceived vulnerability, self-efficacy, and response efficacy partially mediate between issue involvement and attitude to spread. The attitude to spread partially mediates the relationship between threat appraisal and intention to spread, while it fully mediates the relationship between coping appraisal and intention to spread.

Table 4 Results of mediating effect

<i>M/(IV)/(DV)</i>	<i>Items</i>	<i>Effect</i>	<i>Coefficient</i>		<i>Bias-coefficient</i>		<i>Percentile</i>		<i>Mediation existence</i>
			<i>SE</i>	<i>T</i>	<i>95%</i>	<i>CI</i>	<i>95%</i>	<i>CI</i>	
PS/(II)/(AS)	Direct effect	0.579	0.083	6.941	0.415	0.744	0.415	0.744	Non
	Indirect effect	0.041	0.047	0.872	-0.043	0.148	-0.046	0.136	
PV/(II)/(AS)	Direct effect	0.589	0.071	8.288	0.449	0.729	0.449	0.729	Partial
	Indirect effect	0.032	0.016	1.916	0.006	0.074	0.005	0.070	
SE/(II)/(AS)	Direct effect	0.351	0.076	4.602	0.201	0.502	0.201	0.502	Partial
	Indirect effect	0.269	0.052	5.145	0.175	0.380	0.171	0.377	
RE/(II)/(AS)	Direct effect	0.276	0.084	3.286	0.111	0.442	0.111	0.442	Partial
	Indirect effect	0.344	0.061	5.575	0.231	0.472	0.225	0.456	
RC/(II)/(AS)	Direct effect	0.602	0.071	8.460	0.462	0.742	0.462	0.742	Non
	Indirect effect	0.019	0.015	1.266	-0.001	0.062	-0.001	0.060	
AS/(PS)/(IS)	Direct effect	-0.144	0.045	-3.207	-0.233	-0.056	-0.233	-0.056	Partial
	Indirect effect	0.384	0.085	4.517	0.208	0.550	0.211	0.539	
AS/(PV)/(IS)	Direct effect	0.110	0.024	4.462	0.061	0.159	0.061	0.159	Partial
	Indirect effect	0.173	0.043	4.023	0.088	0.258	0.087	0.259	
AS/(SE)/(IS)	Direct effect	0.080	0.042	1.902	-0.002	0.163	-0.002	0.163	Full
	Indirect effect	0.597	0.065	9.184	0.467	0.724	0.467	0.728	
AS/(RE)/(IS)	Direct effect	0.082	0.045	1.806	-0.007	0.172	-0.007	0.172	Full
	Indirect effect	0.655	0.066	3.851	0.519	0.780	0.525	0.784	
AS/(RC)/(IS)	Direct effect	0.004	0.024	0.190	-0.043	0.052	-0.043	0.052	Full
	Indirect effect	-0.137	0.047	-2.914	-0.229	-0.045	-0.230	-0.046	

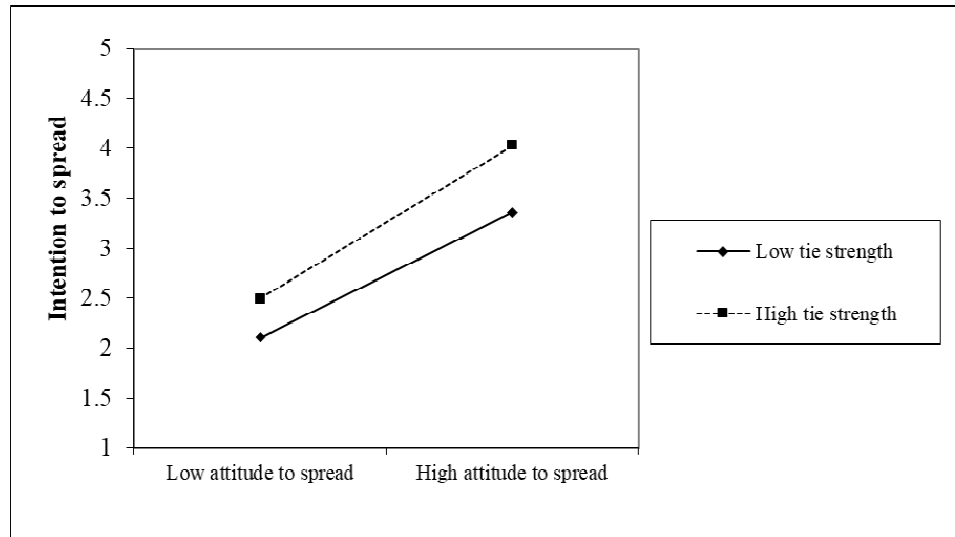
4.4 Moderating effect

This study used moderated PLS-SEM to explore the moderating effect of tie strength between attitude to spread and intention to spread (Teo et al., 2015). Table 5 shows the results of the empirical tests, including the path coefficients and p-values. According to Table 5 and Figure 3, it can be found that different levels of tie strength have moderating effects on the relationship between attitude and intention to spread ($\beta = 0.048$, $t = 2.805$). Therefore, H12 is supported. At the same attitude to spread level, people are more likely to share rumours to information receivers with high tie strength than with low tie strength.

Table 5 Result of moderation analysis

<i>Moderation path</i>	<i>Path coffer</i>	<i>SD</i>	<i>T Statistic</i>	<i>P value</i>	<i>Result</i>
AS*TS -> II	0.048	0.017	2.805	0.005	Supported

Figure 3 Moderating role of tie strength between attitude and intention to spread



5 Discussion

5.1 Key findings

This study explored the factors that influence the intention to spread rumours in public health emergencies. Based on PMT, we constructed a basic research framework. Using a structural equation model to analyse data from 423 respondents, we obtained some valuable conclusions and implications.

First, the study results indicate that the degree of issue involvement has an impact on cognitive appraisal. Issue involvement has a positive effect on threat appraisal. Specifically, when the issue involvement increases, both perceived severity and perceived vulnerability increase. This study suggests that this is because when issue involvement

increases in emergencies, individuals seek information to reduce anxiety. However, people's negative bias psychology makes them more concerned about negative news and perceives the event as serious, thus exaggerating the sense of danger. In the relationship between issue involvement and coping appraisal, issue involvement is closely related to self-efficacy and response efficacy; the finding is similar to previous research results (Verkoeyen and Nepal, 2022). However, although the relationship between issue involvement and response cost is negative, the relationship is not significant. One reason for this may be that response cost refers to all costs incurred in the execution of the behaviour, but everyone's appraisal of cost is different (Ifinedo, 2012).

Second, the study results indicate that there is a close relationship between cognitive appraisal and attitude to spread. In threat appraisal, perceived vulnerability has a significant relationship to attitude, but perceived severity has no significant impact on attitude. Therefore, the main reason that motivates people to protect themselves and acquaintances is the possibility that they will be negatively affected by the event, as compared to the severity of the event. Each factor in the coping appraisal has a significant impact on attitude. The finding is similar to the results seen in previous research on the relationship between coping appraisal and attitudes (Wu, 2020), suggesting that the potential functional value of rumours and confidence in self-efficacy are among the important reasons for rumour-spreading being regarded as a protective measure. In addition, this study explores the mediating effect of protection motivation factors between issue involvement and attitude to spread, among which perceived vulnerability, self-efficacy, and response efficacy play a partial mediating role.

Finally, the study results indicate that attitude positively influences intention to spread and that tie strength plays a positive moderating role. Similar to the finding that attitude predict intention to take protective measures (Tsai et al., 2016), this research found that the attitude to spread is positively related to the intention to spread. In the relationship between attitude and intention to spread, this study found that tie strength with information receivers plays a positive moderating role. The finding suggests that the tie strength allows the information receiver to believe the rumour is credible and allows the information sender to share the rumour with acquaintances. At the same time, this study verifies the mediating role of attitude in cognitive appraisal and intention to spread. Specifically, attitude partially mediates the relationship between threat appraisal and intention to spread and fully mediates the relationship between coping appraisal and intention to spread.

5.2 Theoretical implications

First, this study enriches the rumour-spreading literature by exploring how people's protection motivation affects rumour-spreading. Rumour spreading is motivation-driven communication behaviour (DiFonzo and Bordia, 2007). Previous studies have analysed the influence of motivation, such as self-enhancement, socialising, and entertainment, on rumour sharing (Lin et al., 2022; Shen et al., 2021). However, motivation is influenced by the context, and previous studies ignored the specificity of the context of public health emergencies. People are primarily concerned about health issues during health events and view health information search as protective behaviour during a crisis event. Rumours provide employees with information about the event that provides them with informational and emotional support. Therefore, this study considers protective

motivation as the primary motivation driving people to share rumours in public health emergencies and analyses the formation process of protective motivation.

Second, this study develops PMT by applying it with issue involvement to study rumour spreading in public health emergencies. Protective motivation explains how people are motivated to take measures in response to threats. Based on PMT, previous studies have explored the mechanisms by which people take the appropriate protective measures, such as self-isolation, and qualitatively analysing erroneous protective behaviour, such as panic buying during public health emergencies (Naeem and Ozuem, 2022; Farooq et al., 2020). Applying PMT to rumour-spreading research, this study quantifies why people mistakenly perceive rumour spreading as a protective measure through threat appraisal and coping assessment. Furthermore, this study uses issue involvement as an input to the PMT model and explores how people's relevance and knowledge of the event influence cognitive appraisal. This study enriches the use of PMT and deepens the theoretical understanding of rumour spreading.

Finally, this study contributes to rumour-spreading research by revealing the moderating effect of tie strength with information receivers on the relationship between attitude and intention to spread. Tie strength is an important factor influencing information sharing (Sun et al., 2021). Previous studies have shown that the tie strength with information senders positively influences perceived credibility of the rumour. However, limited attention was paid to the tie strength with information receivers. It is unclear whether the tie strength with information receivers influences rumour spreading. The present study found that tie strength positively moderated the relationship between attitude and intention to spread at the same attitude level, contributing to a better understanding of the effect of tie strength on rumour spreading.

5.3 Practical implications

This study has practical implications for rumour management in public health emergencies. First, we explored how people generate protective motivation to view rumour spreading as a protective measure from the perspective of protective motivation. Our results show that perceived vulnerability in threat appraisal contributes to protective motivation. In public health emergencies, people actively take protective measures when they discover they are exposed to potential harm, whether the measures are right or wrong. Therefore, official institutions should timely announce the impact scope, infectious capacity, and preventive measures of public health emergencies to eliminate people's panic and anxiety. In the coping appraisal, the results show that people spread rumours because they believe that rumour spreading can protect them by providing health precautions for themselves and acquaintances. Due to the urgency and severity of the crisis, people who lack the relevant expertise make incorrect assessments of their coping abilities. Therefore, in a crisis event, people need to be skeptical of their subjective judgments about the validity of health information and to fact-check the information.

Second, we found that the tie strength of people's relationship with information receivers positively moderates the relationship between attitude and intention to spread. Previous studies have also shown that people will believe rumour spread by acquaintances. Tie strength not only influenced message receivers' judgments about the credibility of rumour but also facilitated message senders' intention to spread. The results of this study further explain why rumours spread in close interpersonal relationships. Therefore, in public health emergencies, on the one hand, people should also actively

fact-check information disseminated from familiar people. On the other hand, people should carefully elaborate information to avoid spreading misinformation to acquaintances.

5.4 Limitations and future directions

Although this study contributes to the theory and literature on rumour spreading, it is also essential to carefully examine these issues due to several limitations. First, it is unclear whether the results of this study will vary across the lifecycle of a crisis event due to the limitations of the cross-sectional data. Future research could collect data multiple times to explore the variability of rumour sharing behaviour at different stages of an event's development and incorporate qualitative research to enrich the findings using grounded theory approach (Ma et al., 2022). Second, in this study, we only selected one public health emergency, COVID-19, as the context for the study and data collected using an online questionnaire was used for data analysis. Future studies could collect objective data from different public health emergencies to improve the validity of this study's results. Finally, this study was conducted in the cultural context of China. Research has shown that different countries have different results on rumour validation and sharing (Sharma and Kapoor, 2022), so the influence of protection motivation on rumour spreading in different cultural contexts can be explored.

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Appendix

Table A1 Demographic statistics of participants

<i>Demographic variable</i>		<i>Size</i>	<i>%</i>
Gender	Male	174	41.13
	Female	249	58.87
Age	<18	1	0.24
	18–25	116	27.42
	26–30	110	26.00
	31–40	150	35.46
	41–50	36	8.51
	51–60	8	1.89
	>60	2	0.47
Education	Senior school or below	17	4.02
	Bachelor's degree	345	81.56
	Master's degree	50	11.82
	Doctoral degree or above	11	2.60
Income	≤ 3,000	58	13.71
	3,001–5,000	78	18.44
	5,001–8,000	143	33.8
	8,001–12,000	91	21.51
	> 12,000	53	12.53
Time on the internet	< 2 h	55	13.00
	Between 2 and 4 h	192	45.39
	Between 4 and 6 h	119	28.13
	>6 h	57	13.48