The Relationship between Risk Event Involvement and Risk Perception during the COVID-19 Outbreak in China

Da Qian

College of Economics and Management, Zhejiang Normal University, Jinhua, China

Ou Li*

School of Management, Zhejiang University, Hangzhou, China

Neuromanagment Laboratory, Zhejiang University, Hangzhou, China

Background: The coronavirus disease 2019 (COVID-19) is a worldwide pandemic that continues to spread and the situation continues to deteriorate globally. It is also a risk event for the public in affected areas. However, little is known about the relationship between "being involved/exposed in a risk event at the moment" and people's risk perception of that event. **Methods:** The mediation model and analysis of covariance method were performed on a Chinese sample ($N = 351$) during the outbreak of COVID-19 to test the underlying mechanism between risk event involvement and risk perception. **Results:** Risk event involvement was positively related not only to people's event-related risk perception but also their general risk perception (i.e. risk perception towards other events), and negative emotion mediated these relationships. In addition, the residents of Wuhan (vs. non-Wuhan) exhibited significantly higher event-related risk perception as well as general risk perception. **Conclusions:** The findings deepen our understanding of risk perception by suggesting that being involved in a risk event at the moment is also a nonnegligible variable positively related to risk perception through increased negative emotion. Finally, theoretical and managerial implications of the result are discussed.

Keywords: COVID-19, emotion, risk event involvement, risk judgement, risk perception

INTRODUCTION

Declared a worldwide pandemic by the World Health Organization (WHO) on 11 March 2020, the coronavirus disease 2019 (COVID-19) is now spreading and

---

*Address for correspondence: Ou Li, School of Management, Zhejiang University, 866 Yuhangtang Road, Hangzhou 310058, China. Email: xunyangyue@163.com

the situation continues to deteriorate globally (WHO, 2020a). The COVID-19 pandemic erupted in Wuhan as early as December 2019. It is a type of viral pneumonia and infection with clinical symptoms such as fever, cough, headache, breathing difficulties, and even death or other serious consequences (Chen et al., 2020; Huang et al., 2020). China is the first country where the virus appeared, and as of the time this study was conducted (7 February 2020), it was most severely affected by COVID-19, with all 34 of its provinces infected, 34,598 confirmed cases, and 723 deaths (WHO, 2020b).

Being in the peak phase of COVID-19 has caused enormous psychological pressure and panic among some of the Chinese public. Some citizens were reported to have stay indoors for more than 10 days due to the fear of infection (Li, 2020), snapped up supplies including toilet paper in supermarkets (Chen, 2020), and developed symptoms of post-traumatic stress disorder (PTSD) (Qu et al., 2020). There were also areas in China where highway access was blocked (Liu, 2020) and indiscriminately excluded all people from affected areas (e.g. Wuhan) (Yu, Du, Peng, & Fan, 2020). This phenomenon is corroborated by data from a national survey ($N = 11,479$) conducted during the pandemic, which showed that the Chinese public generally considered COVID-19 to be very dangerous, and more than half of the public thought that they were at the risk of contracting COVID-19 (Zhang et al., 2020).

Needless to say, some of the public's risk awareness of COVID-19 exceeds its actual risk, and there may even be a tendency to overestimate its risk perception. According to the data from *China Statistical Yearbook* published by National Bureau of Statistics of China (2019), during the same period last year (December 2018 to February 2019), nearly 15,700 people in China died from traffic accidents, 38,600 from accidental falls, and 532,700 from heart-related diseases. These fatal events resulted in far more deaths than COVID-19 over the same period, but the risk perception and response intensity of COVID-19 from the public was much higher than that of these events. Although COVID-19 is more likely to stimulate people's risk perception because it is a new and unknown risk (Slovic, 1987) as compared to the traffic accidents and other common events, and because COVID-19 is a sudden risk event that is occurring in the Chinese public —most of whom are deeply involved in it—it is plausible, therefore, that "being in the risk event at the moment", also known as risk event involvement, may also enhance one's risk judgements of the current event. Understanding how the public perceives the risk of sudden risk events can help risk managers and policymakers better recognise the public's attitude and carry out corresponding prevention and control measures. The current outbreak of COVID-19 offers a unique opportunity to understand the relationship between exposure to risk events and the risk perception of the public. Based on this, Chinese samples under the COVID-19 pandemic were chosen in this study to test the aforementioned questions, and it was assumed that:

H1: Risk event involvement is positively correlated with risk perception of that event.

An Emotion-Based Risk Assessment Mechanism

As individuals are not sensitive to numbers and probabilities (Kahneman & Tversky, 1973), they are unable to arrive at risk judgements through deliberate probability calculation and consequence evaluation of all choices (Lowenstein, Weber, Hsee, & Welch, 2001). Instead, they rely on intuition and gut feelings to instantly make "dangerous" or "safe" judgements (Slovic, Finucane, Peters, & MacGregor, 2004). The use of this intuition-based mechanism to judge the risk of events has evolutionary significance (Fessler, Pillsworth, & Flamson, 2004; Loewenstein et al., 2001). As danger often occurs in a flash, basic intuition can help people quickly escape from complex, unknown, and sometimes dangerous environments. Current research supports the notion that emotion seems to be the source of this intuitive risk assessment, which is known as the "risk as feelings" hypothesis (Loewenstein et al., 2001; Slovic et al., 2004). That is, people's judgement of "how dangerous" an event is does not depend on its actual probability of occurrence and severity, but on their subjective and emotional feelings at the time.

Fear (Lerner, Gonzalez, Small, & Fischhoff, 2003) and anxiety (Fan, Zhang, Yang, Mo, & Liu, 2011) are two emotions closely related to risks and emergencies. Previous studies have found that after the occurrence of public health emergencies (e.g. Zika, H1N1 outbreaks), local residents' fear and anxiety rise rapidly in a short time (Tausczik et al., 2011; Yang, Dillard, & Li, 2018). The affect heuristic suggests that these two negatively valenced emotions are likely to induce a pessimistic assessment of risk (Finucane, Alhakami, Slovic, & Johnson, 2000; Wright & Bower, 1992). For instance, Johnson and Tversky (1983) found that people had higher (vs. lower) estimates of the number of deaths originating from a series of causes (e.g. floods, smoking) after reading sad (vs. happy) newspaper articles. In light of this initial exploration, studies began to examine the effect of specific emotions beyond valence on risk perception. Lerner and colleagues found that fear not only leverages American people's risk estimation of negative events such as having brain cancer and strokes (Lerner & Keltner, 2000), but also their perceived probability of future terrorist attacks (Lerner et al., 2003). Relatedly, anxiety has also been shown to enhance people's perception of risk (Butler & Mathews, 1987; Tripp, Tan, & Milne, 1995). Taken together, we inferred that when individuals are exposed to or directly involved in a risk event, those with higher fear and anxiety are more likely to have a higher risk perception. Thus, we assumed:

H2: Event-related fear and anxiety are positively related to risk perception.

Magnify the Danger: Press the Emotion Button

Emotions are unstable and vary dynamically with the changes that people experience at different points in time (Kuppens & Verduyn, 2017). How close they are to a risky event can have a profound effect on people's emotional levels. People who are "closer" (or more closely related) to risk events will acquire more vivid risk information or form affect-laden imagery (Keller, Siegrist, & Gutscher, 2006; Tversky & Kahneman, 1973), and therefore may experience more fear and anxiety caused by risk events. It's like seeing a bad car accident on the news and the death toll is just a number; however, when a similar accident is witnessed at the scene, it will have a substantial emotional impact on people. Psychological distance studies also found that a decrease in psychological distance could heighten people's negative emotional experiences in response to a strongly negative story (Davis, Gross, & Ochsner, 2011). Thus, it can be inferred that the higher the COVID-19 involvement, the higher the corresponding fear and anxiety. Due to the risk as feelings hypothesis, that is, the stronger the negative emotions (such as fear and anxiety) experienced by individuals during their risk assessment process, the higher their judgement on the risk of events will be (Loewenstein et al., 2001; Slovic et al., 2004). Therefore, as people become more involved in COVID-19, or "closer" to it, their risk perception will be enhanced due to the increase of negative emotions. Consequently, we hypothesised the following:

H3: Event-related emotions can mediate the link from risk event involvement to risk perception.

Residents of Wuhan Who are "Closest" to the COVID-19 Outbreak

Wuhan is the source and centre of the COVID-19 outbreak. By 7 February 2020, 55.30 per cent of the confirmed cases in China came from Wuhan City (WHO, 2020b). In order to halt the spread of COVID-19, Wuhan city was the first to take emergency measures such as locking down the city, house-to-house temperature checks, and mass quarantine (Qin, Myers, & Yu, 2020). Most information about COVID-19 on social media was related to Wuhan. Before COVID-19 was officially named, it was referred to as Wuhan pneumonia (Lian, 2020). Therefore, residents from Wuhan were direct experiencers of the COVID-19 pandemic with the highest degree of involvement. In the analysis, we divided the samples into Wuhan and non-Wuhan, and compared the differences in risk perception between the two groups, in order to test the influence of the high involvement/control group on risk perception. We predicted the following:

H4: Residents of Wuhan have a higher risk perception of COVID-19 and a higher risk perception in general than residents of non-Wuhan.

METHOD

Participants

In this study, 424 responses were collected from 4 to 7 February 2020[1] via an online survey platform in mainland China, which provides functions equivalent to Qualtrics. The questionnaire was distributed via social media. Participants were paid a small fee to complete the questionnaire. For the purpose of comparing the sample of Wuhan and non-Wuhan, we also collected data of residents in Wuhan with the help of a research assistant who lived in Wuhan. The following two groups of people were excluded from participation: (1) people working on the frontline against the epidemic, such as medical staff, community workers, and volunteers; (2) people who had been infected with COVID-19. After eliminating invalid responses,[2] a final sample of 351 persons (82.78%) was obtained. There were 162 men (46.15%) and 189 women (53.85%), ranging in age from 15 to 57 years ($M_{age} = 24.99 \pm 7.57$). Valid responses were collected from 26 (out of 34) provinces in China, of which 109 were from Wuhan. Confirmed cases were reported in all sample cities, indicating that all the participants were involved with the pandemic to some degree. This study was approved by the Research Ethics Board of the Neuromanagement Laboratory at Zhejiang University, and informed consent was obtained from all participants.

Measurement

COVID-19 Involvement.   We used involvement to capture how closely individuals experience COVID-19. Following the work of Qin, Niu, Huang, and Xu (2011), we developed a five-item scale to measure COVID-19 involvement, using a 7-point scale (1 = totally disagree, 7 = totally agree). The higher the average score, the closer the individual's experience with COVID-19. Items include "I will actively follow the progress of COVID-19", "I often browse for information on COVID-19 in the news, media, and on the Internet", "I often talk about COVID-19 with my family and friends", "COVID-19 greatly interferes my current life", and "COVID-19 is closely related to my current life". The confirmatory factor analysis (CFA) for fit indicators of the scale showed that $\chi^2/df = 3.22$, RMSEA = 0.07, CFI = 0.95, TLI = 0.92, and SRMR = 0.03, indicating that the construct validity of the scale was acceptable. Cronbach's α for the scale was 0.88.

---

[1] This time period was at the peak phase of the COVID-19 infection in China, and the number of reported cases rose dramatically from 20,438 to 28,985. Therefore, it is deemed suitable for this study.

[2] We adopted a strict screening method to determine our sample, and participants who missed answers, answered incorrectly, or refused to answer were excluded from further analysis.

Negative Emotion.   Negative emotion was measured as a latent construct based on fear and anxiety. Fear and anxiety were measured by the discrete emotion scale developed by Harmon-Jones et al. (2016), including items for fear ("COVID-19 makes me feel terrified/scared/fearful/panicked") and anxiety ("COVID-19 makes me feel worried/anxious/dread/nervous"). Again the 7-point scale (1 = totally disagree, 7 = totally agree) was used. The scale has been proven to have good reliability and validity in many studies (Harmon-Jones et al., 2016). Cronbach's αs for the fear and anxiety subscales were 0.96 and 0.94, respectively.

Risk Perception.   Risk perception consisted of risk perception of COVID-19 and risk perception in general.

Risk Perception of COVID-19—Studies have found that frequency, rather than probability estimates, is a superior indicator of risk perception (Lichtenstein, Slovic, Fischhoff, Layman, & Combs, 1978). The estimated number of casualties caused by risk events can be used as an effective indicator of an individual's perceived risk (Johnson & Tversky, 1983). In the questionnaire guidelines handed out to the participants, we informed them that the number of infections and deaths caused by COVID-19 in China at the time of the research was 20,520 and 426, respectively. They were then asked to estimate, after careful reflection, how many Chinese would eventually be infected and die due to the COVID-19 crisis. As the individual differences in the estimated number of people can reach several orders of magnitude, referring to the general treatment by Johnson and Tversky (1983), we performed logarithmic transformation while analysing the number of estimates. The risk perception of COVID-19 was measured as a latent construct based on the infection and death estimates. Cronbach's α for the risk perception of COVID-19 scale was 0.71.

Risk Perception in General—We adopted the measures of Johnson and Tversky (1983) and Lerner and Keltner (2000). Participants were presented with six causes of death in China: fire, accidental poisoning, homicide, heart disease, traffic accidents, and lung cancer. These causes, which are common in China, were selected from Johnson and Tversky's study, and reported in the *Chinese Health Statistics Yearbook* published by National Health Commission of the People's Republic of China (2019). The chosen causes represent different types of causes of death. The measure asked participants to estimate the annual death toll of each cause of death. To provide a baseline for estimates as Johnson and Tversky did in their study, participants were told that 40,016 people[3] die from drowning each year in China. Drowning is a suitable reference because it is common in China

---

[3] Data were sourced from the *Chinese Health Statistics Yearbook* published by National Health Commission of the People's Republic of China (2019).

and the annual death toll is quite stable (i.e. neither too high nor too low). The participants needed to: (1) estimate as accurately as possible, (2) keep the answers consistent, and (3) feel free to change answers to make the relative frequencies of the entire set consistent with their best opinions. Again, logarithmic transformation was performed during the analysis (Johnson & Tversky, 1983). The risk perception in general was measured as a latent construct based on six evaluations. Cronbach's α for risk perception in general was 0.90.

Control Variables and Data Analysis

The extant literature has found that socioeconomic status (SES) may have a certain influence on risk perception (Lee, Lemyre, Turner, Orpana, & Krewski, 2008). This study adopted the Ladder Scale (Adler, Epel, Castellazzo, & Ickovics, 2000) to measure SES and treated it as a control variable. Moreover, as the samples in this study were from different regions in China, in order to control for potential regional differences, we coded the average risk preference (Weber & Hsee, 1999) and the perceived trust in government (Wachinger, Renn, Begg, & Kuhlicke, 2013) of all sample source regions (city by city) as the control variables according to the Chinese Family Database (a national representative sample, $N = 40,011$).

Mplus 8.3 and SPSS 23.0 were used to analyse the data. After correlation analysis, the role of emotion between risk event involvement and risk perception was investigated (controlling for SES and regional differences). Specifically, the measurement model was validated by predetermined first-order CFA. Then, if the measurement model was satisfactory, the bias-corrected bootstrapping method based on 5,000 bootstraps and 95% confidence intervals (Preacher & Hayes, 2008) was subsequently used to estimate the regression paths simultaneously. Goodness-of-fit indices of the model with the data was assessed by the following indices (Kline, 2005): the ratio of chi-square to degree of freedom (χ^2/df, acceptable if ≤ 3), root mean square error of approximation (RMSEA, acceptable if ≤ 0.08), comparative fit index (CFI, acceptable if ≥ 0.90), Tucker-Lewis index (TLI, acceptable if ≥ 0.90), and standardised root mean square residual (SRMR, acceptable if ≤ 0.08). Finally, the analysis of covariance (ANCOVA) comparing the risk perception of COVID-19 and risk perception in general between the sample of Wuhan and non-Wuhan was employed.

To minimise the issue of common method bias (CMB), similar questions were replaced in different sections of the questionnaire as a means of psychological separation to reset participants' minds throughout the questionnaire (Richey & Autry, 2009). In addition, we diagnosed CMB using Harman's one-factor test which indicates problematic CMB if an exploratory factor analysis (EFA) with all study variables produces eigenvalues suggesting that the first factor accounts for more than 50 per cent of the variance among variables (Podsakoff & Organ, 1986). EFA showed that the cumulative variance explained by the first factor was only 30.43 per cent, indicating that there was no serious CMB in this study.

RESULTS

Descriptive Data and Correlations among Study Variables

The means, standard deviations, and correlation coefficients of the key variables in this study are shown in Table 1. The absolute value of correlation coefficients of the key variables is between 0.17 and 0.36, which is suitable for further analysis.

Mediation Analysis between COVID-19 Involvement and Risk Perception

Risk perception was divided into event-related (i.e. COVID-19) risk perception and general risk perception. We treated COVID-19 involvement as the independent variable, emotion as the mediator and the two types of risk perception as the dependent variables to construct our model. SES and regional differences (i.e. risk preference and perceived trust in government) were included as control variables. It was found that the fit index of the model was good, $\chi^2/df = 2.64$, RMSEA = 0.07, CFI = 0.94, TLI = 0.92, and SRMR = 0.05.

Standardised path coefficients for the model are shown in Figure 1. Analysis of each path in the model revealed that COVID-19 involvement was positively related to emotion ($\beta = 0.36$, $p < .001$). Then, emotion (i.e. fear and anxiety) was positively related to both COVID-19 risk perception ($\beta = 0.36$, $p < .005$) and general risk perception ($\beta = 0.16$, $p = .006$). The bias-corrected bootstrapping method was used to test mediating pathways. The results are displayed in Table 2. First, regarding risk perception of COVID-19, it can be seen that the direct effect of involvement on risk perception of COVID-19 was not significant, with 95% CI [−0.15, 0.14]. However, the mediation effect was significant. The link from COVID-19 involvement to greater risk perception of COVID-19 was

TABLE 1
Means, Standard Deviations, and Correlations

Variable	Mean	SD	1	2	3	4
1 Involvement	6.07	0.98	1			
2 Negative emotion	9.33	2.81	0.36***	1		
3 Risk perception of COVID-19	8.10	0.69	0.16**	0.31***	1	
4 Risk perception in general	27.04	3.28	0.26***	0.21**	0.31***	1

Note: $n = 351$; Negative Emotion was constructed on fear and anxiety; Risk Perception of COVID-19 was constructed on the infection and death estimates, Risk Perception in General was constructed on the six estimates;
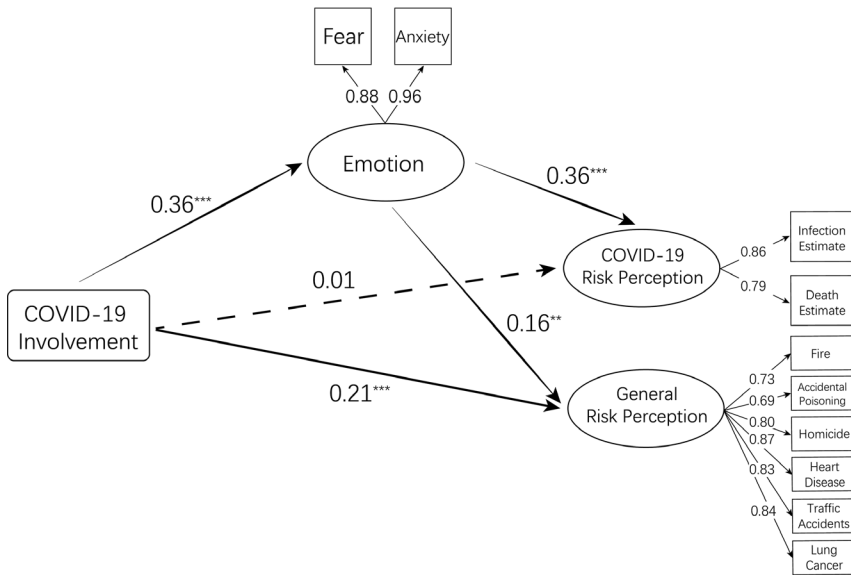**$p < .01$;
***$p < .001$; the same below.

FIGURE 1.   Standardised path coefficients for the mediation model predicting risk perception of COVID-19 and risk perception in general. The dashed line represents the insignificant path.

TABLE 2
Mediation Analysis for COVID-19 Involvement and Risk Perception

Pathways	Estimate	SE	(%)	Lower	Upper
Risk perception of COVID-19				95% CI	
Involvement – risk perception (direct path)	0.01	0.07	7.14	−0.15	0.14
Involvement – emotion – risk Perception	0.13	0.03	92.86	0.08	0.20
Risk perception in general				95% CI	
Involvement – risk perception (direct path)	0.21	0.05	77.78	0.10	0.31
Involvement – emotion – risk perception	0.06	0.02	22.22	0.02	0.11

mediated by fear and anxiety. The estimate of the mediation effect was 0.13, 95% CI [0.07, 0.20]. Secondly, regarding risk perception in general, the result was at variance with that of COVID-19 risk perception. Involvement had a significant direct effect on risk perception in general, with 95% CI [0.10, 0.31]. Similarly, the link from COVID-19 involvement to increased risk perception in general was also mediated by fear and anxiety. The estimate of the mediation effect was 0.06, 95% CI [0.02, 0.11].

Comparison of the Sample between Wuhan and Non-Wuhan

Among our valid data, 109 people came from Wuhan (31.05%) and 242 came from other cities (68.95%). A two-tailed independent t-test of COVID-19 involvement revealed that residents of Wuhan indeed had a higher involvement level than residents of non-Wuhan ($M_{Wuhan} = 6.36 \pm 0.67$ vs. $M_{non-Wuhan} = 5.94 \pm 1.07$, $t(312) = 4.43$, $p < .001$, Cohen's $d = 0.47$).

Results of COVID-19 Risk Perception. A 2 (Area: Wuhan vs. non-Wuhan) × 2 (Evaluation types: infection vs. death) ANCOVA, with SES and regional differences as covariates and estimated population as the dependent variable revealed significant main effects of Area ($F(1, 346) = 29.08$, $p < .001$, $\eta^2 = 0.08$), Evaluation types ($F(1, 346) = 42.49$, $p < .001$, $\eta^2 = 0.11$) and the interaction effect between Area and Evaluation types ($F(1, 346) = 5.10$, $p = .025$, $\eta^2 = 0.02$). More importantly, as shown in Figure 2a, simple-effect analyses showed that residents of Wuhan had a significantly higher number of estimated COVID-19 infections ($F(1, 346) = 20.97$, $p < .001$, $\eta^2 = 0.06$) and
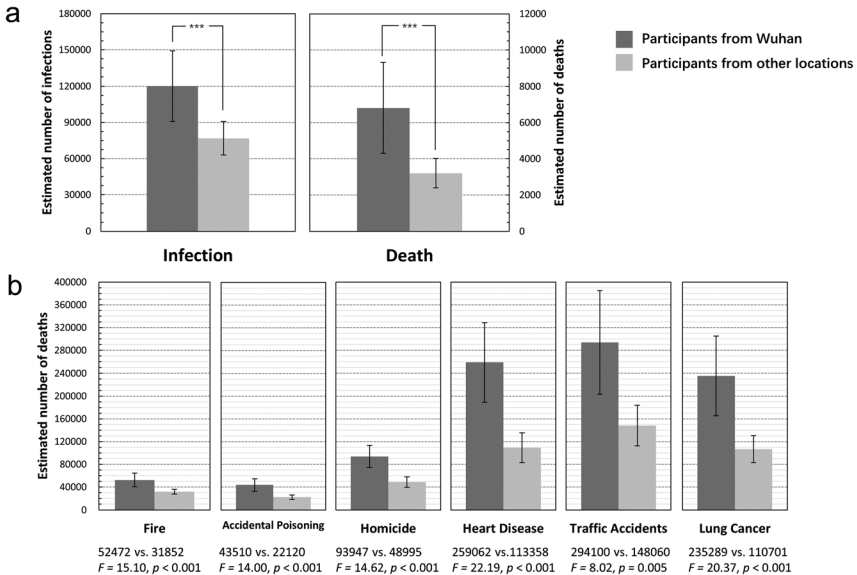

FIGURE 2. Comparison of (a) the estimated number of COVID-19 infections and deaths, and (b) the estimated number of deaths of six common causes in China between residents of Wuhan and non-Wuhan. Logarithmic transformation data were used in the data analysis. Raw data were used to construct this figure for better visual presentation.

deaths ($F(1, 346) = 24.47$, $p < .001$, $\eta^2 = 0.07$) than residents of non-Wuhan. The comparison showed that the estimated number of infections and deaths of COVID-19 by residents of Wuhan (vs. non-Wuhan) was 56.20 per cent and 112.42 per cent higher, respectively.

Results of General Risk Perception.   A single factor (Area: Wuhan vs. non-Wuhan) ANCOVA was used for the six causes of death, with SES and regional differences as covariates, and the estimated number of deaths per year as the dependent variable. As expected, the results showed that residents of Wuhan (vs. non-Wuhan) predicted a significantly higher number of deaths in all six causes, as shown in Figure 2b. The average estimated annual death of the six causes of death by residents of Wuhan (vs. non-Wuhan) was 105.94 per cent higher.

DISCUSSION

Within the context of the COVID-19 pandemic, this study found that a higher involvement in a risk event at the moment was associated with higher event-related and general risk perception via higher levels of emotion (fear and anxiety). Regarding event-related risk perception, with the increase in the involvement of risk events, individuals will experience more fear and anxiety caused by those events. Due to risk as feelings (Loewenstein et al., 2001; Slovic et al., 2004), those who have higher fear anxiety are more likely to have a higher risk perception. In our model, fear and anxiety play similar roles. When it comes to the prediction of general risk perception, the mediating effect of emotion is weakened, with the ratio of the indirect effect to the total effect dropping from 92.86 per cent (COVID-19 risk perception) to 22.22 per cent (general risk perception). However, the direct effect from involvement to general risk perception is significant. In sum, the results of both COVID-19 risk perception and general risk perception support H1, H2, and H3. The comparison between the sample of Wuhan and non-Wuhan served as an experimental control. Since Wuhan was at the centre of the COVID-19 crisis, the sample of Wuhan (vs. non-Wuhan) was assigned to the experimental (vs. control) group. The results showed that the sample of Wuhan (vs. non-Wuhan) was not only higher in the estimated number of COVID-19 infections and deaths, but also in the estimated annual death toll of those common causes of death (unrelated to COVID-19). This again confirms our hypothesis that those who are currently more involved in risky events have higher event-related and general risk perceptions. Thus, we find support for H4.

Interestingly, we found that emotion plays a more influential role in predicting event-related (i.e. COVID-19) risk perception than general risk perception. The emotions measured in this study are those closely related to COVID-19, so they are more likely to be regarded as integral emotions when making risk judgements of COVID-19, and as incidental emotion when making risk judgements of

other common causes of death. Based on previous findings that both integral and incidental emotions can change the level of risk perception of individuals (Johnson & Tversky, 1983; Lerner & Keltner, 2000), this finding further implies that integral emotion may be more powerful than incidental emotion when making risk judgements.

As an exploratory study that tries to illuminate the relationship between risk event involvement and risk perception, it only considers emotion as the explanatory variable. It is plausible that some other factors may also explain the above relationship. First, a higher involvement in a public health emergency with fatal consequences (e.g. the COVID-19 crisis) may cause the individual to be exposed to a higher degree of mortality salience. Based on the terror management theory, it is proposed that the mortality salience will increase people's risk judgement of risk events (Mann & Wolfe, 2016; Miller & Mulligan, 2002). Therefore, the mortality salience may serve as a partial explanatory mechanism. In addition, the social amplification of risk framework implies that the interaction between individuals and media exposure related to risk events will also leverage or attenuate the level of risk perception (Kasperson, Kasperson, Pidgeon, & Slovic, 2003). Therefore, for the two groups with high or low involvement in COVID-19, the differences in their interaction with the media information related to the epidemic, such as the differences in the degree of information exposure, the type of information obtained, and the manner of information transmission, may further give rise to the differences in their emotion and risk perception. Future research may consider the role of mortality salience and media information to further explore the relationship between risk event involvement and risk perception.

The present work contributes to emotion-related studies in the context of public health emergencies. Previous literature has shown that frontline health care workers (Koh et al., 2005) and individuals involved in the epidemic situation, such as those who are acquainted or directly exposed to someone with a diagnosis of SARS (Hawryluck et al., 2004), will have higher negative emotions and even PTSD symptoms. In this study, a sample of the general public under COVID-19 was chosen, and event involvement was taken as a continuous variable to explore the dynamic relationship of the degree of involvement on emotion. This study further explored the downstream effect of event involvement on how "increased emotion" brought about by high degrees of involvement could continue to increase risk perception. In fact, the perception of risk per se can increase people's emotions (Ng, Yang, & Vishwanath, 2017). Therefore, once a risk event is experienced, a loop of emotion and risk perception may be constituted. Since continuously increasing risk perception will lead to many adverse effects, it might indeed provide fertile avenues for future research by elucidating how to reduce this loop, such as exploring how information (Huurne & Gutteling, 2008) and trust (Wachinger et al., 2013) would potentially moderate the effect of event-related emotion on risk perception.

This study also contributes to understanding the relationship between direct experience and risk perception. People with direct experience of risk events have a higher risk perception than those without that experience (Wachinger et al., 2013). For example, people who have experienced floods (Terpstra, 2011) or volcanic hazards (Paton, Smith, Daly, & Johnston, 2008) would predict a higher risk for these events. However, participants in these prior studies have all recalled their own experiences and psychological activities after the event (Paton et al., 2008; Terpstra, 2011; Wachinger et al., 2013). Thus, a risk event is something that has happened in the past for them. The typical flaws associated with using retrospective studies are delays in self-report and psychological feelings, resulting in participants being unable to fully articulate their feelings at the time when risk events occurred due to blurred or forgotten memory. The present study focuses on the impact of the current experience rather than the "recalled" experience on risk perception. Therefore, we can better recognise how public risk perception evolves during risk events by adopting concurrent data to reveal the relationship between event-related experience and risk perception. Moreover, while past research has focused on the role of whether or not the participants have experienced the risk events, we prioritised on delineating the role of the degree of experience of these events.

Our findings also have important managerial implications. The public is often exposed to sudden risk events (such as infectious diseases, earthquakes, and terrorist attacks). These may cause many adverse effects if the risks associated with these events are overestimated. For example, in the current COVID-19 pandemic, some of the public who overestimated the risk had snapped up medical supplies, and their level of mental well-being were severely affected. The significant association between involvement in risk events and risk perception could provide a scientific basis for risk management organisations and policymaking departments to introduce corresponding measures and guidelines to help mitigate the risk perception effectively.

The first limitation of the present study is the cross-sectional design, which has a limited ability to draw conclusive causal inferences (Maxwell & Cole, 2007). The research question of the present study (i.e. what is the relationship between the current COVID-19 involvement and the current risk perception), however, determined that the data should be collected at the same time. The data collection period (from 4 to 7 February 2020) was during the peak phase of the COVID-19 crisis in China. The external environment (such as the number of confirmed cases, government policy, social mood, and foreign situation) was changing dynamically. Therefore, if the data are not collected simultaneously (or rapidly), the differences in the external environment between the sampling intervals may confound the research results. Due to the constraints associated with the cross-sectional design, the second limitation is that there is likely to be a reverse relationship between the variables in the model. A higher risk perception might promote a higher negative emotion, and in turn, lead people to perceive

that they are highly involved in the outbreak. In particular, the conceptualisation of COVID-19 involvement in this study is partly related to people's information and communication behaviour around COVID-19 (i.e. items 1, 2, and 3 in the measurement). Therefore, people who perceive a higher risk of COVID-19 may have more negative emotions, and hence pay more attention to the progression of COVID-19, eventually resulting in the form of higher involvement. Although hypotheses about the causality and paths of this study were carefully derived from the literature, together with the comparison of Wuhan and non-Wuhan samples, which can infer the relationship from involvement to risk perception to a certain extent, the potential reverse relationship still needs to be considered when interpreting the results of this study. Future work may seek more conclusive evidence by incorporating experimental methods or comparing data during and after the crisis.

ACKNOWLEDGEMENTS

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES

Adler, N., Epel, E., Castellazzo, G., & Ickovics, J. (2000). Relationship of subjective and objective social status with psychological and physiological functioning: Preliminary data in healthy, White women. *Health Psychology*, *19*(6), 586–592.

Butler, G., & Mathews, A. (1987). Anticipatory anxiety and risk perception. *Cognitive Therapy and Research*, *11*(5), 551–565.

Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y. . . . Zhang, L. (2020). Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A descriptive study. *The Lancet*, *395*(10223), 507–513.

Chen, X. (2020). Seven notes of Spring Festival, the first day of the lunar new year: From panic to rational resistance. Retrieved 1 March 2020, from https://www.thepaper.cn/newsDetail_forward_5639582.

Davis, J., Gross, J., & Ochsner, K. (2011). Psychological distance and emotional experience: What you see is what you get. *Emotion*, *11*(2), 438–444.

Fan, F., Zhang, Y., Yang, Y., Mo, L., & Liu, X. (2011). Symptoms of posttraumatic stress disorder, depression, and anxiety among adolescents following the 2008 Wenchuan earthquake in China. *Journal of Traumatic Stress*, *24*(1), 44–53.

Fessler, D., Pillsworth, E., & Flamson, T. (2004). Angry men and disgusted women: An evolutionary approach to the influence of emotions on risk taking. *Organizational Behavior and Human Decision Processes*, *95*(1), 107–123.

Finucane, M., Alhakami, A., Slovic, P., & Johnson, S. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, *13*(1), 1–17.

Harmon-Jones, C., Bastian, B., & Harmon-Jones, E. (2016). The Discrete Emotions Questionnaire: A new tool for measuring state self-reported emotions. *PLoS One*, *11*(8), e0159915.

Hawryluck, L., Gold, W., Robinson, S., Pogorski, S., Galea, S., & Styra, R. (2004). SARS control and psychological effects of quarantine, Toronto, Canada. *Emerging Infectious Diseases*, *10*(7), 1206–1212.

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., . . . Cao B. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet*, *395*(10223), 497–506.

Huurne, E., & Gutteling, J. (2008). Information needs and risk perception as predictors of risk information seeking. *Journal of Risk Research*, *11*(7), 847–862.

Johnson, E., & Tversky, A. (1983). Affect, generalization, and the perception of risk. *Journal of Personality and Social Psychology*, *45*(1), 20–31.

Kahneman, D., & Tversky, A. (1973). On the psychology of prediction. *Psychological Review*, *80*(4), 237–251.

Kasperson, J.X., Kasperson, R.E., Pidgeon, N., & Slovic, P. (2003). The social amplification of risk: Assessing fifteen years of research and theory. In N. Pidgeon, R.E. Kasperson, & P. Slovic (Eds.), *The social amplification of risk* (pp. 13–46). Cambridge: Cambridge University Press.

Keller, C., Siegrist, M., & Gutscher, H. (2006). The role of the affect and availability heuristics in risk communication. *Risk Analysis*, *26*(3), 631–639.

Kline, R.B. (2005). *Principles and practice of structural equation modeling* (2nd edn.). New York: Guilford Press.

Koh, D., Lim, M., Chia, S., Ko, S., Qian, F., Ng, V. . . . Fones, C. (2005). Risk perception and impact of severe acute respiratory syndrome (SARS) on work and personal lives of healthcare workers in Singapore. *Medical Care*, *43*(7), 676–682.

Kuppens, P., & Verduyn, P. (2017). Emotion dynamics. *Current Opinion in Psychology*, *17*, 22–26.

Lee, J., Lemyre, L., Turner, M., Orpana, H., & Krewski, D. (2008). Health risk perceptions as mediators of socioeconomic differentials in health behaviour. *Journal of Health Psychology*, *13*(8), 1082–1091.

Lerner, J., Gonzalez, R., Small, D., & Fischhoff, B. (2003). Effects of fear and anger on perceived risks of terrorism. *Psychological Science*, *14*(2), 144–150.

Lerner, J., & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. *Cognition & Emotion*, *14*(4), 473–493.

Li, Z. (2020). Coping with COVID-19: Intervention strategies for psychological problems. Retrieved 19 April 2020, from https://news.gmw.cn/2020-02/29/content_33605203.htm.

Lian, Y.Z. (2020). Why did the coronavirus outbreak start in China? Retrieved 1 March 2020, from https://www.nytimes.com/2020/02/20/opinion/sunday/coronavirus-china-cause.html.

Lichtenstein, S., Slovic, P., Fischhoff, B., Layman, M., & Combs, B. (1978). Judged frequency of lethal events. *Journal of Experimental Psychology: Human Learning and Memory*, *4*(6), 551–578.

Liu, Y. (2020). Hubei province has issued an urgent ban on "Breaking up the highway" to ensure normal road access. Retrieved 1 March 2020, from http://mp.163.com/v2/article/detail/F48A4UC3051289TJ.html.

Loewenstein, G., Weber, E., Hsee, C., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin*, *127*(2), 267–286.

Mann, C., & Wolfe, S. (2016). Risk perceptions and terror management theory: Assessing public responses to urban flooding in Toronto, Canada. *Water Resources Management*, *30*(8), 2651–2670.

Maxwell, S.E., & Cole, D.A. (2007). Bias in cross-sectional analyses of longitudinal mediation. *Psychological Methods*, *12*(1), 23.

Miller, R., & Mulligan, R. (2002). Terror management: The effects of mortality salience and locus of control on risk-taking behaviors. *Personality and Individual Differences*, *33*(7), 1203–1214.

National Bureau of Statistics of China (2019). *China Statistical Yearbook*. Beijing: China Statistical Press.

National Health Commission of the People's Republic of China (2019). *Chinese health statistics yearbook*. Beijing: Peking Union Medical University Press.

Ng, Y., Yang, Z., & Vishwanath, A. (2017). To fear or not to fear? Applying the social amplification of risk framework on two environmental health risks in Singapore. *Journal of Risk Research*, *21*(12), 1487–1501.

Paton, D., Smith, L., Daly, M., & Johnston, D. (2008). Risk perception and volcanic hazard mitigation: Individual and social perspectives. *Journal of Volcanology and Geothermal Research*, *172*(3–4), 179–188.

Podsakoff, P., & Organ, D. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management*, *12*(4), 531–544.

Preacher, K., & Hayes, A. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*(3), 879–891.

Qin, A., Myers, L.S., & Yu, E. (2020). China tightens wuhan lockdown in 'wartime' battle with coronavirus. Retrieved 1 March 2020, from https://www.nytimes.com/2020/02/06/world/asia/coronavirus-china-wuhan-quarantine.html.

Qin, X., Niu, C., Huang, Z.L., & Xu, M.Y. (2011). The familiarity of influenza A (H1N1), perception of vaccine safety, vaccination behaviour and their influential mechanism. *Acta Psychologica Sinica*, *43*(6), 684–695.

Qu, T., Chou, Y., Wu, Z., Lin, M., & Zhao, D. (2020). Psychological warfare of "epidemic" entered into the "phase shift": What are the new risks and how to deal with them? Retrieved 11 March 2020, from http://www.xinhuanet.com/2020-03/11/c_1125697434.htm.

Richey, R.G., & Autry, C.W. (2009). Assessing interfirm collaboration/technology investment tradeoffs. *International Journal of Logistics Management*, *20*(1), 30–56.

Slovic, P. (1987). Perception of risk. *Science*, *236*(4799), 280–285.

Slovic, P., Finucane, M., Peters, E., & MacGregor, D. (2004). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Analysis*, *24*(2), 311–322.

Tausczik, Y., Faasse, K., Pennebaker, J., & Petrie, K. (2011). Public anxiety and information seeking following the H1N1 outbreak: Blogs, newspaper articles, and wikipedia visits. *Health Communication*, *27*(2), 179–185.

Terpstra, T. (2011). Emotions, trust, and perceived risk: Affective and cognitive routes to flood preparedness behavior. *Risk Analysis*, *31*(10), 1658–1675.

Tripp, G., Tan, S., & Milne, J. (1995). Risk perception and anxiety. *New Zealand Journal of Psychology*, *24*(2), 37–43.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, *5*(2), 207–232.

Wachinger, G., Renn, O., Begg, C., & Kuhlicke, C. (2013). The risk perception paradox: Implications for governance and communication of natural hazards. *Risk Analysis*, *33*(6), 1049–1065.

Weber, E., & Hsee, C. (1999). Models and mosaics: Investigating cross-cultural differences in risk perception and risk preference. *Psychonomic Bulletin & Review*, *6*(4), 611–617.

WHO (2020a). Rolling updates on coronavirus disease (COVID-19). Retrieved 1 March, from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen.

WHO (2020b). Coronavirus disease 2019 (COVID-19) situation report-41. Retrieved 8 February, from https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200208-sitrep-19-ncov.pdf?sfvrsn=6e091ce6_4.

Wright, W., & Bower, G. (1992). Mood effects on subjective probability assessment. *Organizational Behavior and Human Decision Processes*, *52*(2), 276–291.

Yang, C., Dillard, J., & Li, R. (2018). Understanding fear of Zika: Personal, interpersonal, and media Influences. *Risk Analysis*, *38*(12), 2535–2545.

Yu, L., Du, Y., Peng, J., & Fan, F. (2020). Beijing responds to the difficulties of Hubei immigrants to enter complex in Beijing: Improvement on the corresponding measures. Retrieved 1 March 2020, from https://m.chinanews.com/wap/detail/zw/kong/2020/02-29/9109183.shtml.

Zhang, C., He, J., Luo, W., Li, W., Zhou, J., & Xie, Y. (2020). Ten thousand people investigation: Facing the epidemic, are you ok? Retrieved 19 April 2020, from http://www.zhishifenzi.com/news/multiple/8146.html.