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Heterogeneous Risk Perception amid the Outbreak of COVID-19 in China: Implications for Economic Confidence

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Background: The ongoing coronavirus disease 2019 (COVID-19) outbreak has elicited concerns about public fear and economic fallout. The current study takes a person-oriented approach to identify the unique response patterns that underlie three risk perception components (likelihood, severity, and protection efficacy) of COVID-19, with information sources as precursors and economic confidence as outcomes. **Methods:** A total of 1,074 Chinese citizens participated in a national online survey in early February 2020. **Results:** A latent profile analysis showed that participants exhibited one of three classes: *Risk Neutrals* (49.9%; moderate in all components), *Risk Deniers* (14.3%; low likelihood, low severity, and high protection efficacy), or *Risk Exaggerators* (35.8%; high likelihood, high severity, and low protection efficacy). Subsequent analyses showed that reliance on unofficial sources (gossip and news spread among friends; WeChat) positively correlated with membership in the *Risk Exaggerators* class. In turn, belonging in the *Risk Exaggerators* class correlated with the lowest short-term (but not long-term) economic confidence. **Conclusions:** This study suggests that exploring the heterogeneity of the public risk perception might help the government to design differentiated risk communication strategies during the COVID-19 outbreak.

Keywords: COVID-19, economic confidence, information sources, latent profile analysis, risk perception

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INTRODUCTION

The ongoing outbreak of the 2019 coronavirus disease (COVID-19) was first identified in December 2019 in Wuhan, Hubei province, China. It was first proclaimed as a Public Health Emergency of International Concern by the World Health Organization (WHO) on 30 January 2020, and then as a pandemic on 11 March because of the rising rates of infection around the world (WHO, 2020). As of 27 March, the epidemic has swept through more than 190 countries and territories, leading to 509,164 confirmed cases (82,078 cases in China) and 23,335 deaths (3,298 deaths in China) globally (WHO, 2020). Given that there is no cure for the human-to-human transmitted disease and its potential economic/political consequences, the Chinese government has adopted strict policies to contain the outbreak, including building makeshift hospitals, curbing population flow among regions, and postponing the reopening of schools and companies. Despite the effectiveness of these containment efforts, the substantial perceived risk of COVID-19 is prevalent in Chinese society, with growing concern about the economic fallout of the outbreak (Bradsher, 2020a; Prasad, 2020). These circumstances suggest a pressing need to elucidate the risk perception and its implications for economic confidence in China. Therefore, the current research aims to illustrate the patterns/classes or heterogeneity of risk perception of COVID-19 as well as to explore their associated antecedents (information sources) and outcomes (economic confidence).

Risk Perception

By integrating the bipartite model of risk perception with protection motivation theory, we proposed that risk perception comprised three components: risk likelihood, risk severity, and risk protection efficacy. The bipartite model of risk perception differentiates between deliberative and affective risk perception (Loewenstein et al., 2001; Slovic et al., 2004). As conceptualised by later empirical studies (Brewer et al., 2007), the deliberative component, or risk likelihood, involves reason-based judgment on the possibility of being infected with a contagious disease. In contrast, the affective component, or risk severity, pertains to the emotional perception of the severity of an infectious disease. Furthermore, the protection motivation theory (Rogers & Prentice-Dunn, 1997) maintains that in addition to the appraisal of risk likelihood and risk severity, what could also determine psychological/behavioral responses to health risk is risk protection efficacy (otherwise known as response efficacy). This concept refers to the belief that individuals and their groups can protect themselves from an outbreak of disease (Kim et al., 2016). Empirically, an investigation into the dimensionality of risk perception among Chinese citizens amid the 2003 SARS outbreak showed that likelihood, severity, and protection efficacy were the three dimensions of risk perception associated with an

infectious disease (X. Xie et al., 2005). Altogether, we explored these three components simultaneously in the present study.

Earlier empirical studies have primarily adopted a variable-oriented approach to test how different components of risk perception exert varying effects on other variables of interest (e.g. Brewer et al., 2007; X. Xie et al., 2005). However, recent research has increasingly used a person-oriented approach (Bergman et al., 2003; Yang & Xin, 2016) to seek patterns or classes of individuals based on the different components of risk perception (e.g. Barnes et al., 2013; Seidl et al., 2013; Tan & Xu, 2019). For the present investigation, we adopted a person-oriented approach and aimed to illustrate the patterns or classes of risk perception for theoretical and practical reasons. Theoretically, protection motivation theory and related studies suggest that when people perceive that the disease is severe and they have a high likelihood of infection and low efficacy to protect themselves from it, they could evince defensive responses (Kim et al., 2016; Rogers & Prentice-Dunn, 1997). Following such logic, the person-oriented approach (vs. the variable-oriented method) has the virtue that it estimates natural covariances between these multiple risk perception components that exist *within* the person. In this way, it enables us to illustrate how people who experienced high likelihood, high severity, *and* low protection efficacy differ from those who displayed low likelihood, low severity, *and* high protection efficacy. Practically, investigating whether Chinese citizens can be classified into different risk perception categories may help identify the heterogeneity of risk perception of the current coronavirus outbreak. Such heterogeneity is vital for the Chinese government and governments of other countries to design effective disease-related risk communication strategies targeting heterogeneous risk perceivers.

Despite the paucity of research on this issue, indirect evidence and the aforementioned theories have suggested a three-type classification of risk perception of environmental concerns. A person-oriented study by Barnes et al. (2013) used a latent profile analysis to identify the classes of risk perception of climate change based on risk domains among a sample of dairy farmers. The results showed three heterogeneous subgroups: *Strong Risk Perceivers*, *Average Risk Perceivers*, and *Risk Deniers*. Another rationale for the hypothesis formulation was derived from the theories on risk perception mentioned previously. The protection motivation theory and follow-up studies have demonstrated that risk appraisals (likelihood and severity) have a negative association with protection efficacy (Kim et al., 2016; Rogers & Prentice-Dunn, 1997). According to the bipartite model of risk perception and supportive evidence, the deliberative (risk likelihood) and affective components (risk severity) are distinct but interrelated (Brewer et al., 2007; Slovic et al., 2004). Hence, individuals belonging in a specific risk perception class could display similar levels of likelihood and severity. We generated our first hypothesis as follows. Three classes on risk perception of COVID-19 would emerge (1) *Risk Neutrals* (average in all of three components); (2) *Risk Deniers* (low in likelihood and severity but high in

protection efficacy); and (3) *Risk Exaggerators* (high in likelihood and severity but low in protection efficacy).

The Role of Information Sources in Risk Perception Type

Prior literature on risk communication and social amplification of risk underscores the importance of understanding information sources as a precursor to public risk perception. According to risk communication research (Leiss, 1996), information generally flows from multiple social forces like regulatory organisations, mass media, and interpersonal channels to the general public. However, the public has the motivation to select which information sources they can rely on before formulating their risk perception. During the constructive dialog between social forces and the public, different information channels can either heighten or attenuate risk perception (Kasperson et al., 1988).

Distinct information sources can be represented in many ways, such as media types (i.e. traditional media, new online media, and interpersonal communication; e.g. Han et al., 2014; Vyncke et al., 2017) and social forces behind multiple media (i.e. official and unofficial information sources; e.g. Barnes et al., 2013; Wei et al., 2017). We mainly focused on the latter classification. However, there are some overlaps between the contents of these two divisions. Unofficial sources include social networking services, which belong to new media, and interpersonal communication (Wei et al., 2017; B. Xie, 2018). By comparison, official sources comprise some traditional/new media that have an responsibility to the government, whereas semi-official sources are those owned by private companies whose content is partly censored by the government (Chen, 2007; Stockmann, 2011). In the present study, we divided information sources into three categories: official, semi-official, and unofficial sources.

As reported in prior studies involving public emergencies, reliance on official information sources is not associated with risk perception, but reliance on unofficial sources can intensify risk perception of likelihood and severity (e.g. Han et al., 2014; Vyncke et al., 2017). The association might be because interpersonal communication and social media have a negativity bias and invoke negative emotions (Baumeister et al., 2001; Oh et al., 2020). Hence, we speculated that relying on unofficial information sources would positively correlate with being categorised in the *Risk Exaggerators* type relative to the other risk perception types.

IMPLICATIONS OF RISK PERCEPTION TYPE FOR ECONOMIC CONFIDENCE

Economic confidence, otherwise known as consumer confidence or consumer sentiment, reflects the confidence individuals place in the future economic situation of their country and household (Katona, 1975). Interest in economic

confidence remains high among scholars, researchers, and policy-makers, perhaps because it serves as a key to macro-level economic growth and individual-level well-being. At the aggregate level, countries during periods of higher (vs. lower) economic confidence exhibited more employment, higher consumer expenditure, and faster growth of gross domestic product (GDP) (Brodeur, 2018; Ludvigson, 2004). At the individual level, individuals who had more confidence in the economy feel higher subjective well-being and more self-efficacy in career decision-making (van Giesen & Pieters, 2019; Kuang et al., 2011).

Previous research has found that economic confidence is vulnerable to environmental risks such as terror attacks and financial crises (e.g. Brodeur, 2018; van Giesen & Pieters, 2019; Kuang et al., 2011). Nevertheless, prior studies have generally neglected the prevalent contagious-disease threat without exploring how risk perception of a contagious-disease outbreak can shape economic confidence. Amid the coronavirus outbreak, the economic confidence decline might not be universally applicable among the general population, but be contingent upon the type of risk perception. Furthermore, it is imprudent to conclude that such confidence differences are ubiquitously salient regardless of the time frame, specifically, near-term and long-term confidence. Taken together, we aimed to explore how economic confidence is subject to risk perception type and time frame.

We drew on the affect-as-information model, optimism bias, and China's economic reality to formulate a hypothesis on economic confidence as a function of risk perception type. According to the affect-as-information model (Clore et al., 2001), people tend to take their current risk feelings as a starting point to judge and anticipate the objective situation, generalising risk feelings in one domain to those in another realm. In the field of economic confidence, evidence has shown that distress perception could lead to economic pessimism because of generalisation and assimilation from the personal state to the economic state (van Giesen & Pieters, 2019). Moreover, another line of research on optimism bias has found that increases in perceived uncontrollability erode confidence in positive events (Weinstein, 1980). Hence, it is reasonable to predict that individuals reporting higher risk likelihood and severity as well as lower protection efficacy (i.e. *Risk Exaggerators*) would exhibit the lowest economic confidence.

The associations between risk perception types and economic confidence could be salient in the short run but not in the long run. That is because the Chinese government has temporarily instructed residents to live in isolation, discouraged companies from reopening, and closed roads between cities to efficiently control the outbreak. The cost of these measures is near-term economic standstill. However, the Chinese government and the Central Bank of China have so far adopted a series of monetary and fiscal policies, including public spending increases, tax cuts, and cheap credit provision, to cushion the economy against the coronavirus outbreak (Prasad, 2020). Implementing these measures, which would accelerate economic recovery, can boost individuals' economic

confidence in the long run. Hence, the role of risk perception type in long-term economic confidence may be offset. Taken together, we assumed that in terms of short-term economic confidence, *Risk Deniers* would exhibit the highest scores, and *Risk Exaggerators* would evince the lowest scores, with *Risk Neutrals* falling in-between. By contrast, no differences would exist in long-term economic confidence across different risk perception types. We also predicted that long-term economic confidence would be higher than the short-term one among Chinese citizens.

Overview of the Present Study

In sum, the present study aimed to (1) identify Chinese citizens' distinct risk perception classes underlying risk likelihood, severity, and protection efficacy of the COVID-19 outbreak, (2) examine the roles of information sources in these unique risk perception classes, and (3) illustrate the implications of such heterogeneous risk perception for near- and long-term economic confidence. The corresponding three hypotheses are summarised as follows: (1) There would emerge three classes of risk perception, that is, *Risk Neutrals*, *Risk Deniers*, and *Risk Exaggerators*. (2) Reliance on unofficial information sources would be related to the higher likelihood to belong in the *Risk Exaggerators* class as compared with the other classes. (3) Among the three risk perception classes, *Risk Exaggerators* would exhibit the lowest scores in short-term economic confidence. In contrast, all three classes would report higher long-term than short-term economic confidence.

METHODS

Participants

A total of 1,074 Chinese citizens (50.5% men; M_{age} = 32.13 years, range = 17 to 71 years) recruited from an online survey platform (http://www.wjx.cn/) participated in the current study. They completed the survey between 6 and 11 February 2020, while the COVID-19 outbreak was spreading. The residence of the participants covered 30 provinces (or autonomous regions/municipalities) in mainland China. There were 50 participants from Hubei providence and 1,024 participants from other areas.

The sample was diverse in demographic characteristics: 64.2 per cent of the participants were married, while 35.8 per cent were single or divorced; 12.0 per cent of the participants earned less than ¥2000 a month, 22.4 per cent made ¥2,000–¥4999 a month, 42.6 per cent received ¥5,000–¥9,999 a month; and the remaining 22.9 per cent had an average monthly income equal to or greater than ¥10,000 (¥1 = US$0.14 at the time of the survey). As for their educational level, 33.3 per cent of the participants had an associate diploma or a lower level of

education, 53.2 per cent held a bachelor's degree, and 13.5 per cent had obtained a master's or doctor's degree. Concerning *hukou* (a household registration record that identifies a Chinese citizen as an urban or rural resident) status, 70.9 per cent of participants had an urban *hukou*, while 29.1 per cent had a rural one. All participants provided informed consent before participating in the study. The Institutional Review Board of Sociology and Psychology at the Central University of Finance and Economics approved the study design and procedures.

Procedure and Measures

The participants gave their informed consent to complete an online survey on "Risk Perception of the Novel Coronavirus Pneumonia Outbreak and Economic Confidence". We used the term "Novel Coronavirus Pneumonia outbreak" or the abbreviation "Pneumonia outbreak" in the survey because the Chinese government, media, and residents have used it to refer to the COVID-19 outbreak.

Risk Perception of Infection. We used 13 adapted items from the Perceived Risk of Ebola Scale (Kim et al., 2016) that were designed to assess risk likelihood, risk severity, and risk protection efficacy of contagious diseases. The adaptations rendered these indicators relevant to the Novel Coronavirus Pneumonia outbreak. The items for the three dimensions of risk perception were as follows. Five items assessed risk likelihood of infection (e.g. "How likely do you think you are to get infected with the Pneumonia?") on a 7-point scale from 1 (*extremely unlikely*) to 7 (*extremely likely*). We employed four items to measure risk severity (e.g. "I think that the present Pneumonia outbreak is very severe"). Moreover, four items gauged risk protection efficacy (e.g. "I feel confident that I can effectively cope with the Pneumonia outbreak" and "I feel confident that the country can effectively cope with the Pneumonia outbreak"). Individuals rated these items on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). We averaged the corresponding indicators to represent risk likelihood ($\alpha = .87$), risk severity ($\alpha = .75$), and risk protection efficacy ($\alpha = .72$), respectively.

Reliance on Information Sources. Individuals rated how often they had relied on each of the seven sources within the previous two weeks to obtain information about the Novel Coronavirus Pneumonia outbreak. The sources included: (1) central and local radio or television stations; (2) central and local government websites; (3) central and local newspapers and their websites; (4) Sina.com, Sohu.com and other news websites; (5) Weibo or online communities; (6) WeChat; and (7) gossip, news spread among friends. All of the items were responded to on a 3-point scale (1 = *never*, 2 = *sometimes*, 3 = *often*). To determine the number of dimensions, we performed a principal component analysis with a varimax rotation method. Results indicated a three-component solution, with eigenvalues ranging from 1.14 to 1.61, factor loadings ranging from .55 to

.81. The three components were: official (including items 1–3), semi-official (including items 4–5), and unofficial information sources (including items 6–7). We therefore calculated the average scores of all items on each component to represent the corresponding information sources, respectively.

Economic Confidence. We adapted questions from the Index of Consumer Sentiment (Katona, 1975) and a Chinese version of the Economic Confidence Questionnaire (Kuang et al., 2011). The questionnaire included four questions, respectively, to assess the short-term (for the next year) and long-term economic confidence (for the next five years) for the country and household. The items designated to measure short-term economic confidence were as follows. In your opinion: (1) What is the general economic situation change in China in 2020 as compared with 2019? (2) What is the employment situation change in China in 2020 as compared with 2019? (3) What is the economic situation change of your household in 2020 as compared to 2019? (4) What is the life quality change of your household in 2020 as compared to 2019? The other four items gauging long-term economic confidence were as follows. In your opinion: (5) What is the general economic situation change in China in the next five years? (6) What is the employment situation change in China in the next five years? (7) What is the economic situation change of your household in the next five years? (8) What is the life quality change of your household in the next five years? Individuals responded to all of the indicators on a 5-point scale (1 = *mostly better*, 2 = *slightly better*, 3 = *fundamentally unchanged*, 4 = *slightly worse*, and 5 = *mostly worse*). These items were reverse-coded, with higher scores representing higher levels of confidence. Because of the sound internal consistency reliability of short-term economic confidence (α = .82) and long-term one (α = .81), we later created average scores for the analyses.

Analytic Strategies

First, we used latent profile analysis (LPA, otherwise known as latent class cluster analysis) to analyse individuals' risk perception types using Mplus 8.3 software (Muthén & Muthén, 1998–2017), after the means of each component of risk perception had been standardised for straightforward interpretation. LPA is a model-based approach assuming that *categorical* latent variables account for the covariation between *continuous* observed variables (indicators). It uses individuals' responses to indicators to estimate their probability of belonging to a given latent class, identifying the latent class to which people most likely belong (Collins & Lanza, 2009).

Based on the recommendation of prior research (Nylund et al., 2007; Nylund-Gibson & Choi, 2018), we used the following fit indices to determine the optimal number of classes in LPA models: (1) Bayesian information criterion (BIC), (2) sample-size adjusted Bayesian information criterion (SABIC), (3) Vuong-Lo-

Mendell-Rubin adjusted likelihood ratio test (VLMR-LRT), and (4) the bootstrapped likelihood ratio test (BLRT). The model with lower BIC and SABIC is better than that with higher ones. For VLMR-LRT and BLRT, a *p*-value below .05 indicates that the *k* class model is superior to the *k*-1 class model (here, *k* represents the number of classes). The other criteria included interpretability and the proportion of individuals in each class. According to Nylund-Gibson and Choi (2018), each emergent class should have more than 5 per cent of individuals because classes with small sample sizes might not represent stable and externally valid categories. Substantial studies have used this criterion of class size when deciding on the number of classes (e.g. Champagne et al., 2016; Mishra et al., 2019). Therefore, we used these criteria to compare the two- to five-class models.

Subsequently, we conducted amultinomial logistic regression predicting participants' latent class membership, with reliance on various information sources as the explanatory variables. We included demographics (gender, age, educational level, income, *hukou* status, whether participants resided in Hubei province) as covariates.

Finally, a repeated-measures analysis of variance examined the interaction between risk perception type and time frame on economic confidence, with time frame (short-term/long-term) as the within-subject variable, and risk perception type as the between-subjects variable.

RESULTS

Risk Perception Classes

Table 1 presents the means, standard deviations, and correlations of study variables. The LPA results are summarised in Table 2. Among the four solutions, the five-class models had the smallest BIC and SABIC, but the non-significant *p*-value of VLMR-LRT suggests that the five-class model was the same as the four-class one. To avoid selecting an over-extracted and potentially unstable class solution, we decided to compare the three- and four-class models. Concerning the proportion of individuals in each class, the four-class model had a class with 2.6 per cent of the sample ($n = 28$). By contrast, each class in the three-class model had more than 5 per cent of the sample. For interpretability, the four-class solution was more complex and ambiguous to interpret than the three-class one. In sum, we selected the three-class as the final model.

As shown in Figure 1, the first—and largest (49.9% of the sample)—latent class consisted of those who had average scores of risk likelihood ($M = -0.20$, $SE = 0.06$), risk severity ($M = -0.27$, $SE = 0.08$), and risk protection efficacy ($M = -0.02$, $SE = 0.06$). We named this class the *Risk Neutrals*. The second—and smallest (14.3% of the sample)—latent class included individuals who reported low likelihood ($M = -0.93$, $SE = 0.10$), low severity ($M = -1.43$,

TABLE 1
Descriptive Statistics and Correlations between Study Variables (N = 1,074)

Study Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1. Risk Likelihood	—							
2. Risk Severity	.49***	—						
3. Risk Protection Efficacy	−.17***	−.30***	—					
4. Short-term EC	−.12***	−.19***	.28***	—				
5. Long-term EC	−.10***	−.13***	.31***	.54***	—			
6. Official	.01	.05	.21***	.11***	.16***	—		
7. Semi-official	.002	.07*	−.01	−.05	−.02	.002	—	
8. Unofficial	.14***	.16***	−.04	−.11***	−.09**	.05	.07*	—
M	3.89	4.65	5.42	2.98	3.85	2.39	2.42	2.33
SD	1.16	1.20	0.99	0.86	0.77	0.49	0.55	0.46

Note: EC represents economic confidence; Official/Semi-official/Unofficial represent reliance on Official/Semi-official/Unofficial information sources, respectively.
*$p < .05$;
**$p < .01$;
***$p < .001$.

TABLE 2
Criteria for Latent Profile Models of Risk Perception Types (N = 1,074)

Model tested	*BIC*	*SABIC*	*VLMR-LRT* (p-*value*)	*BLRT* (p-*value*)
Two-class	8867.89	8836.13	< .001	< .001
Three-class	8814.01	8769.55	< .001	< .001
Four-class	8805.14	8747.97	< .001	< .001
Five-class	8794.03	8724.15	0.340	< .001

Note: BIC = Bayesian information criterion; SABIC = sample-size adjusted Bayesian information criterion; VLMR-LRT = Vuong-Lo-Mendell-Rubin adjusted likelihood ratio test; BLRT = bootstrapped likelihood ratio test.

SE = 0.10), yet high protection efficacy (M = 0.72, SE = 0.07). We labeled this latent class the *Risk Deniers*. Finally, the third latent class (35.8% of the sample) —characterised by high likelihood (M = 0.66, SE = 0.07), high severity (M = 0.97, SE = 0.05), yet low protection efficacy (M = −0.29, SE = 0.06)— was described as *Risk Exaggerators*.

Associations between Information Sources and Risk Perception Classes

Table 3 depicts the results for multinomial logistic regression on the relations between information sources and risk perception type. Results indicated that reliance on official information sources positively correlated with belonging to the *Risk Deniers* (vs. *Risk Neutrals*) and *Risk Exaggerators* (vs. *Risk Neutrals*).

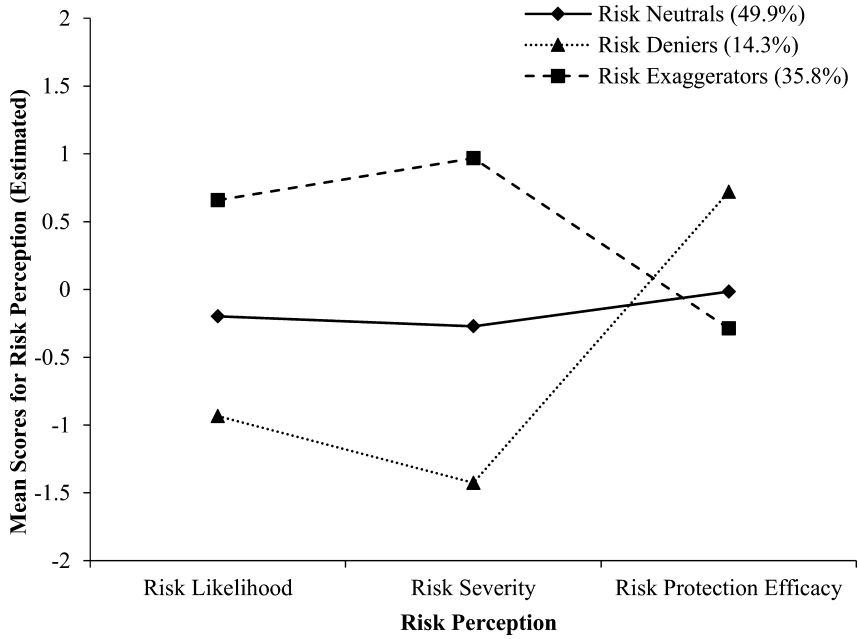

FIGURE 1. The latent classes of Chinese citizens' risk perception of the COVID-19 outbreak (N = 1,074).

Moreover, there was a positive relationship between reliance on unofficial information sources and membership in the *Risk Exaggerators* class relative to *Risk Neutrals* or relative to the *Risk Deniers* class. In terms of the controls, the only significant predictor was age. Age negatively correlated with belonging to the *Risk Exaggerators* (vs. *Risk Neutrals*) class, and was also negatively associated with belonging to the *Risk Exaggerators* (vs. *Risk Deniers*) class.

Associations between Risk Perception Classes and Economic Confidence

As shown in Figure 2, a repeated-measures analysis of variance showed the roles of risk perception type and time frame in economic confidence. Results indicated that the main effect of time frame was significant ($F(1, 1071) = 956.92$, $p < .001$, $\eta_p^2 = 0.47$). Individuals exhibited greater economic confidence in the long run ($M = 3.85$, $SD = 0.77$) than in the short run ($M = 2.98$, $SD = 0.86$). The main effect of risk perception type was significant ($F(2, 1071) = 19.96$, $p < .001$, $\eta_p^2 = 0.04$). More importantly, the interaction was significant ($F(2, 1071) = 5.10$, $p = .006$, $\eta_p^2 = 0.01$). Further analyses suggested that for short-term

TABLE 3
Multinomial Logistic Regression Predicting Risk Perception Type as a Function of Information Sources

Predictors	*Risk Deniers (vs. Neutrals)*		*Risk Exaggerators (vs. Neutrals)*		*Risk Exaggerators (vs. Deniers)*	
	B (SE)	*Odds ratio*	*B (SE)*	*Odds ratio*	*B (SE)*	*Odds ratio*
Information sources						
Official	0.53** (0.20)	1.69	0.66*** (0.15)	1.93	0.13 (0.21)	1.14
Semi-official	0.08 (0.17)	1.09	0.19 (0.13)	1.21	0.11 (0.18)	1.11
Unofficial	−0.35 (0.20)	0.70	0.56*** (0.16)	1.75	0.91*** (0.21)	2.49
Demographics						
Age	0.01 (0.01)	1.01	−0.02* (0.01)	0.98	−0.03* (0.01)	0.97
Education 1[a]	0.21 (0.21)	1.24	−0.17 (0.16)	0.84	−0.38 (0.23)	0.68
Females[b]	−0.26 (0.19)	0.77	−0.15 (0.14)	0.86	0.11 (0.20)	1.12
Income 1[c]	0.07 (0.27)	1.08	−0.39 (0.21)	0.67	−0.47 (0.28)	0.63
Income 2[d]	−0.21 (0.25)	0.81	−0.08 (0.18)	0.92	0.12 (0.26)	1.13
Rural Areas[e]	−0.30 (0.23)	0.74	−0.24 (0.16)	0.78	0.06 (0.24)	1.06
Hubei Province[f]	−0.07 (0.47)	0.94	0.29 (0.32)	1.33	0.35 (0.48)	1.42

Note: [a]Education 1 = associate diploma or lower education; reference group = bachelor's degree or higher education.

[b]Reference group = males.

[c]Income 1 = less than ¥5,000 a month; reference group = ¥10,000 a month or higher.

[d]Income 2 = ¥5,000–¥9999 a month; reference group = ¥10,000 a month or higher.

[e]Reference group = urban areas.

[f]Reference group = other provinces (or autonomous regions/municipalities).

*$p < .05$;

**$p < .01$;

***$p < .001$.

economic confidence, all pairwise comparisons with Bonferroni correction were significant (ps < .001). The individuals who were classified as *Risk Deniers* reported the highest score (M = 3.34, SD = 0.86), followed by *Risk Neutrals* (M = 3.01, SD = 0.81), whereas *Risk Exaggerators* displayed the lowest score (M = 2.80, SD = 0.89). However, for long-term economic confidence, scores of all three classes remained high, and the scores of the *Risk Neutrals* (M = 3.86, SD = 0.72) and *Risk Exaggerators* (M = 3.76, SD = 0.83) did not significantly differ (p = .174), although *Risk Deniers* exhibited a higher score (M = 4.07, SD = 0.73) than the other classes (ps < .01).

To check the robustness of the associations above, we conducted a multivariate analysis of covariance on short-term/long-term economic confidence with risk perception type as the explanatory variable. The covariates included gender, age, educational level, income, *hukou* status, and whether participants resided in

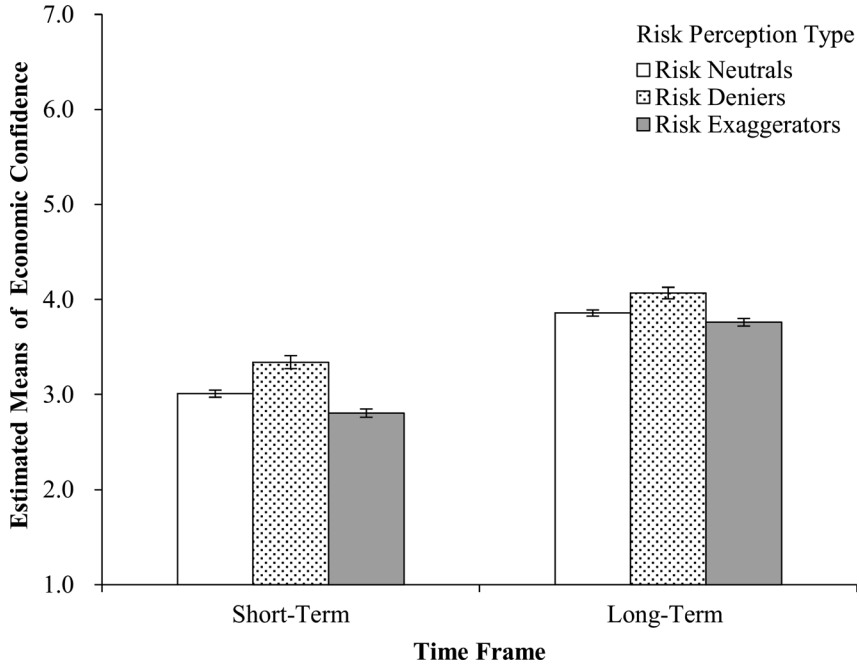

FIGURE 2. Estimated means for short- and long-term economic confidence by risk perception type. *Note*: Error bars represent ±1 standard error.

Hubei province. As presented in Table 4, the results held even when accounting for covariates.

DISCUSSION

Risk Perception Types and their Precursors and Consequences

Linking the bipartite model of risk perception (Loewenstein et al., 2001; Slovic et al., 2004) to protection motivation theory (Rogers & Prentice-Dunn, 1997), the present study focused on the three risk perception components: likelihood, severity, and protection efficacy of the COVID-19 outbreak. Methodologically, we adopted a person-oriented perspective and used the LPA to seek out unique latent classes underlying risk perception. Results showed three latent classes, in which approximately one-third of the sample perceived likelihood/severity to be high and protection efficacy to be low. This *Risk Exaggerators* class's perception diverged vastly from the one-seventh of participants who exhibited low

TABLE 4
Multivariate Analyses of Covariance (MANCOVA) Comparing the Three Risk Perception Types on Economic Confidence

Risk Perception Type	*Short-term economic confidence*	*Long-term economic confidence*
Risk Neutrals	3.01[a] (0.04)	3.86[a] (0.03)
Risk Deniers	3.35[b] (0.07)	4.08[b] (0.06)
Risk Exaggerators	2.79[c] (0.04)	3.75[a] (0.04)
F	25.13***	10.43***
η_p^2	0.05	0.02

Note: Overall MANCOVA model: Wilks' lambda = 0.95, $F(4, 2128) = 12.74$, $p < .001$, $\eta_p^2 = 0.02$.
Covariates: gender, age, education, personal monthly income, *hukou* status, whether participants resided in Hubei province.
Adjusted means are with standard errors in parentheses; means with different superscripts (e.g. a, b, and c) within the same column differed at $p < .01$.
***$p < .001$.

likelihood/severity yet high protection efficacy (i.e. *Risk Deniers* class). The remaining sample belonged to the *Risk Neutrals* class, whose components of risk perception fell between those in the above two classes. The presence of a large group of *Risk Exaggerators* illustrated the worrying phenomenon of mass public fear amid the COVID-19 outbreak.

Furthermore, reliance on different information sources in the past two weeks could be associated with membership in distinct risk perception types. Reliance on official information sources was related to more probability of belonging in the two extreme classes relative to the *Risk Neutrals* class. However, relying on unofficial information sources was positively associated with belonging to *Risk Exaggerators* class compared with the *Risk Neutrals*/*Deniers* classes. These results accord with prior research on the detrimental roles of unofficial information sources in risk perception (Han et al., 2014; Vyncke et al., 2017). That may be because social media and interpersonal communication could prefer negative messages to positive ones and evoke more negative emotions (Baumeister et al., 2001; Oh et al., 2020), thereby heightening risk likelihood/severity and attenuating protection efficacy.

Consistent with evidence that economic confidence declines during disasters (Brodeur, 2018; van Giesen & Pieters, 2019; Kuang et al., 2011), we demonstrated that economic confidence in the household and country diminished amid a contagious-disease outbreak. Extending and deepening prior studies, we found that such a claim has boundary conditions of the time frame and heterogeneity for distinct risk perception classes. Individuals' economic confidence was restored when it concerned long-term confidence and when it involved the *Risk Deniers* class. Those in this class displayed the highest short- and long-term confidence, whereas those in the *Risk Exaggerators* class evinced the lowest short-

term economic confidence. A possible explanation is that individuals might generalise their perception of risk likelihood/severity of the COVID-19 outbreak and protection efficacy to the economic conditions of the country and household (Clore et al., 2001; Weinstein, 1980). The generalisation process could be buffered in the long run, because a series of economic policies taken by the Chinese government might gradually promote economic recovery (Prasad, 2020), leading to long-term economic optimism.

Moreover, our findings on the short-term economic pessimism and long-term optimism suggest the necessity to distinguish between short- and long-term economic confidence amid the COVID-19 outbreak. Such a difference across time frame could provide viable evidence for policy-makers to evaluate and adjust economic policies at an early stage of the epidemic, and offer a reference frame to future researchers to compare economic confidence across distinct stages of the pandemic. As the COVID-19 epidemic has already shifted from primarily being restricted within China in February 2020 to spreading globally, follow-up surveys are needed to answer whether these findings are currently applicable. We reasonably speculated that the difference in economic confidence across the time frame would persist if carrying out the survey now. Given that the global spread of the epidemic has slowed the world economy (WHO, 2020), short-term economic confidence in China could be lower now than in February 2020. However, long-term confidence may remain high. In fact, China and other countries have recently continued to expand economic stimulus policies, including encouraging banks to lend more to companies and factories, helping companies to pay their employees, and distributing vouchers to empower consumers (Bradsher, 2020b). These measures may help rekindle the long-term economic growth.

Limitations and Implications

The main limitation of these findings lies in the cross-sectional correlations, and thus, causal inferences must be drawn with caution. Theoretical models on risk communication and social amplification of risk contend that reliance on information sources precedes risk perception formulation rather than vice versa (Kasperson et al., 1988; Leiss, 1996). Nevertheless, there is a possibility that certain risk perception types may seek different information sources. The cross-sectional design did not allow for ruling out such alternative explanations, so future replication research could profitably use a longitudinal design.

Despite the limitation, the present research is relevant to the design of differentiated risk communication strategies. In particular, we suggest prioritising the *Risk Exaggerators* type when developing communication strategies or intervention programs. This is because membership in the *Risk Exaggerators* class was negatively related to short-term confidence, probably decelerating GDP growth at the aggregate level (e.g. Brodeur, 2018; Ludvigson, 2004) and decreasing subjective well-being at the individual level (van Giesen & Pieters, 2019; Kuang

et al., 2011). For *Risk Exaggerators*, applied psychologists and community organisers should instruct them to (1) reappraise the gossip's authenticity based on deliberation rather than intuition, and (2) refrain from spreading unverified information about the COVID-19 outbreak via social networks. Moreover, despite their high economic confidence, *Risk Deniers* could be too optimistic about vulnerability and controllability to take adequate preventive measures. For *Risk Deniers*, it might be useful for the government to keep the outbreak information and reminders open, transparent, and credible to raise *Risk Deniers*' awareness of contagious risks to a moderate degree.

The current study also has implications for policy-oriented research initiated by applied psychologists. For instance, as a renowned think-tank partly owned by the UK Cabinet Office, Behavioral Insights Groups use psychological insights to tackle social issues in British society (Behavioral Insights Groups, 2020). The Chinese government has also required psychologists to construct a societal psychological service system, applying psychological/behavioral regularities to solve inherent or unexpected social problems (Xin, 2018a, 2018b). Being person-centered, evidence-based, and policy-oriented constitutes the shared tenets of these practices. In this regard, the current study offered useful evidence and a paradigm to these practices by focusing on a significant psychological issue amid a pandemic (risk perception of the COVID-19 outbreak), identifying heterogeneity in the population with a person-oriented method (LPA), and providing policy-makers with specific suggestions (differentiated risk communication strategies).

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