Chapter

Risk Perceptions Following a Substandard Vaccine Crisis in China: An Exploratory Approach to Substantiating the Tripartite Model

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Abstract

Understanding the risk perception is essential to explaining people's judgment and decisions during drug safety crises. In addition to affective and cognitive components, the experiential facet of risk perception captures "gut-level" reactions in heuristic-based risk judgments. However, few empirical studies have explicated the validity of the tripartite approach to analyzing risk perception or examined whether experiential risk perception is a conceptually sound construct distinct from the well-established dual-factor model. Building upon the tripartite model of risk perception, this study acknowledges the current research gap and compares three fundamental components of risk perception as well as their relative capabilities to predict individuals' behavioral intention. Results of an online survey conducted shortly after a substandard vaccine crisis in China empirically support the discriminant validity of the tripartite model, which exhibits significantly better model fit than either single-factor or dual-factor models. A pretest-posttest analysis has further identified a highly controversial gap between experiential and affective risk perceptions: instructional risk message stimuli have provoked a significant change in participants' experiential risk perception but not in the other two components. Moreover, three dimensions of risk perception reveal different patterns of association with behavioral intention. Implications for risk and crisis management are further discussed.

Keywords: behavioral intention, crisis management, drug safety, IDEA model, risk communication, risk perception, vaccine

1. Introduction

Risk perception has long been a central concept in scholarship on risk analysis, risk/crisis communication, and applied psychology. Depicted as a subjective response that influences the way people act toward potential risks, risk perception was usually measured as a construct with dual factors: cognitive risk perception and affective risk perception [1, 2]. This long-held position has recently been challenged, however, due to charges that the predominant affective vs. cognitive dichotomy is

overly simplistic [3–6]. Risk perception is more complex than existing accounts have led many scholars to believe, with the consequence that unexamined dimensions of risk perception have proved an obstacle to further theoretical advancements in risk judgment and decision-making.

1.1 Risk perception: dual-process and tripartite approach

The psychometric approach to risk perception analysis is deeply rooted in the tradition of cognitive psychology and the technical orientation of risk analysis [7], particularly the subdiscipline within cognitive psychology that focuses on judgment and decision-making. Early conceptualizations thus equated risk perception with probability assessments of potential hazards and vulnerabilities based on individuals' logical, rational, and rule-based reasoning [8–10]. The emergence of dual-process theory (DPT, e.g. *heuristic/systematic*, *heuristic/analytic*, *system 1/system 2*) provided a new understanding of risk perception by recognizing affective responses to risk as a significant evaluation mechanism [11–13]. In general, the dual-process model of risk perception has outlined two categorically distinct modes of processing. Cognitive risk perception represents the analytic process, which is slow, deliberate, sequential, and consciously controlled through a high degree of cognitive effort [14, 15]. On the other hand, affective risk perception denotes the heuristic process, which is fast, intuitive, parallel, and automatic with low cognitive effort and less involvement of consciousness [16, 17]. Unlike cognitive risk perception driven by probability-based assessments, affective risk perception represents an emotional reaction or response to the threat. A growing body of risk research demonstrates that negative discrete emotions such as fear, anger [18], and psychological stress [19] are of crucial importance for risk perception. In short, people both *think* and *feel* about risks [17].

As affect specifies "a faint whisper of emotion" [15] consisting of positive and negative feelings, many prior studies accentuated individuals' emotional responses to risk [20–22]. But many of these same studies lose sight of the intuitive aspect of affect heuristics. For instance, Trumbo et al. [23] analyzed perceived levels of fear, worry, and dread to operationalize affective risk perception without capturing the "real" presentative feeling that affect heuristics seek to capture. Furthermore, risk scholars in recent years have contended that the predominant dichotomy between affective and cognitive risk perceptions is oversimplistic [3–6]. Critiques have targeted the categorical foundations of DPT. Samuels [24] argues, for example, that *crossover* occurs whenever a process incorporates both type-1 and type-2 features. When an unconscious process is rule-based, it will be difficult to categorize as either rational or affective processing [25]. Hence, DPT fails to offer a sufficient description of all forms of risk perception.

Theories of experiential risk perception have thus been proposed to capture "gut-level" reactions in heuristic-based judgments [26]. Specifically, experiential risk perception is neither rule-based probability assessments nor full-blown emotional responses. It manifests experiential information processing that is: (1) holistic; (2) constructed upon associative connections; (3) experienced preconsciously; (4) resistant to change; (5) crudely integrated and differentiated; and (6) encoded in concrete images as well as metaphors and narratives [27]. In the field of marketing, an integrated framework of advertising persuasion delineates three message processing strategies—experiential, heuristic, and systematic—and suggests that consumers allocate and mobilize different levels of cognitive resources in information processing to form and correct their judgments for external biases [28]. Neuroscience also

suggests that affective and cognitive perceptions are necessary neuro-processes for the formation of experiential-level feelings [29]. Still, relatively little empirical research has tested the validity of the tripartite approach to analyzing risk perception. One notable exception is the tripartite model of risk perception (TRIRISK) proposed by Ferrer et al. [3], which has distinguished deliberative (cognitive), affective, and experiential risk perceptions related to negative health events, and all three components were found to be associated with self-protective motivations in relation to cancer, heart disease, and diabetes.

1.2 Priming the experiential-affective gap

Most existing studies categorizing risk perception have centered on comparing cognitive with affective perceptions or cognitive with experiential perceptions [15, 30]. However, the major discrepancy between two-factor (cognitive-affective) and tripartite models has been the obscure yet dynamic boundary between experiential and affective facets of risk perception [1, 15]. Despite the umbrella phrase of *risk as feelings*, under which both dimensions share a significant overlap, two key distinctions define the relationship between experiential and affective risk perceptions.

First, unlike affective risk perception which focuses more on *emotion*, experiential risk perception primarily depicts *affect*. Frijda [31] defines affect as the irreducible aspect of emotion that "gives feelings of their emotional, non-cognitive character" (p. 383). As the most fundamental feature of emotion [32], affect has often been conceptualized as either pleasant (i.e. positive feeling) or unpleasant (i.e. negative feeling). According to this argument, experiential risk perception signifies nascent or inchoate affective responses [3] showcasing the general tendency to cater to good feelings and avoid bad feelings, even in the absence of any specific emotional response. On the other hand, affective risk perception pays close attention to the valence (positive vs. negative) and associated arousal (high vs. low) of affective responses to threat, which constitute essential emotions. Emotions—consisting of action readiness, strivings, intentions, and affects [33]—function as a key source for reflection and deliberation on important values in risk perception [6]. As a result, past research typically measured affective risk perception by means of emotional word lists (e.g. "worried," "fearful," "nervous") that refer to particular valences and arousals.

Second, experiential risk perception contains past experiences intuitively drawn from memory [12, 14]. Intuition is therefore another unique element that distinguishes experiential from affective risk perception. In a nutshell, experiential risk perception contains all characteristics of intuition, whereas its affective counterpart does not. Intuition manifests a process through which individuals can make decisions without rational thoughts and cognitive inferences [34]. It operates in a fast, associative, and unconscious way, granting access to preexisting knowledge and past experiences [35]. At a certain level, intuition becomes implicit memory, which cannot be recalled consciously [36, 37]. Such concepts as gut feelings, educated hunches, and the "sixth sense" have been used in association with the construct of intuition [38], which forms a subset of experiential information processing [14].

Past research tends to blur the boundary between experiential and affective risk perceptions by either combining the two components or prioritizing one over the other as the antithesis of cognitive risk perception. More importantly, the implicit memory system is typically recalled and accessed through implicit memory tests (e.g. word fragment completion, word identification, anagram solution). Therefore, cross-sectional survey questions from previous studies are insufficient to probe into

individuals' experiential risk perception. Considering the incompatibility of conducting a separate implicit memory test, we utilize a fictitious stimulus as an alternative solution for obtaining experiential risk perception from our participants.

With limited heuristics for evaluating potential risks, nonscientific publics tend to rely on messages announced by government regulators and delivered through multiple channels to monitor the risk surroundings. Organizational and institutional communicators therefore face challenges in producing and distributing instructional messages that provide protective information for the public and facilitate effective risk communication. An emerging body of research has provided insight into the optimal measurement of instructional risk communication's effectiveness in terms of its effects on risk perception and judgment [39–42]. We adopt the IDEA model of instructional risk messages, which has demonstrated applicability across risk types and cultures, in order to provide an adequate stimulus for priming the distinction between experiential and affective risk perceptions. The IDEA model was developed to capture four components of optimal instructional risk message design: *internalization* (maintaining audience attention by highlighting timeliness, proximity, and personal relevance); *distribution* (multiple distribution channels of instructional information to reach target audience); *explanation* (accurate translation, in simple language, of the background, current situation, and scientific estimation of risks); and *action* (specific guidelines for the meaningful protection of self and others). Empirical evidence has proven that risk perception can be altered via exposure to IDEA components [39, 40]. However, these studies predominantly operationalize risk perception as the cognitive component of the TRIRISK model. The extent to which the other two components would be affected by IDEA messages remains unclear and provides an opportunity for probing into the potential gap between experiential and affective risk perceptions.

1.3 Behavioral intention and risk acceptance

During crises related to drug safety, organizations, policy-makers, and regulatory bodies all seek to effectively influence the public's behavioral intention. Behavioral intention, which refers to the readiness to perform certain types of action [43], is significantly associated with health protection behaviors [22]. A meta-analysis of 58 studies revealed that cancer risk perception is a strong determinant of subsequent screening behaviors reported by patients [44].

Much research has focused on the association between risk perception and behavioral intention [45, 46]. In the past decade, irrational dimensions of risk perception have become a vital source of insight into people's behavioral intention [47, 48]. Slovic et al. [49] found that risk perception could be largely a product of the way one feels about a hazard while exclusive of any rational interpretation of messages concerning that hazard. Moral emotions such as guilt, sympathy, and a sense of responsibility greatly impact ethical considerations in decision-making [6, 50]. A possible explanation for the increasing importance of irrational risk perception may be that one needs to leverage and mobilize all available cognitive resources to initiate analytic information processing [14]. Scholars compared the relative contributions of affective and cognitive risk perceptions to the behavioral intention formation of health-related goals [22]. However, little attention has been paid to the effect of utilizing nonconscious intuitions on conscious judgment and decision-making in such stances [34]. In addition, the explanatory gap between experiential risk perception and its two counterparts (i.e. affective and cognitive risk perceptions) in terms of their relative effects on behavioral intention remains underexplored.

Prior studies mainly regarded behavioral intention as a conceptual synonym of risk acceptance. For instance, Siegrist [51, 52] gauged risk acceptance with items measuring the purchase intention of products associated with new gene technologies. Ross et al. [53] examined risk acceptance by means of participants' willingness to use recycled water. These efforts presumed that if publics have a high level of risk acceptance, they would behave as though no (or very few) threats were perceived. Nonetheless, we assert that risk acceptance is not a rough equivalent to behavioral intention; in turn, behavioral intention is not a corollary of risk acceptance. Taking a cognitive processing approach, the theory of planned behavior [54] offers a succinct conceptualization of behavioral intention that distinguishes it from risk acceptance. In health risk events, risk is mostly unfavorable and accepting risks indicates the willingness to tolerate potential negative consequences. Behavioral intention, however, captures a motivational component suggesting "how hard people are willing to try" and "how much effort they are planning to exert, in order to perform the behavior" [54]. Such motivational factors inducing efforts to carry out certain behaviors are not always present in examples of demonstrated risk acceptance. Put differently, agreeing to tolerate the risk brought by the substandard vaccine crisis examined in our study may not necessarily reflect motivation or willingness to exert efforts to consume or promote domestic vaccines.

1.4 Background and empirical investigation

To explore the tripartite model of risk perception, we conducted an online survey shortly after a substandard vaccine crisis in China. Drug safety, which draws relatively little scholarly attention from risk perception experts, has been a core concern across the globe over the past two decades. Vaccines constitute one of the most cost-effective health measures an individual can take. Yet there are clear trends reflecting increased vaccine hesitancy among publics. In July 2018, the domestic Chinese vaccine manufacturer Changsheng Bio-technology Company was revealed to have provided ineffective vaccines with falsified production and quality control records. Although no injuries or side effects were reported, the crisis sparked one of China's largest public outcries in recent years, challenging both the institutional trust of public stakeholders and the crisis management of government regulators [55]. The crisis is optimal for the study of intuitive experiential risk perception due to its tendency to invoke irrational or implicit fears of vaccines that are not based on any medical evidence.

This study addresses three underexplored but closely interrelated concerns. First, it is unclear whether experiential risk perception is a conceptually sound construct that can be distinguished from the well-established dual-factor model. In this paper, we initially inspect the discriminant validity of the tripartite model's components in the context of the Changsheng crisis and posit that the tripartite-factor model has a better model fit than either the single-factor or dual-factor models (*H1*). To further investigate the nuanced gap between experiential and affective risk perceptions, we employ the IDEA model of instructional risk messages as a solution for capturing experiential risk perception. The key issue of Changsheng crisis rested on fabricated production and quality assurance records rather than any actual harm caused by the vaccines. Professional communicators also agree that the widespread anxiety expressed during the crisis was aggravated by inaccurate and inconsistent instructional risk messages communicated to public stakeholders [56, 57]. Through a pretest-posttest analysis, we examine the extent to which experiential, affective, and cognitive risk perceptions change after exposure to IDEA instructional risk messages related to the substandard vaccine crisis (*RQ1*).

Second, understanding the practical implications of experiential risk perception is still in its infancy. Upon establishing the TRIRISK model, Ferrer et al. [3] demonstrated that deliberative, affective, and experiential risk perceptions are considered separate constructs because they vary in terms of predictability of outcome variables in risk judgment and decision-making. This line of argument pinpoints the potential benefits of effective instructional communication in promoting health-protective behaviors through an enhanced understanding of risk perception. Moreover, measures applied to gauge behavioral intention differ greatly across disciplines. Crisis communication scholars, for example, employ word of mouth (WOM) to predict whether public stakeholders intend to say good or bad things about companies after a crisis has occurred [58]. In marketing and scholarship on consumer behavior, purchase intention receives the lion's share of focus [59]. Because so few studies tend to test the latent variance engendered by different behavioral intentions in the same risk context, we investigate the differential contributions of experiential, affective, and cognitive risk perception to individuals' use intention (*RQ2a*) and WOM intention (*RQ2b*).

Finally, we treat risk acceptance and behavioral intention as two self-contained constructs occurring in sequence and examine the mediation role of risk acceptance between risk perception and behavioral intention. We do so in order to obtain a more complex yet still practical comprehension of how different types of risk perception affect health risk judgments and decision-making. Specifically, we examine the extent to which the relationship between tripartite risk perceptions and individuals' (a) use intention and (b) WOM intention are mediated by their risk acceptance (*R3a-b*).

2. Methods

2.1 Data collection

We recruited 454 participants via Baidu Cloud, an online survey panel that authenticates respondents through a real-name database covering more than 300 cities across China. The sample was limited to Chinese IP addresses and those who had a Baidu account verified through their mobile phone. Eligible participants were required to indicate informed consent and briefed on the Changsheng substandard vaccine crisis at the outset. Participants were then randomly assigned to three different conditions: (1) control group; (2) treatment group A: only-E (explanation), and (3) treatment group B: IEA (all message elements addressed in the IDEA model). Participants assigned to the control group received only the pretest, while those assigned to two treatment groups completed part of the questionnaire before and after being presented with the stimulus messages, which consisted of a statement issued by government regulators. There was no missing data, because the questionnaire was administered to require a response to each item. Each participant was debriefed on the fictional origin of the stimulus exposure and paid 8RMB (roughly equivalent to 1.24 USD) upon completing the survey. Ethical approval of the online survey was granted by the Survey and Behavioral Research Ethics Committee (SBREC) at the university to which one author was affiliated.

Of all participants, 33.5% (n = 152) were randomly assigned to the control group, 31.9% (n = 145) to the only-E group, and 34.6% (n = 157) to the IEA group. Individual

differences among participants were equally distributed across the three groups because of random assignments. In specific, 51.1% (n = 232) were female and 91.2% (n = 414) aged between 18 and 40 years. 81.5% (n = 370) reported having a bachelor's degree or above. In addition, 21.4% (n = 97) reported earning a monthly household income of less than 5000RMB, 38.8% (n = 176) between 5000 and 10,000RMB, 31.1% (n = 141) between 10,001 and 20,000RMB, and 8.8% (n = 40) more than 20,000RMB. One contentious issue of public concern that arose during the substandard vaccine crisis was that Changsheng was suspected of selling ineffective DPT vaccines used to inoculate children against diphtheria, whooping cough, and tetanus. 61.0% (n = 277) of our participants reported having one or more child(ren) whose care they were responsible for.

2.2 Message stimuli

To ensure the authentic feature as well as the ecological validity of message stimuli, we conducted extensive research into the substandard vaccine crisis to facilitate a thorough understanding of the crisis event. We also consulted (1) crisis-relevant official documents obtained from local, provincial, and central governments, (2) regular announcements from the Chinese Center for Disease Control and Prevention (CDC) and the China Food and Drug Administration (CFDA), and (3) the recently passed Vaccine Administration Law to validate the publicly available information about causes and consequences of the focus event.

Different statements were designed for each treatment group based on an official statement issued by the State Administration for Market Regulation (SAMR) in China. The message developed for the E-only condition contains information focused sorely on the outbreak of the crisis. It provides accurate information about what is happening and what has been done to mitigate the problem. In addition to the material included in E-only condition (i.e. source credibility, scientific information, and lucid interpretation), the message stimuli provided for the IEA group also incorporates components addressed in the IDEA model other than *explanation*, i.e. *internalization* and *action* steps to be taken for self-protection. The internalization component was designed to maintain audience attention and aid message retention by highlighting proximity and personal relevance. We accentuated proximity by stating that Changsheng sold 653,120 doses of ineffective DPT vaccines across the country. Personal relevance was addressed by depicting the fact that China's drug regulator accused Changsheng of fabricating production and inspection records related to rabies vaccines, particularly those for infants and children. Moreover, we included specific action steps suggested by the SAMR to encourage people to take proactive and appropriate action to prepare for or respond to the risks engendered by the substandard vaccine crisis. These suggestions included (1) immediately ascertaining their vaccination records and those of close relatives, (2) identifying whether they or their relatives were inoculated with a diphtheria vaccine with batch number 201605014-01 or with any rabies vaccine produced by Changsheng, and (3) calling or going to the local hospital for a timely revaccination at no additional cost.

Graphic templates for government announcements were employed to make participants' stimulus exposure more realistic. All press releases were purposefully kept the same length to rule out any external effects caused by heuristic cues other than the substance of stimuli.

2.3 Measures

2.3.1 Experiential, affective, and cognitive risk perception

A certain risk event may affect one's risk perception not only of the parties involved, but also entire industries that may have only been indirectly responsible for accident outcomes. The substandard vaccine crisis stirred a wave of criticism of the entire health care industry as Changsheng comprises a sizable share of the vaccine market in China. In order to reflect the holistic risk context and to avoid potential one-sided evaluation, risk perception was measured by assessing participants' perceptions of "domestic vaccines" rather than vaccines produced by a specific company. Items were adapted from the TRIRISK model [3] and selected based on their applicability to the vaccination crisis we focused on in this study. Participants were asked to state their agreement (1 = *strongly disagree* to 7 = *strongly agree*) with six items concerning experiential risk perception (M = 5.47, SD = 1.18, Cronbach's α = .87), six items concerning affective risk perception (M = 5.46, SD = 1.24, Cronbach's α = .91), and five items concerning cognitive risk perception (reverse-coded; M = 4.08, SD = 1.43, Cronbach's α = .93). **Table 1** presents items for each dimension of risk perception.

2.3.2 Use intention and WOM intention

Items were adapted from prior studies on behavioral intention [58, 59]. For use intention, participants stated their level of agreement (1 = *strongly disagree* to 7 = *strongly agree*) on whether they would (1) allow relatives to inject domestic vaccines, (2) select domestic products when they were next due for vaccinations, and (3) inject domestic vaccines themselves. Responses were averaged to form a scale (M = 4.35, SD = 1.52, Cronbach's α = .91). For WOM intention, in the event that their relatives or friends turned to them for advice, participants were asked whether they would (1) encourage them to inject domestic vaccines, (2) recommend domestic vaccines to them, and (3) say positive things about domestic vaccines. These responses were measured on a seven-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Three items were averaged to form a scale (M = 3.89, SD = 1.62, Cronbach's α = .92).

2.3.3 Risk acceptance

Participants were asked to rate their level of agreement (1 = *strongly disagree* to 7 = *strongly agree*) with three statements: (1) "I have a high tolerance for the potential risks engendered by domestic vaccines"; (2) "I think domestic vaccines do more good than harm"; and (3) "I can accept the potential risks that accompany domestic vaccines." Three items were averaged to form a scale (M = 4.12, SD = 1.48, Cronbach's α = .83).

2.3.4 Control variables

Demographics including age, gender, education, and income were set as covariates to control for potential extraneous effects. Moreover, two approaches were adopted to control for participants' perceived susceptibility to illness, which was found to be positively associated with the intention to vaccinate [60]. First, participants were asked whether they had one or more child(ren) and were responsible for their care (1 = *Yes*, 0 = *No*). Second, participants stated their level of agreement (1 = *strongly*

	Pretest (n = 454)	**Posttest (n = 302)**
Experiential		
1. I am concerned about being affected by domestic vaccines in my lifetime.	.76***	.80***
2. It is easy for me to imagine myself (and my relatives) being affected by domestic vaccines.	.79***	.83***
3. I (and my relatives) feel very vulnerable to domestic vaccines.	.80***	.80***
4. I am not confident that I can avoid being affected by domestic vaccines.	.64***	.72***
5. I would be lying if I said "there is no chance of me (and my relatives) being affected by domestic vaccines."	.67***	.68***
6. My first reaction when I hear of someone being affected by domestic vaccines is that "that could happen to me (and my relatives)."	.64***	.72***
Affective		
1. I am worried about the consequences that arise from getting a domestic vaccine.	.81***	.79***
2. I am fearful about the consequences that arise from getting a domestic vaccine.	.82***	.84***
3. I am annoyed about the consequences that arise from getting a domestic vaccine.	.77***	.83***
4. I feel angry with the consequences that arise from getting a domestic vaccine.	.76***	.85***
5. I feel discontented with the consequences that arise from getting a domestic vaccine.	.76***	.84***
6. I feel nervous about the consequences that arise from getting a domestic vaccine.	.78***	.76***
Cognitive		
1. The likelihood that I (and my relatives) will be affected by domestic vaccines at some point in the future is very low.	.86***	.90***
2. The way I (and my relatives) look after my (our) health means that my (our) odds of being affected by domestic vaccines are very low.	.89***	.92***
3. When I think carefully about my lifestyle, it seems that the probability I (and my relatives) could be affected by domestic vaccines is very low.	.90***	.90***
4. If I look at myself from a professional perspective, I realize that the likelihood that I (and my relatives) put me (us) at risk of being affected by domestic vaccines is very low.	.84***	.83***
5. Compared to the average person, the chance that I (and my relatives) will be affected by domestic vaccines in the future is very low.	.77***	.77***

Note. All items were measured on a seven-point scale (1 = strongly disagree to 7 = strongly agree). ***$p < .001$.

Table 1.
Scale items for pretest and posttest risk perceptions and standardized factor loadings.

disagree to 7 = *strongly agree*) with two statements to assess their perceived relevance: "the substandard vaccine incident has something to do with me" and "the substandard vaccine incident may affect my life." Both items were averaged to form a scale (M = 4.90, SD = 1.69, r = .59).

3. Results

Manipulation checks were conduced to measure participants' perceived internalization, explanation, and tendency to act based on the message stimuli. Immediately after reading through the message, participants in the two treatment groups were asked to state their level of agreement with statements that the message: (1) makes me realize potential risks the vaccine crisis has posed to me (internalization, M = 5.40, SD = 1.56); (2) makes me realize that the vaccine crisis is relevant to me (internalization, M = 5.55, SD = 1.42); (3) provides a succinct description of the vaccine crisis (explanation, M = 5.25, SD = 1.36); (4) provides an explanation of the crisis that is easy to understand (explanation, M = 5.11, SD = 1.47); (5) gives me specific action steps I should take (action, M = 5.05, SD = 1.59); and (6) makes me know the efficient action steps I should take (action, M = 4.89, SD = 1.70). Results of the independent-sample t-test revealed that the IEA group reported a higher level of perceived internalization (t (153) = 2.09, p < .05) and intention to act (t (153) = 3.89, p < .001) than the E-only group. But the two groups demonstrated no difference in perceived explanation (t (153) = 1.17, p = .244). Hence, the effectiveness of the manipulation in this study is satisfactory.

By conducting a series of confirmatory factor analyses, we examined a single-factor model, three dual-factor models, and a tripartite model independently based on participants' risk perception in the pretest. Specifically, we tested the tripartite structure against a one-factor structure and three dual-factor structures where: (1) affective and experiential risk perceptions were combined into a single factor (A-E); (2) cognitive and experiential risk perceptions were combined into a single factor (C-E); and (3) affective and cognitive risk perceptions were combined into a single factor (A-C). The internal reliability of three constructs was consistently high (Cronbach's α = .87 to .93).

To evaluate model fit, we adopted the multiple fit criteria by Hu and Bentler [61], which suggests cutoff values of .95 or higher for the comparative fit index (CFI) and the Tucker–Lewis index (TLI), and .06 for the root mean square error of approximation (RMSEA). As presented in **Table 2**, the tripartite factor structure was the only model that met all cutoff criteria: CFI = .97, TLI = .97, and RMSEA = .05. To compare the model fit of different structures, χ^2 difference between models were tested. Results showed that the tripartite model had significantly better model fit than the other four factor structures (see **Table 2**). Therefore, H1 was supported with regard to Chinese participants' risk perception of the substandard vaccine scandal. The tripartite model had significantly better model fit than both the single-factor model and dual-factor models.

A pretest-posttest analysis of two treatment groups was conducted using a paired-sample t-test to determine how three types of risk perception would be altered after introducing the IDEA instructional risk message stimuli (RQ1). **Table 3** presents the descriptive statistics and paired-sample t-test results. Participants reported significantly lower levels of experiential risk perception after exposure to either the E-only message, which merely explains the substandard vaccine incident (t = 3.62, p < .001),

Factor structure	Model fit							Model fit compared to TRIRISK model		
	χ^2	df	*p*	CFI	TLI	RMSEA (90% CI)	CMIN/df	χ^2	df	*p*
One-factor	1024.0	119	<.001	.824	.786	.134 (.127, .142)	9.143	768.5	3	<.001
Dual-factor (A-E combined)	369.1	118	<.001	.951	.942	.070 (.062, .078)	3.209	113.6	2	<.001
Dual-factor (C-E combined)	910.6	118	<.001	.846	.811	.126 (.119, .134)	8.204	655.1	2	<.001
Dual-factor (A-C combined)	911.5	118	<.001	.845	.811	.126 (.119, .134)	8.212	656.0	2	<.001
Tripartite	255.5	116	<.001	.972	.967	.053 (.044, .061)	2.261	—	—	—

Note. CFI = comparative fit index. TLI = Tucker-Lewis index. RMSEA = root mean square error of approximation. CMIN/df = the minimum discrepancy divided by its degrees of freedom. Because χ^2 is sensitive to both sample size and model complexity, it is not an adequate indicator for comparing absolute model fit.

Table 2.
Model fit analysis summary of risk perceptions.

	E-only pretest (n = 145)	E-only posttest (n = 145)	IEA pretest (n = 157)	IEA posttest (n = 157)	E-only pre-post paired-sample *t*-test *df* = (1, 144)	IEA pre-post paired-sample *t*-test *df* = (1, 156)
Experiential	5.50 (1.27)	5.19 (1.28)	5.44 (1.09)	5.27 (1.18)	3.62***	2.05*
Affective	5.49 (1.29)	5.32 (1.28)	5.43 (1.18)	5.48 (1.21)	2.42*	−.58
Cognitive	4.42 (1.38)	4.42 (1.47)	3.98 (1.42)	4.08 (1.48)	.04	−1.32

*Note. Standard deviation in parentheses following group mean. df = degrees of freedom. *p < .05, ***p < .001.*

Table 3.
Descriptive statistics and paired-sample results for experiential, affective, and cognitive risk perceptions by message type.

or the IEA message, which further assists people in internalizing its personal relevance, potential impact, and precautionary measures (t = 2.05, p < .05). Moreover, participants who viewed the E-only instructional message reported significantly lower affective risk perception (t = 2.42, p < .05), while those who viewed all elements contained in the IDEA model did not. In contrast, neither treatment group showed significant pre-post differences in cognitive risk perception. Essentially, both E-only and IEA message stimuli prompted a significant reduction in participants' experiential perceptions, but results varied in the other two risk components.

To assess the differentiated predictability of experiential, affective, and cognitive risk perceptions for the public's behavioral intention to use and spread WOM domestic vaccines (RQ2a-b), we employed a hierarchical regression of behavioral intention on

	Use intention		WOM intention	
	B	***SE***	***B***	***SE***
Block 1: Demographics and controls				
Age	−.02	.09	−.12	.09
Gender	−.22*	.11	−.19	.12
Education	−.13	.14	−.35*	.15
Income	−.10	.06	−.10	.06
Children	.38*	.17	.43*	.18
Personal relevance	−.06	.04	−.04	.05
Block 2: Risk perceptions				
Experiential	.11	.09	−.05	.09
Affective	−.23**	.09	−.24**	.09
Cognitive	−.25***	.05	−.29***	.05
R^2	.11		.15	

*Note. B = unstandardized effect size, SE = standard error. *p < .05, **p < .01, ***p < .001.*

Table 4.
Regressing use and WOM intentions on demographics, controls, and risk perceptions.

the three components of risk perception using pretest data. As presented in **Table 4**, demographics and controls were entered into the first block, while experiential, affective, and cognitive risk perceptions were entered into the second block. The overall model was reliable: $F(9, 444) = 6.21/8.93$, $p < .001$. Affective risk perception ($B = -.23$, $SE = .09$, $p < .01$) and cognitive risk perception ($B = -.25$, $SE = .05$, $p < .001$) significantly predicted use intention, while experiential risk perception did not. Similarly, affective risk perception ($B = -.24$, $SE = .09$, $p < .01$) and cognitive risk perception ($B = -.29$, $SE = .05$, $p < .001$) had a significantly negative impact on WOM intention, whereas experiential risk perception demonstrated no statistical significance.

In respect to RQ3a-b, we employed structural equation modeling to examine how the relationship between risk perceptions and behavioral intentions is mediated by risk acceptance. **Figure 1** presents the results of the full structural equation model with the nonsignificant paths represented by dashed lines. By and large, examination of the direct effects along each layer of the model showed that cognitive risk perception was negatively related to risk acceptance ($\beta = -.32$, $p < .001$) but positively related to both use intention ($\beta = .08$, $p < .05$) and WOM intention ($\beta = .09$, $p < .05$). Affective risk perception negatively predicted risk acceptance ($\beta = -.32$, $p < .01$) but demonstrated no significant linkage with behavioral intentions. In contrast, experiential risk perception exhibited no significant relationship with risk acceptance and behavioral intentions.

This suggests that each of the TRIRISK components influenced participants' intentions to use or orally recommend domestic vaccine in different ways. After incorporating risk acceptance as a mediator into the model, experiential risk perception consistently showed no effect on the outcome variables. However, the significantly negative relationship between affective and cognitive risk perceptions and behavioral intentions, as presented above, were partially or fully mediated by risk acceptance. In specific, risk acceptance fully mediates the relationship between affective risk

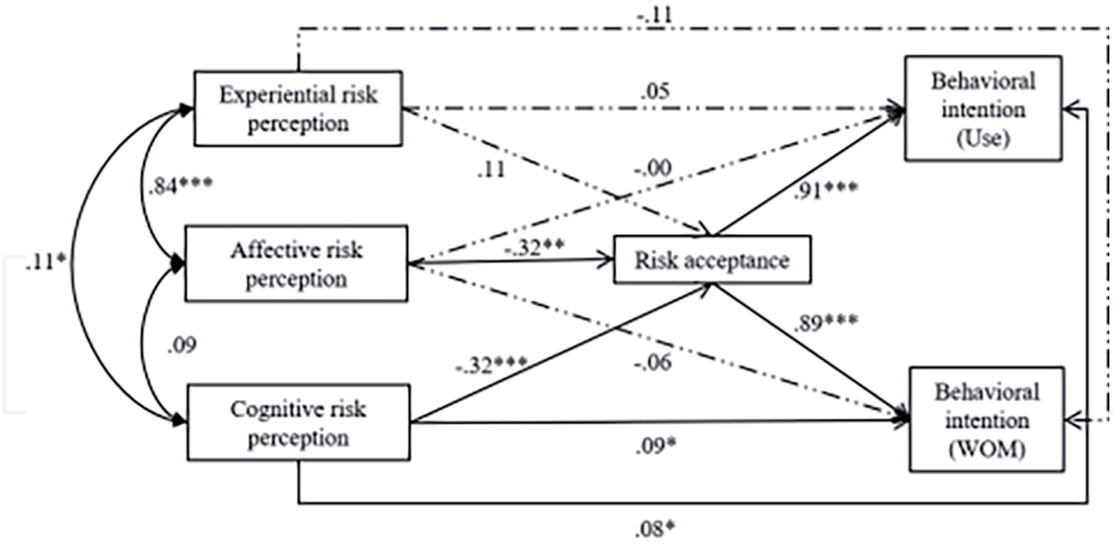

Figure 1.
Results of structural equation modeling. Note. Betas are standardized coefficients. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

perception and behavioral intentions. The fact that participants who rated higher on affective risk perception intended to reduce consumption and encourage others not to consume domestic vaccines was predominantly explained by their lower willingness to tolerate any potentially negative effects from the vaccine. Interestingly, the partial mediation role played by risk acceptance turned the significantly negative relationship between cognitive risk perception and both behavioral intentions into one that was positive. This counterintuitive finding indicates that participants who make high deliberative assessments of the risk that accompanies domestic vaccines would not be willing to tolerate the potential negative consequences but may still continue using and promoting domestic vaccines after any incident occurs. These positive associations are understandable, because participants who intend to consume and recommend domestic vaccines may feel fully informed about the scandal and generally knowledgeable about domestic vaccines, thus leading to increased expectations of coming into contact with domestic vaccines after the probability-based risk assessment. Further analyses of longitudinal data are necessary for clarifying the direction between cognitive risk perception and behavioral intentions.

4. Discussion and conclusion

Our study lends empirical support, gathered through an online survey conducted shortly after the Changsheng substandard vaccine crisis, to the proposition that risk perception consists of three fundamental dimensions that together compose the tripartite model. Past theories and models, including the health belief model [62], the protection motivation theory [63], the self-regulation model [45], and the extended parallel process model [46], mostly adopted either a unitary or a dichotomous approach to investigating risk perception. Results of our study suggest, however, that previous theoretical frameworks can be enriched and enhanced by distinguishing experiential from affective and cognitive risk perceptions. We arrived at this insight through our finding that the model fit of the tripartite model was significantly higher than that of either single-factor or dual-factor models. More scholarly attention should be paid to the tripartite model so that the conceptualization of risk perception can be explicated in greater detail.

Results of the paired-sample *t*-test demonstrated that experiential risk perception was successfully differentiated from affective risk perception. The IDEA instructional message stimuli have provoked a significant change in experiential risk perception but not in affective or cognitive risk perceptions. In other words, experiential risk perception is intuitively dynamic, whereas affective and cognitive risk perceptions are more static and resistant to extrinsic changes. According to Ferrer et al. [3], experiential risk perception is amenable to measuring via self-reports, because individuals can be aware of intuitive cues contained in survey questions. However, our study employed a pretest-posttest analysis to demonstrate that the implicit memory mobilized in experiential risk perception can hardly be retrieved through conventional self-reported responses. Instead, an adequately designed stimulus may be capable of capturing an accurate picture of experiential risk perception as well as the explicit gap between experiential and affective risk perceptions.

In contrast to previous work on the TRIRISK model, our study demonstrated that the three dimensions of risk perception exhibit different patterns of association with behavioral intentions. While this affirms once again the discriminant validity of the tripartite model, we showed that experiential risk perception is the only dimension that has no statistically significant impact on behavioral intentions. Moreover, cognitive risk perception emerges as the strongest predictor of outcome variables, whereas prior research showed that affective risk perception has the strongest predictability among the three components [3]. The case specificity and the measurement of behavioral intention might explain these new findings. Ferrer et al. [3] paid closer attention to cancer screening, on which individuals expend relatively little cognitive effort due to the low probability of negative effects on their health as a result of the screening. However, the Chinese substandard vaccine crisis involved risks that were mostly posed to children under the age of 6 years. In our study, participants were asked to measure their intention not only to use domestic vaccines on themselves but also to use such vaccines on their children and to recommend through WOM that other relatives do so as well. This is likely to arouse participants' analytic information processing and deliberative judgments. Moreover, we controlled for participants' perceived susceptibility to illness, which proves to be significantly associated with both use (B = .38, SE = .17, p < .05) and WOM (B = .43, SE = .18, p < .05) intention.

Compared with cognitive and affective risk perceptions, experiential risk perception exhibited a limited predictive power even after incorporating risk acceptance into the model as a mediator. One possible explanation for this low predictability may be participants' varying levels of familiarity regarding the risk objects. The online survey was conducted against the backdrop of a recent series of Chinese drug safety scandals, among which vaccine issues were at the center of controversies and debates. Some participants may have already formed strong opinions about domestic vaccines, while others with low levels of attention paid to current affairs may have never encountered such information. Additionally, cognitive risk perception in particular was aided by our process of providing participants with concrete information about the Changsheng crisis, which enabled them to access a rich network of cognitive associations related to the risk event. Future research could focus on unfamiliar risk objects that might lead to different findings, according to the notion that people rely more on affects and emotions in unfamiliar cases [64]. In situations of limited knowledge, individuals are more likely to access affective associations toward an unfamiliar risk object than to construct cognitive associations. Subsequent iterations of the method used here should delve deeper into the question of how unfamiliarity can make people fall back on more intuitive decision-making processes—and how that in turn affects the relationship between risk perception and behavioral intention.

4.1 Implications

Findings from this study also suggest several takeaways for risk and crisis communication practitioners and for future research. First, our results demonstrate satisfactory construct reliability and discriminant validity of the tripartite model of risk perception. This finding contributes to the two-way, audience-centric approach to defining the effectiveness of risk communication. Effective risk communication plays a significant role in both mitigating harmful actions and promoting safe behaviors. Past studies found that typical risk and crisis messages only focus on creating accurate comprehension through instructional explanation without catering to the psychological proximity of information receivers [39]. Messages with logical reasoning may only facilitate cognitive learning that elicits cognitive risk perception. Such explanation-oriented messages have a relatively limited impact on people's experiential and affective risk perceptions. In order to further enhance the reliability and effectiveness of instructional messages in risk contexts, communication professionals are expected to move beyond plain explanations and incorporate elements intended to impact irrational facets of the public risk perception.

Second, the nature of crisis events helps determine the applicability and predictability of the three components of risk perception. For instance, the risk of cancer is most often attributed to one's own habits, family history, and physique, while government regulators, companies, and other social institutions are often blamed for vaccine crises. Different attributions may provoke different ways of perceiving risk. If external organizations and institutions are the "responsible parties," the public may take more cognitive approaches to risk perception. Therefore, the nature of a specific event should be fully analyzed so that communication professionals can develop audience-centric messages that accommodate different aspects of risk perception.

Last but not least, our findings might serve as a starting point for further research on how the three risk perception components could be targeted individually and how the magnitude and direction of each component changes. Such experiments would help inform practitioners how to generate the maximum impact on behavioral outcomes. In cases of emergencies where immediate precautionary or avoidance actions are required, e.g. warnings to evacuate coastal areas because of an inbound tsunami, explanations and numeric data are useless. Visual messages, which are more capable of eliciting negative feelings and triggering past experiences with extreme weather, can be more effective in heightening experiential risk perception and may be more adequate to be disseminated in such a context.

4.2 Limitations

Our study is limited in several ways. Designed from the perspective of government regulators in the context of the Changsheng substandard vaccine crisis, this study measures only the intention to perform desirable behaviors, i.e. domestic vaccine use and WOM. Consequences and effects of these actions are restricted to participants and to their immediate family members and close friends. However, other behaviors of crucial importance to the risk and crisis management of drug safety may have consequences beyond the individual level. For instance, participating in anti-vaccine activism may impact not only individuals' lives but also the functioning of the larger community. The motivational component that drives risk acceptance to behavioral intention may vary with anticipated consequences. High levels of risk acceptance may be sufficient to motivate intentions to use domestic vaccines, but insufficient

to arouse intentions to sign a petition supporting domestic vaccines. It is therefore necessary to investigate whether other types of behavioral intention should be studied. One such focus should be on communicative behavioral intention, the specific mechanism of which merits more scholarly attention considering the rapid development of social media and mobile applications. Another notable limitation rests on our sampling strategy. With respect to educational background, 81.5% (n = 370) of participants reported having a bachelor's degree or higher, far exceeding the national average of 8.73% [65]. We are thus unable to generalize our findings to the wider Chinese public. Future research should test the factor structure of the tripartite model using a more generalizable sample. Further, we also note that each participant was randomly assigned to one of the two treatment groups and exposed to stimuli over the Internet. It is unclear whether our findings would have changed—and if so, how—had participants been exposed to the message stimuli in person and in naturalistic environments. Finally, our findings may be somewhat sensitive to the case we selected, i.e. the Changsheng substandard vaccine crisis. Future studies should verify the applicability of the tripartite model to other public health crises and events.

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Conflict of interest

The authors declare no conflict of interest.

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