

Effects of Mass Media Exposure and Social Network Site Involvement on Risk Perception of and Precautionary Behavior Toward the Haze Issue in China

XIAOHUA WU
XIGEN LI

City University of Hong Kong, China

This study examines the effects of mass media exposure and social network site (SNS) involvement on risk perception of and precautionary behavior toward the haze issue in China. It also tests the impersonal impact hypothesis and the differential impact hypothesis in the context of social media communication. SNS involvement is found to be a stronger predictor of risk perception than mass media exposure. Both mass media exposure and SNS involvement mediate the effect of direct experience on risk perception. The impersonal impact hypothesis, which assumes that media differentially affects social risk perception and personal risk perception, is not confirmed, while the differential impact hypothesis is supported. Personal risk perception mediates the effect of mass media exposure and SNS involvement on precautionary behavior. The findings clarify the inconsistency in the effect of interpersonal communication on perceived personal risk and suggest an interplay of the predictors of precautionary behavior.

Keywords: mass media exposure, SNS involvement, risk perception, vulnerability, precautionary behavior

Haze, an atmospheric phenomenon containing dust, smoke, and other dry particles that obscure the clarity of sky, has existed in China for decades (Kaiser & Qian, 2002). For instance, Che et al. (2009) examined the patterns and trends of haze in 31 provincial capitals of China between 1980 and 2005. Scholars also have examined the effect of haze on human health (e.g., Chameides et al., 1999; Kaiser & Qian, 2002). However, the public did not pay much attention to the haze issue in China until 2006, when the media started using the word *haze* to define the phenomenon and began covering it regularly. The seriousness of the haze issue, when reported by mainstream media in China in recent years, has led to heated public discussions. It eventually became one of the buzzwords of 2013 (Jiang, 2013). Media alerts led to changes in people's precautionary behaviors. For example, in December 2015, masks and purifiers went out of stock in many stores in Beijing, which suffered from serious haze during that period (Li, Li, & Wang, 2015). Although the haze issue dominates the media regularly, few studies have examined the

Xiaohua Wu: amanda.xiaohua.wu@gmail.com

Xigen Li: lixigen@cityu.edu.hk

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effect of exposure to media messages about haze on people's precautionary behaviors. This study tests to what degree mass media exposure and social network involvement mediate the effect of direct experience on people's risk perception of haze. It also explores how vulnerability moderates the effects of mass media exposure and SNS involvement on perceived social and personal risks, respectively. Finally, the study examines how these factors interact to influence precautionary behavior.

Literature Review

Media Use and Risk Perception

Media use in the digital age becomes an activity that crosses a broad range of communication channels. In addition to the traditional media, various online social media become regular channels through which people access and exchange information. Among the online social media, social network sites (SNSs) are the fastest growing personal network channels. SNSs are online platforms that allow users to create public profiles and interact with one another on various topics. Information access through SNSs is not merely simple exposure to news but also involves information sharing and discussion with other network users (Lee & Ma, 2012). Interconnections between people on SNSs enhance the process of information dissemination and amplify the influence of that information (Luarn, Yang, & Chiu, 2014).

Media use is often perceived as the primary source of risk perception (Bastide, Moatti, & Fagnani, 1989). Risk perception refers to a person's subjective judgment about the seriousness of the potential harm due to some situation related to natural hazards and threats to the environment or health (Douglas, 1986). Brewer et al. (2007) identified three dimensions of risk perception: perceived likelihood, susceptibility, and severity of risk. Respectively, they refer to the perceived probability that one will be harmed by the hazard, constitutional vulnerability to a hazard, and the extent of harm a hazard would cause. People's perception of the world is derived from their life experience, which can be divided into direct and indirect experience. Direct experience refers to firsthand sensory contact to reality, while indirect experience generally comes from interpersonal communication and media exposure (Tyler, 1980). Constrained by a limited living sphere, people get only a small amount of information from direct experience (Tyler, 1980). In comparison, interpersonal communication expands people's information to a certain extent (McLeod, Scheufele, & Moy, 1999), while mass media act as systematic, everlasting, and steady information sources for people to know the world outside their living sphere (Mutz, 1998). As a specific arena of perception, risk perception is likely to be affected by factors such as exposure to mass media coverage and direct experience of the severity of the risk in real life (Dake & Wildavsky, 1991).

The influence of mass media on risk-related judgments has been a topic studied by many scholars especially since the 1970s (Coleman, 1993; Lin & Lagoe, 2013). Media messages were seen as important sources for people's risk perception of HIV/AIDS (Agha, 2003; Romer et al., 2009) and of using new technologies (Bastide et al., 1989). Repeated media coverage keeps people alert to risk (Wahlberg & Sjöberg, 2000). One study suggests that it is not just the seriousness of infectious diseases covered by media but also the frequency of media coverage that increases people's perceived severity of the disease (Young, King, Harper, & Humphreys, 2013).

Cultivation theory emerged as an instrumental theory for research about the effect of media exposure on risk perception (Shrum & Bischak, 2001). Proposed by Gerbner in the 1970s, the theory explains the influence of TV program exposure on people's perception of the real world. Cultivation theory has been confirmed in the context of different cultures and topics, such as HIV/AIDS (Bekalu & Eggermont, 2013), domestic terrorism (Pfefferbaum et al., 2001), and global warming (Mazur & Lee, 1993).

However, cultivation theory also has been criticized for its inconsistency and oversimplification. Gerbner later modified the theory and added the concepts of "mainstreaming" and "resonance." The notion of resonance suggests that the people whose life experience is more related to what is depicted on TV are more likely to be affected by the television message (Gerbner et al., 2002). Life experience is considered an important condition for resonance. In the case of haze in China, direct experience of haze could produce some resonance. Frequent media exposure could activate direct experience and connect it with risk perception. Even if people do not have much knowledge about haze, media coverage may substantiate their understanding of the risk perceived through direct experience, and it could become an essential factor to link direct experience and risk perception. Therefore, the effect of direct experience on risk perception is likely to be mediated through mass media exposure.

In the process of forming risk perception, individuals obtain information through mediated communication, either from mass media coverage or from interpersonal communication with friends, neighbors, and coworkers (Tyler, 1980). In this study, mass media exposure refers to access to media content from both traditional media and their affiliates on the Internet, such as newspapers and television and their Web and mobile applications. Interpersonal communication is represented by information access, sharing, and discussion through social networking sites.

The process of forming risk perception involves two aspects: cognitive and affective. Interpersonal communication affects both cognitive and affective dimensions of judgment on scientific and technological risk (Dunwoody & Neuwirth, 1991). Mass media generally make the risk of an issue more salient, and people may turn to interpersonal communication channels to make further judgments. SNSs, as a digital form of interpersonal communication, facilitate information exchanges on the issue of risk and will generate discussions among various social network users. Therefore, involvement in SNSs entails more cognitive processing of the risk information. Compared with exposure to risk information through mass media, the interpersonal communication that takes place through SNSs may require users to employ more mental resources to process risk information (Mou & Lin, 2014). Although some studies have explored the relationship between media exposure and risk perception (Han, Zhang, Chu, & Shen, 2014; So, Cho, & Lee, 2011), seldom do researchers examine the relationship between SNS involvement and risk perception and to what degree mass media exposure and SNS involvement differ in their effects on risk perception (Mou & Lin, 2014; Yang, Chen, & Feng, 2016). Therefore, we propose the following hypotheses:

H1: Compared with mass media exposure, SNS involvement is a stronger positive predictor of risk perception of haze.

H2: *Both mass media exposure and SNS involvement mediate the effect of direct experience on risk perception of haze.*

Impersonal Impact Hypothesis and Differential Impact Hypothesis

Although studies have confirmed the correlation between mass media exposure and risk perception of the real world, there were exceptions (Hughes, 1980). The *impersonal impact hypothesis* was proposed to explain the inconsistencies. The impersonal impact hypothesis has two components. First, it suggests that personal and social-level judgments about risk are separate, and media effects may occur on one level without the other level being influenced. Second, media effects occur primarily on the social level rather than the personal level (Tyler & Cook, 1984). *Social* risk perception refers to individuals' estimation of the generalized level of loss or damage to society, while *personal* risk perception refers to a chance of loss or damage felt by individuals on themselves (Tyler & Cook, 1984).

Sufficient empirical evidence supports the impersonal impact hypothesis. In the early 1980s, several studies found that time spent watching TV programs about crime and violence was unrelated to the fear of self-victimization (Hughes, 1980; Skogan & Maxfield, 1981; Tyler, 1980). While these studies found a minimal effect of TV programs on personal-level risk perception, they confirmed the effect of mass media exposure on social-level judgments about the crime rate (Skogan & Maxfield, 1981; Tyler, 1980). The impersonal impact hypothesis was verified by three experiments on different topics (Tyler & Cook, 1984). Subsequent studies confirmed the impersonal impact hypothesis in other contexts (e.g., Mutz, 1998).

Scholars conceive the role of communication channels as follows: People obtain information about society from mass media and information about peers from social interactions, but they have to infer their own risk status (Dunwoody & Neuwirth, 1991; Tyler & Cook, 1984). Interpersonal communication as an informal social communication, therefore, could influence personal risk perception (Tyler, 1980). Discussing skin cancer risk with others has an effect on one's perceived personal risk, while mass media exposure affects the perceived social risk (Morton & Duck, 2001). However, other studies have yielded contradictory results. A study on home-based radon exposure found both interpersonal discussion and mass media exposure related to social-level judgments (Mazur & Hall, 1990). Another study about health risk demonstrated that interpersonal communication predicted a risk judgment on the societal dimension rather than on the personal dimension (Coleman, 1993). Therefore, when a risk such as haze threatens both the society and individuals, interpersonal communication could have a discrete role in the process, which remains to be resolved in the digital age, with various channels for interpersonal communication.

Although studies based on the impersonal impact hypothesis have asserted that media mainly affect social risk perception rather than personal risk judgments, they also have indicated that the hypothesis applies to some conditions, issues, and types of people. This notion was termed the *differential impact hypothesis* (Tyler & Cook, 1984). Media reports tend to affect personal-level judgments when respondents identify with problems as portrayed and see the problems as applicable to themselves. Therefore, some personal characteristics could play a moderating role in the mass media's effect on people's personal risk perception (Tyler & Cook, 1984). A recent study supports the differential impact

hypothesis in a social media context. When stories are delivered through an interpersonal channel, the personal perception may be heightened by the comments from Facebook "source" (Schweisberger, Billinson, & Chock, 2014).

Studies in this area examined the moderators on the effect of media coverage on personal risk perception. One such moderator is vulnerability, which refers to the likelihood that an individual or a group will be exposed to and adversely affected by a hazard (Cutter, 1996). Vulnerability has two sides: an external side of risks, shocks, and stress to which an individual or household is subject and an internal side, which is a sense of defenselessness or lack of means to cope with damaging loss (Chambers, 1989). One noticeable external indicator of vulnerability is direct experience of a high-risk environment, such as living in a city with high levels of fine particulate matter known as PM_{2.5}—microscopic solid or liquid matter suspended in the Earth's atmosphere (Seinfeld & Pandis, 2016). The internal indicator of vulnerability is one's own health status. The effect of mass media exposure on personal risk perception would be strengthened when people are highly vulnerable (Tyler & Cook, 1984). A study about online privacy risks found that personal experience has moderation effects by decreasing the gap between personal- and social-level risk estimates (Cho, Lee, & Chung, 2010). Therefore, the study reported in this article examines how vulnerability moderates the effect of mass media exposure and SNS involvement on personal and social risk perceptions. The following hypotheses and research question are proposed:

H3: Mass media exposure has a stronger effect on social risk perception than on personal risk perception.

RQ1: To what degree does SNS involvement contribute to (a) social risk perception and (b) personal risk perception?

H4a: Vulnerability moderates the effect of mass media exposure on social risk perception and personal risk perception.

H4b: Vulnerability moderates the effect of SNS involvement on social risk perception and personal risk perception.

Factors Influencing Precautionary Behaviors

Precautionary behavior is defined as the protective actions people take to reduce potential negative effects (Tewksbury, Moy, & Weis, 2004). People need enough knowledge and information related to a certain risk before making an important decision to act. Mass media generally serve as a channel disseminating information to a large audience, and media messages alone seem insufficient to produce changes in behavior. Interpersonal interaction is necessary for individuals to be persuaded to adopt healthy behaviors (Cassell, Jackson, & Chevront, 1998). Discussion with peers has been found to be a major predictor of antismoking behaviors (Hafstad & Aaro, 1997). Therefore, interpersonal communication is an important channel for discussion of salient issues, and it could induce behavior changes (Morton & Duck, 2001).

Mass media can interact with interpersonal communication in affecting personal behaviors. Studies have shown that the timing and context of information received from mass media enable people to realize the personal relevance of the information, and then lead to discussion within their social networks (Southwell & Yzer, 2009). Morgan (2009) noted that information originated from mass media is possibly spread within the social networks through interpersonal communication, and it affects the subsequent behaviors of network participants. Therefore, SNS involvement could mediate the effect of mass media exposure on risk perception.

Scholars see risk perception as a central construct in health behavior theories, such as the health belief model and persuasion adoption process (Abraham & Sheeran, 2015; Rudisill, 2013). Specifically, precautionary behavior was found to correlate with personal risk perception in a test of the health belief model (Becker, 1974). Other scholars confirmed this correlation in crime studies (Janz & Becker, 1984; Tyler, 1980). Researchers also found that personal-level risk perception is more strongly correlated with behavior intention about risk than is social-level risk perception (Paek, Oh, & Hove, 2016). Therefore, a person's personal risk perception could mediate the effect of mass media exposure and SNS involvement on his or her precautionary behaviors. We propose the following hypotheses (see Figure 1).

- H5: SNS involvement mediates the effect of mass media exposure on precautionary behavior.*
- H6: Compared with social risk perception, personal risk perception has a stronger effect on precautionary behavior.*
- H7a: Personal risk perception mediates the effect of mass media exposure on precautionary behavior.*
- H7b: Personal risk perception mediates the effect of SNS involvement on precautionary behavior.*

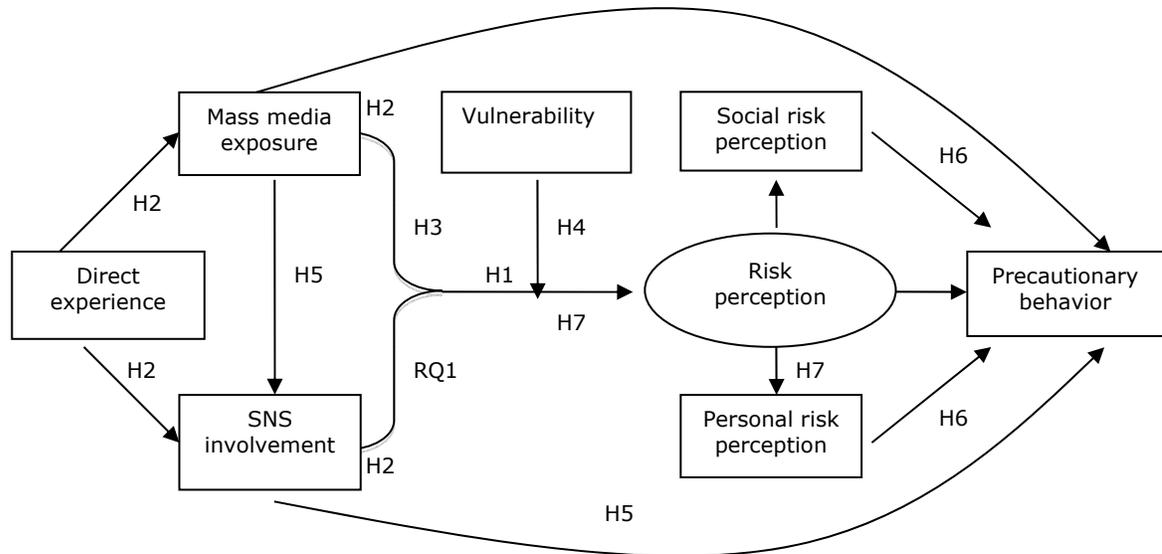


Figure 1. Proposed model of media use, risk perception, and precautionary behaviors.

Method

The participants in this study are Chinese Internet users who have access to mass media and their affiliates on the Internet and SNSs. The participants were recruited through a link to a questionnaire sent to SNSs users to invite them to participate in the survey.

The questionnaire contained 25 questions. The purpose of the survey was explained to participants, and their confidentiality was ensured. Two filter questions were employed to ensure that the respondents had access to mass media and were active SNS users. Location was used to classify respondents from regions with various levels of seriousness of haze. The respondents selected through this process constitute the sample. Because the study employed a convenience sample not representative of the population, we are not able to make strong inferences about the general population.

Measurement

The Chinese version of the questionnaire was finalized after being checked by three bilingual communication researchers and by incorporating their suggestions. A pretest was conducted among a small group of SNS users to check the readability of the questions and confirm the measurement of the underlying concepts of the key variables. Ambiguous or inaccurate items were removed or revised. Except for direct experience and vulnerability, a 5-point verbal frequency scale from *seldom* to *frequently* was used to measure mass media exposure and SNS involvement, and a 5-point Likert scale ranging from

strongly disagree to *strongly agree* was used to measure all other variables. A reliability test was conducted to ensure internal consistency of the items. The Cronbach's alphas of all variables were above .70.

Mass media exposure was measured by asking how often a respondent reads/watches news about a certain issue from different mass media channels (Li, 2014). Specifically, five items were adapted to measure self-reported exposure to mass media contents related to haze through the following channels: (1) television news programs, (2) newspapers, (3) news apps on mobile phones/news websites, (4) media's public platforms on microblogs/WeChat, (5) radio. The five items were added to create a composite index for mass media exposure ($M = 3.17$, $SD = 0.81$, $\alpha = .78$).

SNS involvement refers to the degree to which respondents use online platforms to communicate with other users with whom they share a relationship (boyd & Ellison, 2007). SNS involvement was measured by four items concerning activities about the haze-related issue on social network sites such as Sina Weibo and WeChat: (1) talk about, (2) pay attention to, (3) post messages, and (4) relay messages. The four items were added to create a composite index for SNS involvement ($M = 2.87$, $SD = 0.88$, $\alpha = .87$).

Risk perception was measured at two levels: personal risk perception and social risk perception. The measure incorporated the three dimensions of risk perception: perceived likelihood, susceptibility, and severity of risk (Brewer et al., 2007). The six items measuring social and personal risk perceptions were added and averaged to form the measure of risk perception ($M = 4.31$, $SD = 0.66$, $\alpha = .89$).

Social risk perception was measured with three items indicating the perceived seriousness of potential harm by haze for the nation, society, and community with the statements: (1) For China, haze is a serious problem; (2) haze is a potential threat for the healthy and orderly development of society; (3) haze is harming the health of residents in the community. The three items were added to create a composite index for social risk perception ($M = 4.44$, $SD = 0.70$, $\alpha = .87$).

Personal risk perception was measured by three items indicating the perceived seriousness of potential harm by haze on oneself with the statements: If I live in places affected by haze, (1) my respiratory system would be impaired by haze; (2) I am worried that I will get chronic diseases induced by haze; (3) my health would be impacted by haze. The three items were added to create a composite index for personal risk perception ($M = 4.18$, $SD = 0.79$, $\alpha = .91$).

Precautionary behaviors are generally measured by the frequency or willingness to take specific actions to reduce a risk (Li, 2014). Four items adapted from a previous study (Tewksbury et al., 2004) were used to measure the variable: If hazy weather occurs in my place of residence, I will (1) wear masks outdoors, (2) install air purification devices at home, (3) reduce the time of unnecessary outdoor activities, (4) reduce the time of opening windows for ventilating. A composite measure of precautionary behavior was calculated by adding the four items ($M = 3.60$, $SD = 0.83$, $\alpha = .72$).

Direct experience refers to a person's immediate sensory contact to the reality (Tyler, 1980) and is represented in this study by the seriousness of local haze. Data on respondents' provinces/municipalities of residence were collected. The seriousness of haze is measured by the index of the primary component of haze, PM_{2.5}. This study collected the monthly PM_{2.5} statistics of each province/municipality from October 2013 to April 2015 on the website of China's online air quality monitoring platform (<http://www.aqistudy.cn>). An individual's direct experience was measured by the average monthly PM_{2.5} value in his/her province/municipality of residence standardized to a range of 1 to 5 ($M = 2.67$, $SD = 1.23$).

Health status was measured by a self-reported response on a 5-point semantic differential scale ranging from *very good* to *very poor* ($M = 3.78$, $SD = 0.89$).

Vulnerability refers to the likelihood that an individual will be exposed to and adversely affected by a hazard (Cutter, 1996), and consists of external and internal components. Direct experience, represented by the average monthly PM_{2.5} value, is an external indicator of an individual's vulnerability to the risk of haze, while one's own health status reflects his/her vulnerability on the internal side. The average of the two indicators composes the measure of vulnerability ($M = 2.45$, $SD = 0.75$, $r = .13$, $p < .05$). While the external indicator and internal indicator vary significantly and yield a relatively low correlation, the content validity of the measure stands. Table 1 shows a correlation matrix of all key variables.

Results

A total of 347 questionnaires were collected, of which 345 were complete. Most respondents (73%) are between the ages of 18 and 25; 67% are women; and 72% have a bachelor degree or above. The respondents are from 25 provinces of China.

Hypothesis 1, that, compared with mass media exposure, SNS involvement is a stronger positive predictor of risk perception, is supported. A hierarchical regression analysis was conducted. With risk perception as the dependent variable, we entered the independent variables in two blocks: (1) demographics (age, gender, and education) and (2) mass media exposure and SNS involvement. The demographics block explained no variance of precautionary behavior ($R^2 = .01$, $p > .05$). The regression model with the two independent variables added was statistically significant ($R^2 = .17$, $p < .01$). The result indicated that mass media exposure was a positive predictor of risk perception ($\beta = .12$, $p < .05$). SNS involvement was also a positive predictor of risk perception ($\beta = .23$, $p < .01$). Fisher's z -score transformation showed that the difference between the regression coefficients of mass media exposure ($\beta = .12$, $p < .05$) and SNS involvement ($\beta = .23$, $p < .01$) on risk perception was statistically significant ($z = 1.76$, $p < .05$). Therefore, the effect of SNS involvement on risk perception was stronger than that of mass media exposure.

Hypothesis 2, that both mass media exposure and SNS involvement mediate the effect of direct experience on risk perception, is supported. The hypothesis was tested using mediation analysis to estimate bootstrap with 1,000 samples (Shrout & Bolger, 2002) through PROCESS, an add-on macro for

SPSS developed by Hayes (2013). Direct experience was a significant predictor of mass media exposure ($\beta = .10, p < .01$) and risk perception ($\beta = .09, p < .01$). In the mediation model, both direct experience ($\beta = .07, p < .01$) and mass media exposure ($\beta = .21, p < .01$) were significant predictors of risk perception ($R^2 = .10, p < .01$). The indirect effect of direct experience on risk perception mediated by media exposure was $.04, p < .05, 95\% \text{ CI } [.01, .08]$. Therefore, the partial mediation effect of mass media exposure is confirmed (see Table 2).

Table 1. Correlation Matrix of Key Variables and the Means, Standard Deviations, and Alphas of the Variables (N = 345).

	Media exposure	SNS involvement	Experience	Risk perception	Social risk perception	Personal risk perception	Vulnerability	Precautionary behavior
Media exposure	—							
SNS involvement	.47**	—						
Experience	.15**	.28**	—					
Risk perception	.28**	.37**	.18**	—				
Social risk perception	.23**	.32**	.16**	.87**	—			
Personal risk perception	.27**	.34**	.15**	.90**	.56**	—		
Vulnerability	.08	.24**	.84**	.18**	.14*	.17**	—	
Precautionary behavior	.19**	.38**	.04	.45**	.30**	.49**	.05	—
<i>M</i>	3.17	2.87	2.67	4.31	4.44	4.18	2.45	3.60
<i>SD</i>	0.81	0.88	1.23	0.66	0.70	0.79	0.75	0.83
Alpha	.78	.87	—	.89	.87	.91	—	.72

* $p < .05$. ** $p < .01$.

Table 2. Analysis of the Effect of Direct Experience on Risk Perception Mediated by Media Exposure and SNS Involvement (N = 345).

Predictors	Mediator	Risk perception
Direct experience	.10**	.09**
<i>Media exposure as mediator</i>		
Direct experience		.07**
Media exposure		.21**
Direct experience mediated by media exposure		.04*
Bootstrap 95% CI		.01, .08
Direct experience	.20**	.09**
<i>SNS involvement as mediator</i>		
Direct experience		.04
SNS involvement		.26**
Direct experience mediated by SNS involvement		.10**
bootstrap 95% CI		.06, .15

* $p < .05$. ** $p < .01$.

The mediation analysis of SNS involvement as a mediator of the effect of direct experience on risk perception is also conducted with bootstrap estimation. Direct experience was a significant predictor of SNS involvement ($\beta = .20, p < .01$) and risk perception ($\beta = .09, p < .01$). In the mediation model, SNS involvement ($\beta = .26, p < .01$) was a significant predictor of risk perception, while direct experience ($\beta = .04, p > .05$) was not a predictor ($R^2 = .03, p < .01$). The indirect effect of direct experience on risk perception mediated by SNS involvement was $.10, p < .01, 95\% \text{ CI } [.06, .15]$. Therefore, the mediation effect of SNS involvement was also confirmed. Since the effect of direct experience on risk perception becomes nonsignificant, whereas SNS involvement significantly predicts risk perception, SNS involvement completely mediated the effect of direct experience on risk perception.

Hypothesis 3, that mass media exposure has a stronger effect on social risk perception than on personal risk perception, is not supported. First, a paired-sample t -test was conducted. The result indicated that difference between social risk perception ($M = 4.44$) and personal risk perception ($M = 4.18$) was statistically significant ($t = -7.0, p < .01$). A regression analysis was conducted, and the result showed that media exposure had a positive effect on both social risk perception ($\beta = .10, p < .05$) and

personal risk perception ($\beta = .14, p < .05$). The results do not support the hypothesis that mass media exposure has a stronger effect on social risk perception than on personal risk perception (see Table 3).

Research question 1—"To what degree does SNS involvement contribute to (a) social risk perception and (b) personal risk perception?"—compares the effect of SNS involvement on social risk perception ($\beta = .21, p < .01$) with that on personal risk perception ($\beta = .25, p < .01$). The research question was answered with Steiger's equation for comparing regression coefficients sharing a common independent variable: SNS involvement. The results showed that the difference of the two regression coefficients was not statistically significant ($z = 1.25, p > .05$). Therefore, the answer to research question 1 is that SNS involvement positively predicts social risk perception and personal risk perception, while SNS involvement does not differ in its contribution to social risk perception and personal risk perception (see Table 3).

We found partial support for Hypothesis 4a, that vulnerability moderates the effect of mass media exposure on social risk perception and personal risk perception. Vulnerability moderated the effect of mass media exposure on personal risk perception, but it did not moderate the effect of mass media exposure on social risk perception. A hierarchical regression analysis was conducted. We respectively used social risk perception and personal risk perception as a dependent variable, and entered the independent variables in two blocks: (1) demographics and (2) mass media exposure, vulnerability, and the product of mass media exposure and vulnerability. The interaction term, the product of vulnerability and media exposure, was a significant predictor of personal risk perception ($\beta = .08, p < .05$), and the model was statistically significant ($R^2 = .11, p < .01$). However, the interaction term was not a significant predictor of social risk perception ($\beta = .06, p > .05$; see Table 3).

Table 3. Moderation Analysis of Vulnerability on the Effect of Mass Media Exposure and SNS Involvement on Risk Perception (N = 345).

Predictors	Social risk perception	Personal risk perception	Risk perception
<i>Demographics</i>			
Age	.03	.05	.04
Gender	.15	.14	.15
Education	.03	.00	.02
R^2	.01	.01	.01
<i>Communication channel</i>			
Mass media exposure	.10*	.14*	.12*
SNS involvement	.21**	.25**	.23**
R^2	.12**	.14**	.17**

<i>Mass media exposure as moderator</i>			
Mass media exposure	.20**	.25**	.22**
Vulnerability	.11*	.15**	.13**
Mass media exposure × Vulnerability	.06	.08*	.07*
R^2	.09**	.11**	.13**
<i>SNS involvement as moderator</i>			
SNS involvement	.24**	.29**	.27**
Vulnerability	.07	.10	.17**
SNS involvement × Vulnerability	.06	.03	.05
R^2	.12**	.13**	.16**

* $p < .05$. ** $p < .01$.

Hypothesis 4b, that vulnerability moderates the effect of SNS involvement on social risk perception and personal risk perception, is not supported. A hierarchical regression analysis was conducted. We respectively used social risk perception and personal risk perception as dependent variables, and entered the independent variables in two blocks: (1) demographics and (2) SNS involvement, vulnerability, and the product of SNS involvement and vulnerability as moderator. The interaction term was not a significant predictor of social risk perception ($\beta = .06, p > .05$) and personal risk perception ($\beta = .03, p > .05$).

Hypothesis 5, that SNS involvement mediates the effect of mass media exposure on precautionary behavior, is supported. A mediation analysis was conducted with bootstrap estimation. Mass media exposure was a significant predictor of SNS involvement ($\beta = .51, p < .01$) and precautionary behavior ($\beta = .20, p < .01$). In the mediation model, SNS involvement ($\beta = .35, p < .01$) was a significant predictor of precautionary behavior, while mass media exposure ($\beta = .02, p > .05$) was not a predictor ($R^2 = .14, p < .01$). The indirect effect of mass media exposure on precautionary behavior mediated by SNS involvement was $.17, p < .01, 95\% \text{ CI } [.11, .24]$. Therefore, the mediation effect of SNS involvement was confirmed. Since the effect of mass media exposure on precautionary behavior became nonsignificant while SNS involvement significantly predicted the precautionary behavior, SNS involvement completely mediated the effect of mass media exposure on precautionary behavior (see Table 4).

Hypothesis 6, that, compared with social risk perception, personal risk perception has a stronger effect on precautionary behavior, is supported. With precautionary behavior as the dependent variable, we entered the independent variables in two blocks: (1) demographics and (2) social risk perception and personal risk perception. A multiple regression analysis showed that the effect of social risk perception on precautionary behavior was not significant ($\beta = .05, p > .05$), while the effect of personal risk perception on precautionary behavior was significant ($\beta = .46, p < .01$). Therefore, it was confirmed that, compared with social risk perception, personal risk perception had a stronger effect on precautionary behaviors.

Hypothesis 7a, that personal risk perception mediates the effect of mass media exposure on precautionary behavior, is supported. A mediation analysis was conducted with bootstrap estimation. Mass media exposure was a significant predictor of both personal risk perception ($\beta = .26, p < .01$) and precautionary behavior ($\beta = .20, p < .01$). In the mediation model, precautionary behavior was predicted by personal risk perception ($\beta = .49, p < .01$), but not by mass media exposure ($\beta = .07, p > .05$). The indirect effect of mass media exposure on precautionary behavior mediated by personal risk experience was $.12, p < .01, 95\% \text{ CI } [.06, .19]$. Therefore, the mediation effect of personal risk perception was confirmed. Since the effect of mass media exposure on precautionary behavior became nonsignificant while personal risk perception significantly predicted the precautionary behavior, personal risk perception completely mediated the effect of mass media exposure on precautionary behavior (see Table 4).

Hypothesis 7b, that personal risk perception mediates the effect of SNS involvement on precautionary behavior, is supported. A mediation analysis was conducted with bootstrap estimation. SNS involvement was a significant predictor of both personal risk perception ($\beta = .31, p < .01$) and precautionary behavior ($\beta = .35, p < .01$). Precautionary behavior was predicted by personal risk perception ($\beta = .43, p < .01$) and SNS involvement ($\beta = .22, p < .01$). The indirect effect of media exposure on precautionary behavior mediated by personal risk experience was $.14, p < .01, 95\% \text{ CI } [.09, .20]$. Therefore, the partial mediation effect of personal risk perception was confirmed (see Table 4).

Table 4. Mediation Analysis of SNS Involvement and Perceived Risk on the Effect of Media Exposure and SNS Involvement on Precautionary Behavior (N = 345).

Predictors	Mediator	Precautionary behavior
Media exposure	.51**	.20**
<i>SNS involvement as mediator</i>		
Media exposure		.02
SNS involvement		.35**
Media exposure mediated by SNS involvement		.17**
Bootstrap 95% CI		.11, .24
Media exposure	.26**	.20**
<i>Perceived risk as mediator</i>		
Media exposure		.07
Perceived risk		.49**
Media exposure mediated by Perceived risk		.12**
Bootstrap 95% CI		.06, .19

SNS involvement	.31**	.35**
<i>Perceived risk as mediator</i>		
SNS involvement		.22*
Perceived risk		.43**
SNS involvement mediated by Perceived risk		.14**
Bootstrap 95% CI		.09, .20

* $p < .05$. ** $p < .01$.

Discussion

The positive effect of mass media exposure on risk perception, as found in previous studies, was confirmed in the case of the haze issue in China. Based on the previous literature, the study introduced SNS involvement, which reflects online interpersonal communication in the Internet context. SNS involvement was confirmed to play a significant role in predicting risk perception, just like interpersonal communication does in off-line settings. More importantly, the SNS involvement is confirmed to have a stronger effect on risk perception than mass media exposure. The result of testing H1 provides evidence that the interactive exchange of risk information is more effective than one-way exposure to risk information in the process of shaping people's risk perception. The findings highlight the active role of SNS involvement, a digital form of interpersonal communication, in the process of health and environment communication.

Direct experience of haze was found to be a significant predictor of risk perception. In addition, the findings of H2 suggest a mediation effect of mass media exposure and SNS involvement over the effect of direct experience on risk perception. Direct experience affects risk perception with the information activated through mass media exposure and SNS involvement. Direct experience of haze could be an accustomed routine, and people may get desensitized to haze due to daily occurrence. Mass media exposure and SNS involvement play an essential role in turning direct experience into risk perception, especially in the case of SNS involvement. The finding has several implications: First, it confirms the role of the media, whether traditional or emerging media, in shaping risk perception. Second, it reveals the role of interpersonal communication in the case of SNS involvement in forming risk perception. Third, it suggests that new media such as SNSs play a more active mediation role in shaping risk perception than the traditional mass media.

In this study, the hypothesis and the research question related to the impersonal impact hypothesis were not confirmed. The impersonal impact hypothesis suggests that mass media mainly affect people's social risk perception and have a minimal effect on personal risk judgments. The test result of H3 found that mass media exposure exerted an effect not only on a social level but also on a personal level. Similarly, the test result of RQ1 shows that SNS involvement was a significant predictor of both social and

personal risk perception. Interpersonal communication was considered to have an effect on personal risk perception, but with inconsistent findings. The results of this study support the notion that interpersonal communication has effects on both social risk perception and personal risk perception (Morton & Duck, 2001; Tyler & Cook, 1984), and provide contextual evidence on why that is the case.

This study's rejection of the impersonal impact hypothesis can be explained by the differential impact hypothesis, which notes that media exposure tends to affect personal-level judgments when respondents identify with problems as portrayed and see an application to themselves. When covering risk-related issues, media can arouse intense emotional responses through dramatic narratives and vivid images, and therefore make the given risk more salient and serious to audience, which could lead to a higher personal-level risk perception (Coleman, 1993; So et al., 2011). In the digital age, media are more flexible and effective in delivering messages on a specific topic through various channels. The subsequent interactions between media and audiences and the discussions among audiences make the issue even more salient, which could amplify the personal and social relevance of the messages and allow audiences to see more personal implications. Therefore, compared with the media contents presented through the traditional media, exposure to multimedia contents and engaging in interactive communication in the digital age are more likely to enhance individuals' personal risk perception.

The findings of RQ1 also provide evidence that clarifies the inconsistency in the effect of interpersonal communication on perceived personal risk. The type of risk involved and the context of communication could be major factors that determine whether interpersonal communication affects personal risk perception as well as social risk perception. While various channels through social media for interpersonal communication may facilitate the discussion of the personal pertinence of haze, social network platforms could also be a forum to discuss public concerns about the risk. The type of risk with both personal relevance and public implication and a communication context that accommodates both interpersonal communication and the discussion of public issues would result in social media communication that affects perceived personal risk as well as social risk.

The study examined the differential impact hypothesis with vulnerability as a moderator. The result of testing H4a shows that vulnerability moderates the effect of mass media exposure on personal risk perception, which is consistent with the notion that high vulnerability can make the effect of mass media exposure on people's personal risk perception more salient (Tyler & Cook, 1984). Vulnerability is measured with both internal and external indicators. The internal indicator, health status, is a personal attribute. In the context of social media communication, where the information exchange is interactive instead of one-way, the knowledge and responses obtained from the interactive communication can change the understanding of the issue and eventually reshape risk perception. SNS involvement itself plays a major role in the process and could dwarf the effect of relatively sensitive self-judged health status and diminish the moderating role of vulnerability. Thus, the test of H4b reveals that vulnerability does not moderate the effect of SNS involvement on risk perception. In addition, because the moderation effect of vulnerability with mass media exposure is weak, further verification in the same or other contexts is required.

As expected, all four hypotheses about the influencing factors of precautionary behavior were supported. The findings show an interaction among media exposure, SNS involvement, and risk perception in the process of influencing precautionary behavior. Both mass media exposure and SNS involvement affect precautionary behavior. However, as shown in the result of testing H5, mass media exposure loses its influence on precautionary behavior when SNS involvement, which entails interpersonal information exchange and discussion of the issues, is considered in the process. The findings suggest a more active role of SNS involvement than of the traditional media in producing behavior change when people are exposed to media content.

The findings of H6 and H7 also provide new insight into the effect of risk perception in the process of generating precautionary behavior. Personal risk perception has a stronger effect on precautionary behavior than social risk perception. Personal risk perception as a mediator of the effects of mass media and SNS involvement on precautionary behavior demonstrates its critical role in the process. While mass media exposure and SNS involvement both influence precautionary behavior, the role of personal risk perception in mediating this effect is not trivial. In the case of mass media exposure, personal risk perception completely mediates its effect on precautionary behavior. The interactive influence also implies that while informational factors are important in generating behavior change, perceptual factors are often not negligible in the process and could alter such change.

Despite all the enlightening findings, this study has some limitations. First, the study was conducted with a convenience sample. Although the study offers illustrative findings, the results cannot be generalized to the population. It is necessary to retest the hypotheses with a probability sample to validate the findings. Second, although the frequency of media access is measured, the study did not ask the respondents what media contents they were actually exposed to, and the measure of mass media exposure did not take into account the active use of media. The measure of SNS involvement also lacks specific aspects of risk information exchange. Future studies should explore the effect of specific media contents on risk perception, because the risk assessment is based on how media cover the haze issue and what information regarding the issue is actually processed. Other social and psychological factors that could have played a role in the process—such as one's attitude toward the haze issue, knowledge about haze, and locus of control—could also be taken into consideration when examining the process of media exposure and risk perception. In addition, the model of media use, risk perception, and precautionary behaviors could be tested with structural equation modeling to validate the model as a comprehensive presentation of the process.

Conclusion

The study examined the effects of media exposure and SNS involvement on risk perception and the factors that influence precautionary behaviors regarding the haze issue in China. The major contributions of this study are as follows. First, it determined that SNS involvement is a more important predictor of risk perception than mass media exposure. The findings offer empirical evidence of the effect of SNS involvement on risk perception in an online environment and how the effect of SNS involvement compares with that of media exposure. Second, the study confirmed that the effect of direct experience of haze on a person's risk perception is mediated through mass media exposure and SNS involvement, which

activate direct experience and help establish the link between direct experience and risk perception. Third, the study did not find evidence supporting the impersonal impact hypothesis. The more flexible and interactive media environment and the extensive interpersonal information exchange that involves issues of not only personal relevance but also public concerns are considered the key reasons that informational activities would affect both personal and social risk perception. Finally, through testing personal risk perception as a mediator of the effect of mass media and SNS involvement on precautionary behavior, this study illustrated an interplay of predictors of precautionary behaviors and showed the dynamic role of personal risk perception during the process.

The impersonal impact hypothesis did not exhibit consistent effects. Morton and Duck (2001) stated that the impersonal impact hypothesis is intuitively appealing, while it is too simplistic. Multichannel communication in the new media environment and interactive communication lead people to engage in various social and personal activities, and multimedia contents of mass media no longer just inform audiences of risks, as the traditional media did in the 1980s, when the hypothesis was proposed. There is much to be explored regarding the theoretical groundings in the multichannel and interactive contexts. The findings of this study shed some light in this respect and could be used as the basis to further validate the impersonal impact hypothesis as well as the differential impact hypothesis in the new media environment.

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