



Effective strategies for responding to rumors about risks: The case of radiation-contaminated food in South Korea

Hye-Jin Paek, Thomas Hove*

Department of Advertising and Public Relations, College of Communication & Social Science, Hanyang University, 55 Hanyangdaehak-ro, Ansan-si, Gyeonggi-do 15588, South Korea

ARTICLE INFO

Keywords:

Government public relations
Risk/crisis communication
Rumor type
Rumor response strategy
Situational crisis communication theory

ABSTRACT

This experimental study explores how governments should respond to rumors about national-level risk issues. Informed by research in rumor psychology and risk/crisis communication, it investigates whether type of rumor and rumor response strategy have main and interaction effects on reducing rumor beliefs and intention to disseminate rumor. The two featured rumor types are the bogie rumor, which highlights feared outcomes, and the wedge rumor, which aims to reinforce differences between rival groups. Derived from Situational Crisis Communication Theory, the three response strategies examined are refuting the rumor, denying it, and attacking its source. Data were drawn from part of a large-scale online experiment, and the sample of the analysis was 942 South Korean adults. The experiment had a between-subjects design of 2 rumor type (wedge vs. bogie) x 3 government response strategies (refutation, denial, attack the attacker). Results show that all three rumor response strategies significantly reduced rumor beliefs, but only the refutation strategy significantly reduced intention to disseminate the rumor. Rumor type (bogie) and response strategies (refutation) had main, but not interaction, effects on reduction of intention to disseminate the rumor.

1. Introduction

Contemporary risk situations have an inherent uncertainty (Paek & Hove, 2017). In response to this uncertainty, people often produce and spread rumors (DiFonzo & Bordia, 2000, 2007). Rumors can be defined as messages that convey information which could be important or relevant but has not yet been verified (Allport & Postman, 1946). During government efforts to protect the public from risks, the spread of unreliable information can create serious problems. Now that so many people get their information from social media, risk experts and government officials worry that the increased dissemination of rumors could worsen public trust in government risk management efforts.

Although most rumors that spread during outbreaks of national-level risks are inaccurate, people tend to believe them. To prevent the public panic that sometimes results, governments try to publicly refute or deny the rumors, or even threaten legal punishments for people who create and spread them. Several government rumor response strategies have been proposed by institutions such as the World Health Organization and the U.S. Centers for Disease Control. However, we still do not know which of these strategies are most effective and why. In the related field of crisis communication, studies tend to focus on how, when crises occur, organizations that are perceived to be responsible for risks might protect their reputations (Coombs & Holladay, 2004; Coombs, 2000). But in research on situations of national-level risks, few studies have investigated which rumor response strategies are effective and what makes them

* Corresponding author.

E-mail addresses: hjpaek@hanyang.ac.kr (H.-J. Paek), tbhove@hanyang.ac.kr (T. Hove).

<https://doi.org/10.1016/j.pubrev.2019.02.006>

Received 10 September 2018; Received in revised form 12 December 2018; Accepted 24 February 2019

Available online 15 May 2019

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effective.

The current study's purpose is to examine how, during a national-level risk situation, governments can most effectively respond to risk-related rumors. Informed by research in rumor psychology and crisis communication (Coombs, 2000; DiFonzo & Bordia, 2000, 2007), it explores three questions. First, what effects do different types of risk rumors have on people's beliefs in the rumor and their intention to disseminate the rumor? Second, what kinds of rumor response strategies significantly lower rumor beliefs and intentions to disseminate rumors? Drawn from Situational Crisis Communication Theory, the three response strategies examined are refuting the rumor, denying it, and attacking its source. Third, are there possible interaction effects between types of rumor and types of rumor response strategies? We address these research questions in the context of rumors related to food safety risks, specifically radiation-contaminated foods from the seas near Fukushima, Japan. This risk issue takes center stage in this study because, in South Korea for the past seven years, it has received ongoing attention in the public, media, and government agendas.

2. Literature review

2.1. The Fukushima nuclear disaster, radiation exposure, and perceived food risks in South Korea

On 11 March 2011, a powerful earthquake and tsunami hit the northeast Tohoku region of Japan, where Fukushima Prefecture is located. Among the disaster's serious consequences was damage to the Fukushima Daiichi Nuclear Power Plant. Dangerous radioactive material was released into the environment, and thousands of people were evacuated. After the air, land, and seas near Fukushima were found to be contaminated, the neighboring country of South Korea banned imports of agricultural and seafood products originating from the area. For months and years afterward, several rumors about these radiation hazards spread among the South Korean public. Many rumors were about whether Japan was exporting contaminated seafood, and whether the Japanese and South Korean governments were colluding to cover up foisting that food onto unwitting South Korean consumers (Kim & Kim, 2017). In the months immediately after the nuclear accident, sales of Japanese fishery products in South Korea plummeted (Jeong, 2011). One year later in 2012, fish caught from the seas near Fukushima were found to contain dangerously high levels of radioactive cesium (Fish with, 2013). In 2013, the South Korean government widened its ban and issued stricter safety standards on seafood imports from Fukushima and surrounding areas. As recently as April 2018, the legality of these stricter regulations remained under dispute at the World Trade Organization by the Japanese and South Korean governments (Koreans still, 2018; S. Korea files, 2018).

South Koreans continue to hold strong beliefs about the health risks of radiation contained in Japanese seafood and other products. A 2017 survey conducted by the South Korean Consumers Union reports the following: 46 percent of South Korean consumers support a complete ban of all food imports from Japan; over 50 percent avoid buying Japanese seafood and dairy products; safety concerns are the reason why many have reduced or curtailed their consumption; and substantial numbers of people are concerned that radiation exposure may cause cancer, birth deformities, and hereditary disease. However, in light of current scientific findings, most of these fears are unfounded or at least exaggerated (Koreans still, 2018).

2.2. Risk communication and rumors

People's responses to risks are often determined not by the actual hazards they face but by their subjective judgments about risks — that is, their risk perceptions (Slovic, 2000). Compared to experts, lay people are understandably under-informed and uncertain about many risk issues. Risk communication therefore plays a key role in efforts to give people necessary information, cultivate accurate risk perceptions, reduce public uncertainty, and help people make the right decisions for dealing with risks (Walaski, 2011). However, during risk outbreaks one thing that often interferes with these efforts is the spread of rumors. A rumor can be defined as “a proposition for belief of topical reference disseminated without official verification,” and it tends to have three characteristics: first, it is often transmitted, and thereby distorted, through word-of-mouth; second, it provides information regarding particular persons, events, or conditions; third, it serves certain communities' emotional needs (Knapp, 1944, pp. 22–23). Rumors have been classified into several types depending on factors such as content characteristics, discursive quality, valence, time period of occurrence, cause of occurrence, motive of occurrence, and breadth of dissemination (Kim, 1997; Peterson & Gist, 1951).

Among content-based classifications of rumors, the most widely used is Knapp's (DiFonzo & Bordia, 2007), which includes the following. The *pipe-dream* or *wish* rumor consists of wishful thinking expressing the desires and hopes of the intended audience. The *bogie* rumor refers to outcomes that the intended audience would fear. The *wedge*, *wedge-driving*, or *aggression* rumor reinforces differences between the intended audience and rival groups. According to a content analysis of 10 years of 1297 news stories about risk-related rumors in South Korea, the bogie rumor was most prevalent (74.7%), followed by wedge (20.0%) and pipe-dream (5.3%); most rumors presented were negative (94.5%) and accidental (83.4%) (Yang & Paek, 2018).

In risk and crisis situations, rumors can have serious consequences. For certain ongoing public health issues such as vaccination and contraceptive use, rumors may influence people to disregard experts' health and safety recommendations (DiFonzo & Bordia, 2007). During several major disasters and infectious disease outbreaks, rumors have misled people into panicking and taking unnecessary or counterproductive actions such as stocking up on foods and staying home from work (DiFonzo & Bordia, 2007). As a result of misleading rumors spread online during the 2015 Middle East Respiratory Syndrome coronavirus (MERS-CoV) outbreak in South Korea, people were persuaded to avoid health clinics where MERS-infected patients were falsely reported to have been admitted (Lee, 2015). At that time there were also steep sales increases for vitamins and foods that were marketed as, but not proven to be, effective in treating MERS (Choi, 2015).

After the Fukushima Daiichi nuclear power plant disaster, misleading rumors spread in the wake of news reports about

contamination of neighboring seawater by radioactive material. As of 2018, a Google search of the Korean terms for “Japan + radiation + rumor” yielded about 39,000 results, and “Fukushima + fishery + rumor” in Korean yielded about 10,000 results. In the aftermath of the disaster, the South Korea Ministry of Oceans and Fisheries was compelled to respond to multiple rumors related to Japanese food radiation matters (Japan’s radioactivity, 2013). The rumors claimed that Japan was exporting radiation-contaminated seafood to South Korea, and that the South Korean government and importers were accepting it, selling it to unwitting Korean citizens, and covering up their conspiracy. In this case, the types of unverified claims that were spread illustrate the tendency for risk-related rumors to be negative, inaccurate, conspiracy-laden, and likely to frighten people. In 2013, two years after the Fukushima disaster, persistent rumors about contaminated food imports were so widespread and inaccurate that the South Korean Prime Minister publicly threatened legal punishments for people caught spreading them (Kim & Kim, 2017).

Most academic studies of risk-related rumors have focused on those that arise during corporate public relations crises. When they jeopardize an organization’s reputation, rumors themselves are considered to be a type of crisis (An, Gower, & Cho, 2011; Coombs, 2006; DiFonzo & Bordia, 2000). Several studies of crisis-related rumors in South Korea have focused on how rumor types or rumor characteristics relate to the following variables: rumor-related beliefs about risks, intention to disseminate risk rumors, risk-related purchasing behaviors, and perceptions of the reputations of organizations deemed responsible for causing risks (e.g., Kim, Yoo, & Kahn, 2015; Lee & Kim, 2016; Zhang & Cho, 2017). Among the examined factors that affected rumor beliefs and dissemination intention are channel characteristics (e.g., trust in Internet information: Kim & Kim, 2017; Ryu & Kim, 2016), audience characteristics (involvement, efficacy, emotional reaction: Ahn & Lee, 2011), and information processing (Kwon & Cho, 2017).

Although few studies have focused on rumors about national-level risk issues, several of the rumor characteristic variables from corporate crisis research are appropriate to this context. For example, one corporate crisis study found that the conspiracy-type rumor — a rumor that a particular company or organization is plotting for its own self-interest or hiding important facts — had a higher level of rumor beliefs than did the contaminating-type rumor — a rumor that contains claims about a product’s contamination, deformation, or damage that may affect perceptions of the product’s value (Zhang & Cho, 2017). Of interest in national-level risk contexts are the extent to which people believe in rumors and intend to disseminate them. These variables — rumor beliefs and intention to disseminate rumor — have been important outcome variables in rumor research because they could lead to serious behavioral consequences. For these reasons, and informed by a content analysis showing that bogie and wedge rumors appear most frequently during risk outbreaks (Yang & Paek, 2018), the current study investigates possible differential effects of rumor type on rumor beliefs and intention to disseminate rumor. Due to a lack of empirical evidence justifying statement of a hypothesis, we propose the following research question.

RQ1. Which type of rumor (bogie vs. wedge) has a higher level of (1) rumor beliefs and (2) intention to disseminate rumor?

2.3. Rumor response strategy

When rumors spread during disasters and other public risk situations, governments may use different strategies to respond, such as refuting the rumor with facts and evidence, flatly denying it without evidence, and attacking or threatening the rumor’s source. These types of responses have been documented in studies on information processing (Tybout, Calder, & Sternthal, 1981) and crisis communication (Coombs & Holladay, 2004; Coombs, 2004).

In crisis communication, an influential framework for examining rumor effects and response strategies is Situational Crisis Communication Theory (SCCT). Its foundations are attribution theory from psychology (Weiner, 1985) and image repair theory from public relations (Benoit, 2013). According to SCCT, when organizations are linked to crises, people try to identify the actors who should be held responsible, and they make attributions about these actors’ intentions and actions. Depending on the types of attributions people make, organizational reputation and credibility will be affected in positive or negative ways.

In SCCT, based on the level of responsibility for a crisis that people attribute to an organization, crisis type can be clustered into three categories: (1) victim (low attribution of responsibility); (2) accidental (modest attribution); and (3) preventable (strong attribution) (Coombs & Holladay, 2004). The victim cluster includes rumor, natural disaster, terror, and workplace violence. The accidental cluster includes technical error, accident/recall, and mega damage. The preventable cluster includes human breakdown accident, product recall, and organizational misdeeds with and without injuries (An et al., 2011).

For organizations to protect their reputations in the aftermath of a crisis, they need to match the type of crisis with the proper strategy for responding to it (Coombs & Holladay, 2004; Coombs, 2004). Crisis response strategies can be classified according to how much responsibility an organization accepts, ranging from no acceptance — in which case organizations attack their attackers — to very high acceptance — in which case they issue full apologies for having caused the crisis (Coombs, 2006). One study found that, during a 2009 oil spill accident in South Korea, people attributed responsibility to the Samsung company when it did not provide sufficiently detailed information about the accident, and that higher attributions of the company’s responsibility were associated with higher levels of punitive attitudes and behavior toward the company (Jeong, 2009).

For the context of risk-related rumors, DiFonzo and Bordia (2007) compiled a range of response strategies, including refutation, denial, and attacking the attacker (in the current study’s context, “attacker” means any source who produces or spreads the rumor). They argue that a common aim across the various strategies is to reduce uncertainty and rumor beliefs by providing prompt and appropriate corrective information. DiFonzo and Bordia also surveyed 74 public relations professionals to examine types of organizational rumors, the effects of these rumor types, and effective rumor management strategies. Three variables they discovered that led to rumor activity were uncertainty, anxiety, and beliefs (DiFonzo & Bordia, 2000).

Studies have yielded different findings about which rumor response strategy is most likely to be effective. According to DiFonzo and Bordia (2007), refutation is most effective because it reduces uncertainty by providing information indicating why the rumor

should not be believed. By contrast, [Coombs \(2000\)](#) found that different strategies are effective in different circumstances: when the attacker is identified, refutation and attacking the attacker are more effective; when the attacker is not identified or when attributed corporate responsibility is low, either explanation or denial is more effective. In relation to the desired outcomes of product purchase intention, CEO credibility, and corporate credibility, one study found that more aggressive strategies — e.g., refutations and attacks via legal actions, evidentiary materials, or formal press conferences — are more effective than passive denial strategies ([Jang & Cho, 2013](#)).

National-level risks differ from corporate crises in two ways: they are more likely to affect the entire citizenry rather than selected stakeholders, and they may not always be attributed to errors made by the relevant organization — in this case, the government. Notwithstanding these differences, a variety of previous studies have converged on the same three crisis or rumor response strategies of refutation (with evidence), denial (passive form, without evidence), and attacking the attacker. In this study, we propose the following research question to explore whether types of rumor response strategies have different consequences.

RQ2. Which rumor response strategy — refutation, denial, attacking the attacker — leads to greater reduction in rumor beliefs and intention to disseminate rumor?

Situational Crisis Communication Theory (SCCT) explains that a crisis response strategy is most likely to be effective when it matches the type of crisis. A meta-analysis of 35 investigations from 24 studies found that people's attribution of an organization's responsibility was strongly and negatively associated with its reputation: for accidental crises, the association between a matching response strategy and reputation was moderate, while for preventable crises it was weak ([Ma & Zhan, 2016](#)). Despite the overlap between the current study's variable of rumor type and that of crisis cluster in SCCT, little research has demonstrated the relation and matching effect between rumor type (bogie and wedge) and rumor response strategies (refutation, denial, attacking the attacker). To explore this relation, we raise the following research question about interaction effects.

RQ3. Do type of rumor and type of government rumor response strategy have interaction effects on reduction in rumor beliefs and intention to disseminate rumor?

3. Methods

3.1. Research design

Based on results of a content analysis of 10 years of media coverage on risk-related rumors, the most prevalent types of rumors were bogie and wedge, and the most prevalent government responses were refutation, denial, and attacking the attacker ([Yang & Paek, 2018](#)). Informed by those findings, and focusing on rumors and government responses regarding the risk of food contaminated by radiation from the Fukushima nuclear disaster, the current study used a between-subjects experimental design of 2 rumor type (bogie vs. wedge) x 3 government response strategies (refutation, denial, attacking the attacker).

3.2. Data collection

A major research firm in South Korea was hired to recruit the study participants. This company secured a panel of about 1.3 million people that reflects nationally representative demographics including gender, region, and age (one exception was that it underrepresented people over 50). Each person was given a unique ID and the choice to volunteer to participate in a study in exchange for points that could count toward online purchases from designated companies.

The current study is part of larger risk communication project involving six conditions that were randomized to be sent to the study participants. Only adults were qualified to participate. Once they logged in to the company's online survey website, they were asked to answer five questions on trust in government. On the next page, they were asked to read one randomly assigned rumor message. After they answered questions for manipulation check and on rumor beliefs and dissemination intentions, they were randomly assigned to one of the three rumor response messages. Last, they were asked about demographic information such as gender, education, income, and residence.

Each of the six conditions had a relatively similar sample size, totaling 942 participants: $N = 154$ for the wedge + attack condition; $N = 156$ for bogie + refutation and bogie + denial conditions; $N = 158$ for the wedge + refutation condition; $N = 159$ for the bogie + attack and wedge + denial conditions. Mean age was 39.68 ($SD = 10.82$). Males and females were evenly distributed (50.0%). For median monthly household income, 18.2% fell into the range of 4–5 million won (equivalent to approximately \$3700–4600); 16.9%, 3–4 million won; and 15.5%, 2–3 million won. More than half of the respondents had a 4-year college degree (52.2%), followed by 2–3 year technical college degree (17.7%) and high school degree (13.5%).

3.3. Message stimuli

To ensure ecological validity, the two rumor messages were chosen from actual online news articles but slightly modified to be equivalent across manipulation conditions and topics. The bogie rumor message was, "Radiation has been detected in recently imported Russian seafood products. Russian fishermen have made deals with Japan to catch and import seafood from the waters near Fukushima. As a result, people who eat Russian seafood may be exposed to radiation." The wedge rumor message included the same sentences, but with the following sentence appended to frame the South Korean government as a rival interest group: "Even though the South Korean government knows about this development, it has imported Russian seafood without subjecting it to special inspection." Respondents were randomly assigned to one of the two conditions and were introduced to the rumor message stimulus

with this prompt: “The following information related to radiation in imported Russian seafood products was made available online. Please read it and answer the questions that follow.”

After answering questions related to manipulation check, rumor beliefs, and message dissemination intentions, respondents were randomly assigned to one of the three rumor response messages introduced with the sentence, “The South Korean Ministry of Ocean and Fisheries will respond to the information you just read about as follows.” These were the different response messages:

- *Refutation response*: “The information spread online about Russian seafood products is a groundless rumor. Although Russian fishermen have made deals to operate in other countries’ waters, they have not made deals for permission to fish in Japan’s waters.”
- *Denial response*: “The information spread online about Russian seafood products is a groundless rumor. Radiation has not been detected in imported Russian seafood products, and Russian fishing boats have not been operating in waters off the coast of Fukushima, Japan.”
- *Attack (attacking the attacker) response*: “The information spread online about Russian seafood products is a groundless rumor. Due to the public distress this rumor has caused, the Ministry of Ocean and Fisheries is recommending legal actions against those who have been spreading it.”

After reading the government’s rumor response message, participants answered questions related to rumor awareness (whether they have heard about the rumor), manipulation check, rumor beliefs, and intention to disseminate the rumor.

3.4. Measures

The independent variables — *rumor type* and *government response strategy* — were manipulated. Dependent variables included *rumor beliefs* and *intention to disseminate rumor*.

Rumor beliefs was measured by averaging the following two question items (7-point Likert scale, 1 = not at all to 7 = very much) drawn from existing literature (Lee & Kim, 2016): “This information is believable”; “This information is trustworthy” (inter-item correlation = .87; $M = 4.55$, $SD = 1.05$).

Intention to disseminate rumor was measured by averaging the following two question items (7-point Likert scale, 1 = not at all to 7 = very much) drawn from previous studies (Blodgett, Hill, & Tax, 1997; Kwon & Cho, 2017): “I will talk with others about this information”; “I will share this information with others” (inter-item correlation = .87; $M = 4.88$, $SD = 1.12$). After the government response messages were provided, *rumor beliefs* and *intention to disseminate rumor* were measured once more with the same question items: for *post-rumor beliefs* measure, inter-item correlation = .89, $M = 4.07$, $SD = 1.13$; for *post-intention to disseminate rumor* measure, inter-item correlation = .90, $M = 4.75$, $SD = 1.30$.

4. Results

4.1. Manipulation check

The manipulation check question for the rumor type was asked using a 7-point semantic differential scale, from (1) “The information you just read contains content that creates fear and anxiety” to (7) “The information you just read contains content that attacks and finds fault with the government.” The same two questions were also asked using a 7-point Likert scale (1 = not at all, 7 = very much). Independent samples t-tests showed that respondents who read the bogie rumor tended to think that the message contains content that creates fear and anxiety ($M = 3.23$, $SD = 1.38$), while those who read the wedge rumor thought that it contains content that attacks and finds fault with the government ($M = 4.01$, $SD = 1.70$; $t(940) = -7.73$, $p < .001$). Statistically significant difference was also found between the bogie and wedge rumor conditions for the question, “The information you just read contains content that attacks and finds fault with the government” ($M = 4.01$ vs. 5.07 , $SD = 1.31$ vs. 1.30 ; $t(940) = -12.41$, $p < .001$). By contrast, no statistically significant difference was found between the bogie and wedge rumor conditions for the question, “The information you just read contains content that creates fear and anxiety” ($M = 5.22$ vs. 5.29 , $SD = 1.05$ vs. 1.16 ; $t(940) = .97$, $p = ns$).

There were two manipulation check questions for the government response strategy. The first asked participants to choose the best description of the government response message they read: “Did the message...” (1) “refute the rumor by giving concrete evidence?”; (2) “deny the rumor without providing any evidence?”; (3) “attack the rumor producer by mentioning a penalty for spreading rumors about radioactivity?”; or (4) “None of the above.” Chi-square tests showed that, in each message condition, the greatest number of respondents chose the matching message description: 69.7% of those in the refutation condition chose answer (1); 43.7% in the denial condition chose answer (2); and 71.4% in the attack condition chose answer (3). The difference was statistically significant, chi-square (6) = 234.24, $p < .001$.

The second question used the same three descriptions as the first, with a 7-point Likert scale, from 1 = not at all to 7 = very much. One-way ANOVA tests show that the refutation response had the highest mean for the refutation response choice (1) ($M = 4.40$, $SD = 1.59$, $F(2, 939) = 91.34$, $p < .001$); the denial response had the highest mean for the denial choice (2) ($M = 5.07$, $SD = 1.45$, $F(2, 939) = 56.99$, $p < .001$); and the attack response had the highest mean for the attack choice (3) ($M = 4.81$, $SD = 1.27$, $F(2, 939) = 180.30$, $p < .001$). These results suggest that the manipulations for the rumor and response messages were successful.

4.2. Research question results

Research Question 1 asked which type of rumor would have a higher level of rumor beliefs and intention to disseminate rumor. As shown in Table 1, independent samples *t*-tests indicated that, while rumor beliefs and intention to disseminate rumor were greater in the wedge rumor condition than in the bogie condition, the difference did not reach statistical significance of $p < .05$.

Research Question 2 asked which rumor response strategies —refutation, denial, attack— would result in greater reduction of rumor beliefs and intention to disseminate rumor. To answer this question, a total of six sets of paired sample *t*-tests were performed for two dependent variables and for three rumor response strategies respectively. The two dependent variables were constructed by abstracting pre-measures of rumor beliefs and intention to disseminate rumor from the corresponding post-measures. As shown in Table 2, results indicate that all three rumor responses significantly reduced rumor beliefs (for refutation, denial, and attack response strategies, mean diff .52, .45, .47, $t = 8.41, 7.74, 7.97$, all $p < .001$). However, only the refutation strategy condition significantly reduced intention to disseminate rumor (Table 3: mean diff = .21, $t = 4.24$, $p < .001$).

Research Question 3 was about interaction effects of type of rumor and type of response strategy on reduction of rumor beliefs and intention to disseminate rumor. To explore this question, we performed two sets of two-way ANCOVA with two factors (type of rumor, type of response strategy) and two dependent variables (reduction of rumor beliefs and intention to disseminate rumor). Rumor awareness (or prior knowledge about the rumor) was included in the model as a covariate because previous research has found that it has effects on rumor beliefs and dissemination intention (Kwon & Cho, 2017).

As shown in Table 4, although no interaction effects of rumor type and rumor response strategy were found, there were some noteworthy main effects. Specifically, both rumor type ($F(1, 935) = 7.70$, $p = .006$, partial eta-squared = .008) and government response strategy ($F(2, 935) = 4.775$, $p = .009$, partial eta-squared = .010) had main effects on pre-post difference of intention to disseminate rumor. Pairwise comparison tests show that intention to disseminate rumor was significantly more reduced in the bogie condition than in the wedge condition (mean diff = .143, $p = .006$). In addition, intention to disseminate rumor was significantly more reduced in the refutation than in either the denial condition (mean diff = .144, $p = .022$) or the attack condition (mean diff = .185, $p = .003$). However, neither main nor interaction effects were found on pre-post difference in rumor beliefs.

Table 1
Rumor beliefs and intention to disseminate rumor by rumor type.

	Rumor type	N	M	SD	<i>t</i>	<i>p</i>
Rumor beliefs	Bogie	471	4.50	1.01	−1.47	.143
	Wedge	471	4.60	1.08		
Intention to disseminate rumor	Bogie	471	4.81	1.25	−.93	.350
	Wedge	471	4.89	1.23		

Table 2
Differences of pre-post rumor beliefs and intention to disseminate rumor per response strategies.

	Variables	M	SD	<i>t</i>	<i>p</i>
Refutation	Pre- Rumor Beliefs	4.57	.99	8.41	< .001
	Post- Rumor Beliefs	4.04	1.16		
	Pre- Intention to Disseminate Rumor	4.93	1.24		
	Post- Intention to Disseminate Rumor	4.72	1.34		
Denial	Pre- Rumor Beliefs	4.48	1.06	7.74	< .001
	Post- Rumor Beliefs	4.02	1.10		
	Pre- Intention to Disseminate Rumor	4.79	1.24		
	Post- Intention to Disseminate Rumor	4.73	1.27		
Attack	Pre- Rumor Beliefs	4.61	1.08	7.97	< .001
	Post- Rumor Beliefs	4.14	1.13		
	Pre- Intention to Disseminate Rumor	4.84	1.23		
	Post- Intention to Disseminate Rumor	4.81	1.29		

Table 3
Reduction in rumor beliefs and intention to disseminate rumor by response strategies.

	Refutation (N = 314)	Denial (N = 315)	Attack (N = 313)
	M (SD)	M (SD)	M (SD)
Pre-Post Rumor Beliefs	.52 (1.10)	.45 (1.04)	.47 (1.05)
Pre-Post Intention to Disseminate Rumor	.21 (.88) ^a	.06 (.70)	.03 (.79) ^b

Note. a > b, $p < .05$.

Table 4
ANCOVA results.

Factor	Pre-Post Rumor Beliefs				Pre-Post Intention to Disseminate Rumor			
	M ^a	SE ^b	F	partial-eta squared	M ^a	SE ^b	F	partial-eta squared
Rumor Type			.08	.000			7.70**	.008
Bogie	.49	.05			.17	.04		
Wedge	.47	.05			.03	.04		
Response Strategy			.38	.000			4.78**	.010
Refutation	.52	.06			.21	.05		
Denial	.45	.06			.07	.04		
Attack	.48	.06			.02	.05		
Rumor Type × Response Strategy			1.10	.002			.40	.001
Rumor awareness (Covariate)			.55	.001			7.46**	.008

Note: degrees of freedom = 1, 935, except for Rumor Type × Response Strategy where df = 2,935.

^a M: Marginal mean (after controlling for rumor awareness as a covariate).

^b SE: Standard error.

** $p < .01$.

5. Discussion

During national-level risk outbreaks, the spread of rumors may lead to public panic and other adverse outcomes. Previous studies have examined people's reactions to rumors and to rumor response strategies, but mainly in the field of public relations and specifically the context of corporate crises. Thus far, few studies have focused on rumors about risk issues affecting public health, and even fewer have examined how governments and risk communication professionals might effectively respond to them. The purpose of the current study was to identify which type of rumor people tend to believe more and intend to disseminate more, and which type of government response strategies might effectively reduce these reactions. We explored three research questions in the context of rumors about radiation-contaminated seafood products originating from the seas near the site of Japan's Fukushima nuclear disaster.

First, our results show no difference between the bogie and wedge rumor in terms of rumor beliefs and intention to disseminate rumor. However, when it comes to reduction in rumor beliefs and intention to disseminate rumor after the government response was provided, the bogie rumor had a lower intention to disseminate than the wedge rumor. This finding indicates that the spread of wedge rumors, which in this type of case are more likely to reinforce feelings of difference between the intended audience and the government, may be more difficult to restrain regardless of government response efforts. Furthermore, results for our manipulation check show that there was no difference between the two rumor types in terms of the manipulation check question, "The information you just read contains content that creates fear and anxiety." This result suggests that, even though bogie rumors specifically highlight outcomes that the intended audience is likely to fear (DiFonzo & Bordia, 2007; Knapp, 1944), any type of rumor related to a risk conveys uncertainty and unease. Accordingly, risk communicators should pay special attention to wedge rumors because their content — criticisms about government actions and conspiracies — may be more likely to generate emotional reactions such as panic and distrust of the government.

Second, our findings show that each government rumor response strategy, regardless of type (refutation, denial, attack), seemed to reduce people's rumor-related beliefs. This outcome suggests that *any* government effort to respond to rumors about national-level risks could achieve some desired effects. However, controlling people's beliefs about the rumor may be only a relatively minor goal. A more important goal may be preventing people from further disseminating the rumor's unsubstantiated or false information.

The only response strategy which seemed effective in reducing people's intention to disseminate rumor was refutation, which is consistent with previous studies' theoretical reasoning and empirical evidence. According to DiFonzo and Bordia (2007), refutation is most effective because it reduces people's uncertainty by providing information that indicates why a rumor should not be believed. In the context of corporate crisis situations, Jang and Cho (2013) also found that the most effective strategies are not passive ones such as denial but rather more aggressive ones such as attacks and refutations via legal actions, evidentiary materials, or formal press conferences. In the current study's context of risk issues affecting public health, the government's perceived ability to handle a risk is critical, particularly when rumor sources may not be easily identified. However, if the government attacks rumor sources by threatening punishments, this strategy might have adverse consequences on people's trust in government and their perceptions of its ability to deal with the risk. For these reasons, the best rumor response strategy to use in the case of rumors about a public health issue such as food safety seems to be refutation.

With further respect to the issue of trust in government, risk management and communication literature has highlighted the importance of public trust in the institutions responsible for dealing with risks, for example government, industry, and civic interest groups (Peters, Covello, & McCallum, 1997; Poortinga & Pidgeon, 2003). If people do not trust these institutions, they will not attend to, much less comply with, their recommendations. While the role of trust in government in risk rumor contexts has not yet been explored and was not a primary focus of the current study, our instrument included it, and we performed a post-hoc analysis, i.e., ANCOVA with the variable as a covariate. Results show that trust in government did not affect our findings on the main and interaction effects of rumor type and rumor response strategies. However, the trust variable itself had some marginal effects on reduction in rumor beliefs ($F(1,934) = 3.05, p = .08$), as well as on intention to disseminate the rumor ($F(1,934) = 3.46, p = .08$). This finding suggests that trust in government may be an important element in the rumor management process. Future research about

risk rumor management should therefore more closely examine its potential mediating and moderating roles.

As for interaction effects of rumor type and response strategy on reducing rumor beliefs and intention to disseminate rumor, none were found. In the context of developing effective crisis response messages, Coombs (2000) has recommended deploying different strategies under different circumstances: when the attacker is identified, refutation and attacking the attacker are more effective; when the attacker is not identified or when attributed corporate responsibility is low, explanation or denial are more effective. Our findings, though, do not support such conditional effects. This result may point to key differences between rumors about risk issues that affect public health and rumors about crisis issues that affect organizations' reputations. If more studies identify and confirm such differences, risk communicators will be better informed about appropriate ways to respond to rumors during national-level risks.

6. Limitations, future research, and implications

While this study is among the first to explore effective strategies for responding to risk-related rumors affecting public health, we focused on only one risk issue, radiation-contaminated food. Future research should study rumor response strategies in the context of other risks — e.g., natural disasters, infectious diseases, terrorism — to see whether our findings are replicable across types of risk. Another limitation is that this study mainly explored the role of rumor type and response strategies on rumor beliefs and intention to disseminate rumor. Future research should further investigate both main and interaction effects of rumor type and response strategies on other outcomes such as uncertainty reduction, emotional reactions, or behavioral responses. Also, in addition to rumor type and response strategy type, various other factors in this process should be taken into consideration, such as characteristics of rumor, rumor source, and audience. Last, another research question worth exploring would be whether the effects of rumor response strategies on reduction of rumor beliefs and intention to disseminate rumor are best explained by cognitive or emotional mechanisms.

Despite these limitations, the current study provides important theoretical and practical implications in the area of risk-related rumor management. Theoretically, our study integrates insights and findings from rumor psychology and Situational Crisis Communication Theory from the field of public relations to explore effective rumor response strategies in the context of a national-level risk. Practically, our findings suggest that the government's response to a rumor plays an important role in controlling public beliefs about it. However, to make that control more effective, what matters more is which specific rumor response strategy the government uses. During outbreaks of rumors about risks, particularly food-related risks, the government should aggressively and promptly refute the rumor — not with flat denials or threats of punitive actions but rather with sufficient evidence and persuasive arguments.

Acknowledgments

This article was supported by research funds given to the first author by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2017S1A5A2A01026338).

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