ASIAN COMMUNICATION RESEARCH
December 2021, Vol. 18, No. 3, pp. 131-150
e-ISSN 2765-3390, p-ISSN 1738-2084
https://doi.org/10.20879/acr.2021.18.3.131

Original Research

Interplay of Threat, Efficacy, and Uncertainty in Cancer News Coverage: Analysis of News Content and Effects in South Korea

Minsun Shim [1], **Yong-Chan Kim** [2], **and Keeho Park** [3, 4]

[1] Department of Media and Communication, Inha University, Republic of Korea
[2] Department of Communication, Yonsei Uiversity, Republic of Korea
[3] Cancer Policy Branch, National Cancer Control Institute, National Cancer Center, Republic of Korea
[4] Graduate School of Cancer Science and Policy, National Cancer Center, Republic of Korea

Corresponding author
Keeho Park
Graduate School of Cancer Science and Policy, National Cancer Center, 323 Ilsan-ro Ilsandong-gu, Goyang-si, Gyeonggi-do, 10408, Republic of Korea
Email: park.keeho@gmail.com

Disclose statement
This work was supported by the National Cancer Center (grant number 1310260) and Inha University Research Grant.

Received
5 July 2021

Revised
22 October 2021

Accepted
27 November 2021

ABSTRACT

This research presents findings from two studies that examine portrayal of threat, efficacy, and uncertainty in cancer news stories, and investigate the effects of variations in a combination of news content on perceived risk, perceived efficacy, and behavioral intentions. Study 1 analyzed the content of cancer news, using a representative sample (N = 1,438) of television, newspapers, and other news media in South Korea over a five-year period. Study 2 examined the effects of exposure to a cancer news story, conducting an experiment with Korean adults (N = 717). Study 1 demonstrated that threat was more prevalent than efficacy in cancer news coverage. Uncertainty information was much less frequent, and when included, it was more about threat uncertainty than efficacy uncertainty. Study 2 showed that a high threat, high efficacy story led to higher levels of perceived efficacy and intention for preventive behaviors than did a low threat, low efficacy story. However, adding efficacy-related uncertainty nullified the beneficial effects of the high threat, high efficacy information whereas the impact of threat-related uncertainty was not significant. The theoretical and practical implications based on the results are further discussed.

KEYWORDS

cancer news, threat, efficacy, uncertainty, perceived risk, efficacy, behavioral intention

There is wide public interest in information about cancer, which is a leading cause of death but largely preventable (World Health Organization, 2018), thereby both highly feared and newsworthy. As reductions in cancer development or mortality are associated with lifestyle changes (Colditz et al., 2006) and screening (Andriole et al., 2012), it is important to obtain relevant information from the media (Yu & Han, 2018). Research has shown that cancer information scanning is positively related to cancer knowledge and prevention behaviors (Shim et al., 2006); however, other research suggests that exposure to certain types of news reports, such as local television news, leads to fatalistic beliefs about cancer prevention (Niederdeppe et al., 2010). Such

differential effects of cancer news merit thorough investigation of specific content characteristics of news stories.

In view of this research need, the present research examined portrayal of content in cancer news and its impacts. Drawing from the extended parallel process model (EPPM, Witte, 1992, 1994) and uncertainty management theory (UMT, Brashers, 2001), we focused on three elements of news content: *threat, efficacy,* and *uncertainty*. The EPPM posits that messages about risks need to present strong threat information to grab audience attention but that threat needs to be accompanied by efficacy information to ensure proper actions. According to the UMT, uncertainty can be viewed either as threatening, having people engage in efforts to reduce it, or as opportune, having people adapt to chronic uncertainty. Linking threat and efficacy to uncertainty is important in examining the effects of health news because uncertainty may cause an overwhelming threat or have people question their efficacy to avoid it (Han et al., 2018).

In this article, we present findings from a pair of studies. In Study 1, we conducted a content analysis of cancer news coverage, using a nationwide sample of television news, newspapers, and other outlets over a 5-year period. In Study 2, we conducted an experiment to examine the effects of variations in a combination of threat, efficacy, and uncertainty information in a cancer news story. Both studies were conducted with data from South Korea, where cancer is the leading cause of death, same as in the worldwide (Jung et al., 2018).

Portrayal of Threat and Efficacy in Cancer News

Cancer is a common and frequent health news (Viswanath et al., 2006). The U.S. National Cancer Institute (NCI) conducted a comprehensive content analysis of cancer news in 1980 (Freimuth et al., 1984), and this effort was expanded in large project funded by NCI in 2000s (e.g., Jensen et al., 2010; Stryker et al., 2007). Comprehensive research in several countries, including the U.S. (Cohen et al., 2008; Niederdeppe et al., 2014), U.K. (Konfortion et al., 2014), and South Korea (Kye et al., 2015), have accumulated findings regarding the trends of cancer news coverage.

One consistent finding is that cancer news coverage focuses more heavily on treatment in comparison to prevention, detection, or coping across the cancer continuum (Jensen et al., 2010). Treatment-focused reporting was frequent even for highly preventable cancers (Slater et al., 2008), and efficacy of prevention behaviors was rarely included in news (Moriarty & Stryker, 2008). When the prevention information appeared less in news as opposed to more often, there was a weaker association between self-reported news attention and prevention knowledge (Stryker et al., 2007). It is thus likely that lay people may associate cancer with post-hoc reaction than preventive action (Jensen et al., 2010).

Lack of information on prevention efficacy in cancer news corresponds to the concern raised by the EPPM. According to the EPPM, messages about risk issues can gather attention if strong threat information is conveyed but it is critical that efficacy information accompanies threat to lead people to take proper actions to cope with the threat (Witte, 1992, 1994). Threat in the EPPM is defined as a combination of susceptibility (i.e., perceived likelihood of getting a certain condition) and severity (perceived seriousness of the consequences caused by the threat). Efficacy also encompasses two elements: self-efficacy (belief in one's ability to perform recommended behaviors) and response efficacy (belief that recommended behaviors are effective in averting the threat). The EPPM was originally developed for designing and evaluating fear-appeal messages (Cho & Witte, 2005; Lee et al., 2018). Later it has been applied to research regarding health risk messages which

do not include threat and efficacy purposely for campaigns but may nonetheless contain them, such as news (Goodall et al., 2012) and social media messages (Shi et al., 2019).

Findings from research applying the EPPM to a content analysis of news stories on various topics are overall consistent. Goodall et al. (2012) examined news coverage of the H1N1 virus in the U.S. Most news stories (87%) made reference to the threat of the virus, either severity (86%) or susceptibility (30%); by contrast, about half of the stories contained efficacy information referencing recommended individual actions (56%) and their effectiveness (15%). Another research (Turner et al., 2013) examined the content of newspaper articles and government press releases during the cough syrup contamination crisis in Panama. While the majority (82%) of government press releases included a balance of threat elements (severity and susceptibility) and efficacy elements (self-efficacy and response efficacy), news coverage emphasized threat over efficacy, with 61% mentioning threat alone and 29% including both threat and efficacy. Similar patterns were observed in cancer news coverage in South Korea. Information on threat severity appeared in most news (82%), with variations across different cancer types, but efficacy was included less frequently (42%) (Shim et al., 2016). Building upon from past research on health news and extending research on cancer news, we posed the following research questions:

RQ1: What percentage of cancer news stories mention threat elements (severity and susceptibility)?

RQ2: What percentage of cancer news stories mention efficacy elements (self-efficacy and response efficacy)?

RQ3: What is the distribution of threat and efficacy elements in combination in cancer news?

Portrayal of Uncertainty in Cancer News

Cancer news abounds with complex and confusing information and a resulting sense of uncertainty (Clarke & Everest, 2006). But at the same time, cancer news often omits the limitations or details of scientific evidence for the sake of clarity and simplicity for lay audiences (Jensen et al., 2011). People encounter uncertainty "when details of situations are ambiguous, complex, unpredictable, or probabilistic; when information is unavailable or inconsistent; when people feel insecure in their own state of knowledge, or the state of knowledge in general" (Brashers, 2001, p. 478). This can be a reason why people often get confused with or misinterpret information in cancer news.

Conceptualization of uncertainty in illness in theories, including UMT (Brashers, 2001) and Mishel's (1988, 1990) theories, has focused on an individual's experience and appraisal with uncertainty – making sense of, assigning value to, or predicting the outcomes of uncertainty. Communication is construed, originally in UMT, as a cause of or response to uncertainties appraised by an individual either as threatening or as opportune (Hurley et al., 2011). However, a growing number of studies have built upon from UMT to examine the content of health messages in reflecting, conveying, and creating uncertainty (e.g., Goodall et al., 2012; Goodall & Reed, 2013; Hurley et al., 2011; Jensen et al., 2017). In these studies, uncertainty is examined not as psychological appraisal variables but as message features (Gustafson & Rice, 2020). For example, Hurley et al. (2011) noted the potential for online news to act as a source of uncertainty by examining the types and prevalence of uncertainty-provoking content about cancer. Results indicated that 65% of online cancer news contained uncertainty features, including improper volume of information, ambiguous information, complex information, and conflicting information.

There have been efforts to examine uncertainty

content in news in reference to the EPPM. In their research on the news coverage of the H1N1 virus, Goodall et al. (2012) distinguished two types of uncertainty based on the EPPM elements: uncertainty about threat (questioning the seriousness and potential spread of the H1N1 virus) and uncertainty about efficacy (questioning the effectiveness or feasibility of suggested protective actions). Threat-related uncertainty appeared in 38% of news stories while efficacy-related uncertainty appeared in 18% of news. Relatedly, Niederdeppe et al. (2014) examined two types of uncertainty in cancer news: uncertainty about cancer causes and uncertainty about prevention behaviors. They found that overall, most news stories (82% of local TV news and 73% of newspapers) contained some levels of certainty rather than uncertainty, in a similar degree for both cancer causes and prevention. Threat versus efficacy, or cause versus prevention, is a meaningful distinction in identifying the types of uncertainty content in cancer news, integrating the EPPM and the UMT. Following these past approaches, we posed:

RQ4: What percentage of cancer news stories mention threat-related uncertainty and efficacy-related uncertainty?

RQ5: What is the joint distribution of threat, efficacy, and uncertainty in cancer news stories?

STUDY 1

Method

Data included a representative sample of cancer news stories (N = 1,438) in South Korea over a five-year period (January 1, 2008 to December 31, 2012; see Kye et al., 2015 for more information). News stories were collected from a total of 23 news outlets in four media type, including 16 general newspapers, 3 major television news (*KBS, MBC, SBS*), 3 medical newspapers (e.g., *Yeihyub-Sinmun*), and 1 news agency (*Yonhap News*). News stories were collected using Eyesurfer (version 3.0), an online database news scrap service system. The search terms used were a combination of a primary keyword "cancer" ("ahm" in Korean) and sub-keywords ("cause," "occurrence," "carcinogenesis," or "engenderment"). We retrieved 13,583 news stories at first. About 10.5% of them (N = 1,438) were selected as the final sample through systematic stratified sampling, considering the quota of ratio by the number of articles in each news outlet.

Coding Procedure and Measures

The unit of content analysis was the entire news article. Six graduate student coders attended several workshops on the coding schemes led by the research team. Pilot coding was conducted with 100 randomly selected stories (not included in the final sample) for training and refinement of the coding scheme. Coding disagreements were resolved through discussion and the resolution was noted for future coding. Then, another set of 100 stories were double-coded to establish intercoder reliability, with Krippendorff's alphas ranging from .83 to .95. The remainder of the sample was divided between coders and coded independently. All variables were coded as being present (= 1) or absent (= 0) in each article.

Threat. Threat was coded regarding severity and susceptibility. *Severity* was operationalized as any reference to the seriousness of the harm (Goodall et al., 2012; Turner et al., 2013) expected from cancer risk. We identified whether or not each story explicitly mentioned the severity of cancer either generally or with specific mentions of hospitalization, death, and serious symptoms of illness. For example, severity was coded as present if a story mentioned that "cancer caused by cell phone radiation is lethal" or depicted "a patient

who has been battling cancer and expects the approaching end of life." *Susceptibility* was defined as any reference to the heightened likelihood of getting cancer (Goodall et al., 2012; Turner et al., 2013) for either specific cancer types or overall cancer. The examples of susceptibility include "a higher risk of cancer among women in menopause" and "men in 40-50s are at greater risk for prostate cancer."

Efficacy. Efficacy was coded with respect to self-efficacy and response efficacy. *Self-efficacy* was defined as any reference to an individual's ability to perform recommended behaviors (Turner et al., 2013) whereas *response efficacy* was operationalized as any reference to effective strategies to reduce cancer risk (Niederdeppe et al., 2014). The examples of self-efficacy include "engaging in regular physical activity is not so difficult as thought" and "prevention behaviors under one's control." Response efficacy references any actions effective to lower cancer risk, either for a specific cause (e.g., "using a hands-free headset for a cell phone to lower brain cancer risk") or more generally (e.g., "healthy diets to reduce overall cancer risk").

Uncertainty. Two types of uncertainty were coded: threat-related uncertainty and efficacy-related uncertainty (Goodall et al., 2012). *Threat-related uncertainty* was defined as any reference to uncertainty about threat information in news, questioning about the severity or susceptibility of encountering cancer risk. *Efficacy-related uncertainty* was defined as any reference to uncertainty about the effectiveness or feasibility of proposed actions to lower cancer risk, questioning about whether the strategies are effective, feasible, or easy to follow. Uncertainty was thus coded only for stories containing threat or efficacy elements. Guided by past research (Goodall et al., 2012; Jensen et al., 2011, Niederdeppe et al., 2014), we considered whether a news story used tentative language, indicated whether the issue was controversial or lacked evidence, reported sources to support the counterargument, or used hedging. Examples include "there is limited evidence that cell phone radiation causes serious brain cancer" (threat-related uncertainty) and "a mammogram may not be effective for Korean women given their dense breast tissue" (efficacy-related uncertainty).

Results

Table 1 reports the descriptive statistics from content analysis of cancer news stories. Regarding threat (RQ1), most news stories (79.6%) referenced severity and 20.9% of stories mentioned susceptibility. As for efficacy (RQ2), only a small percentage of stories (3.3%) mentioned self-efficacy and 48.3% of the stories mentioned response efficacy.

Table 1. *Descriptive Statistics of Content Analysis of Cancer News Stories (Study 1)*

Coding variables		Proportion of stories (*N*)
Threat	Severity	79.6% (1,145)
	Susceptibility	20.9% (300)
Efficacy	Self-efficacy	3.3% (48)
	Response efficacy	48.3% (694)
Uncertainty	Threat-related uncertainty	292 (20.3%)
	Efficacy-related uncertainty	60 (4.2%)

N = 1,438. Values are percentages in the total sample and counts.

To examine the patterns in which news stories included the EPPM elements in combination (RQ3), we first categorized stories into four groups by threat elements: stories mentioning both severity and susceptibility, only severity, only susceptibility, and neither one. News stories were also divided, based on efficacy elements: stories mentioning both self-efficacy and response efficacy, only self-efficacy, only response efficacy, and neither one. We then paired the two categories to identify the distribution across sixteen combinations (see Table 2). News stories referencing severity and response efficacy took the largest proportion (31.2%), closely followed by stories with severity and no efficacy elements (28.2%). 11.8% of stories included neither threat nor efficacy, and 10.1% contained both severity and susceptibility without any efficacy elements.

RQ4 concerns the proportion of cancer news stories mentioning uncertainty. As shown in Table 1, 20.3% of stories mentioned threat-related uncertainty whereas 4.2% mentioned efficacy-related uncertainty. These proportions counted 24.7% of the stories that contained threat elements, and 8.6% of the stories that included efficacy elements, respectively, suggesting that threat-related uncertainty was more prevalent than efficacy-related uncertainty in cancer news, $z = 8.63$, $p < .001$.

The joint distribution of threat, efficacy, and uncertainty in cancer news (RQ5) is presented in Table 3. The two most frequent news stories were stories containing both threat and efficacy but no uncertainty (29.6%) and stories containing threat without any other elements (29.3%). Stories referencing threat-related uncertainty were also often reported, including those simultaneously presenting threat (10.5%) or both threat and efficacy (8.9%).

Table 2. *Distribution of Cancer News Content by the EPPM Elements (Study 1)*

Threat elements	Efficacy elements				
	Self-efficacy and response efficacy	Only self-efficacy	Only response efficacy	No efficacy	Total (row)
Severity and susceptibility	0.6% (9)	0.0% (0)	7.7% (111)	10.1% (145)	18.4% (265)
Only severity	1.8% (26)	0.0% (0)	31.2% (449)	28.2% (405)	61.2% (880)
Only susceptibility	0.1% (2)	0.0% (0)	0.7% (10)	1.6% (23)	2.4% (35)
No threat	0.6% (9)	0.1% (2)	5.4% (78)	11.8% (169)	17.9% (258)
Total (column)	3.2% (46)	0.1% (2)	45.1% (648)	51.6% (742)	100% (1,438)

Note. $N = 1{,}438$. Values are percentages in the total sample and counts.

Table 3. *Distribution of Cancer News Content by Threat, Efficacy, and Uncertainty (Study 1)*

Content elements in cancer news				% (*N*)
Threat (severity, susceptibility)	Efficacy (self-efficacy, response efficacy)	Threat uncertainty	Efficacy uncertainty	
Present	Present	-	-	29.6% (426)
Present	-	-	-	29.3% (422)
-	-	-	-	11.8% (169)
Present	-	Present	-	10.5% (151)
Present	Present	Present	-	8.9% (128)
-	Present	-	-	5.7% (82)
Present	Present	-	Present	2.8% (40)
Present	Present	Present	Present	0.9% (13)
-	Present	-	Present	0.5% (7)

Note. $N = 1{,}438$. Values are percentages in the total sample and counts.

Discussion

Cancer news coverage in South Korea emphasized threat of cancer risk over efficacy to reduce the risk, consistent with past research in other countries. Of the threat elements, severity was more prevalent than susceptibility, and of the efficacy elements, response efficacy appeared more frequently than self-efficacy. The frequency of uncertainty in this study was comparable to the past reports on traditional news media (Goodall et al., 2012; Niederdeppe et al., 2014), but was much lower than that in online cancer news (Hurley et al., 2011). Specifically, threat-related uncertainty was reported more often than efficacy-related uncertainty. Taken together, lay people appeared to be inundated with information about the severity of the harm caused by cancer risk factors, but were less likely to receive information about their ability to reduce the threat as well as how to do so effectively. Such imbalanced information was coupled with another disproportion between threat-related uncertainty and efficacy-related uncertainty, awaiting research on its impacts.

Data in Study 1 were descriptive in nature and could not be used for causal claims, but the findings suggested the importance of communicating both threat and efficacy in cancer news, along with a consideration of uncertainty. It was thus needed to examine the effects of variations in a combination of threat, efficacy, and uncertainty in news. Particularly with respect to uncertainty in cancer news, past findings are inconsistent (Gustafson & Rice, 2020). The positive effects of acknowledging scientific uncertainty in news on reducing cancer fatalism was found among college students (Jensen et al., 2011) but not among adult participants (Jensen et al., 2017), and a combination of moderate uncertainty about both cancer causes and prevention behaviors seemed undesirable (Niederdeppe et al., 2014). Moreover, little is known about the effects of specific types of uncertainty, related to either threat or efficacy, in cancer news. Study 2 addressed this question, conducting a randomized experiment.

STUDY 2

Effects of a Combination of Threat and Efficacy in Cancer News

According to the EPPM (Witte, 1992, 1994), individuals may go through two possible response pathways after being exposed to threat in messages: danger versus fear control. Danger control is elicited when high threat is accompanied by high efficacy, leading people to take adaptive behaviors to address the threat. On the contrary, when efficacy information is absent, efficacy judgments are made based on past experience or generalized perceptions, such as perceptions of controllability of cancer, which tend to be fatalistic (Powe & Finnie, 2003). High threat, low efficacy messages thus elicit fear control, having people take steps to lower the aversive emotional state, such as turning attention away from risk messages.

As such, cancer news stories can cause either self-protective actions or self-defeating actions depending on the combination of threat and efficacy. Consistent with the two paths of the EPPM, we posited hypotheses. H1 proposes fear control responses: a story containing both high threat and high efficacy, as opposed to a control condition with a low threat, low efficacy story, increases both perceived risk and perceived efficacy, thereby enhancing self-protective intentions. By contrast, H2 concerns danger control by a story containing high threat and low efficacy, which increases perceived risk but reduces perceived efficacy and self-protective intentions. Specifically, perceived risk encompasses perceived severity and perceived susceptibility, and perceived efficacy includes self-efficacy and response efficacy (Witte, 1992, 1994). For self-protective behavioral intentions, we concern the intention to perform preventive

behaviors and intention to seek information:

H1: A news story with *high threat* and *high efficacy* leads to higher perceived risk, higher perceived efficacy, and higher behavioral intentions, compared with a low threat, low efficacy story.

H2: A news story with *high threat* and *low efficacy* leads to higher perceived risk, lower perceived efficacy, and lower behavioral intentions, compared with a with a low threat, low efficacy story.

The effects hypothesized above can be sequential processes, as implied by the EPPM. The processes begin with exposure to messages, then go through threat and cognitive appraisals (or emotional responses), and finally get to protective action (or defensive motivation). Consistent with the theoretical model and empirical research (e.g., Carcioppolo et al., 2013; So et al., 2016), we examined the effects of message content on behavioral intentions mediated through perceptions:

RQ6: Are the effects of a news story on behavioral intentions mediated through perceived risk and perceived efficacy?

Differential Effects of Uncertainty Types in Cancer News

The UMT (Brashers, 2001) shares conceptual overlaps with the EPPM as it also attends to the role of appraisal and emotion. Individuals appraise the meaning of uncertainty for potential harm or benefits, which leads to emotional reactions to the experience and subsequent actions (Brashers et al., 2000). Two distinct types of appraisals have been explicated (Brashers, 2007). When uncertainty is appraised as hope, individuals may perceive a positive outcome of taking actions; in appraising uncertainty as danger, individuals may feel anxiety about the potential outcome of uncertainty (Rains & Tukachinsky, 2015).

Because of the different types of uncertainty appraisals, the way in which people respond to uncertainty in cancer news is not simple (Jensen et al., 2017). According to Gustafson and Rice's (2020) review of 48 experimental studies on communicating uncertainty, extant findings are mixed, including positive, negative, and null effects. A study (Jensen et al., 2011) reported the positive effects of uncertainty in news on lowering cancer fatalism among college students; however, these effects were not replicated with adult participants (Jensen et al., 2017). Negative effects were also reported, such as the effects of uncertain health news on lowering intentions toward healthy behaviors (Chang, 2015).

One way to untangle the differential effects of uncertainty in cancer news is to distinguish the types of uncertainty. Integrating the EPPM and the UMT, this research is interested in the effects of threat-related versus efficacy-related uncertainty. Specifically, this research concerns whether the beneficial impacts of presenting high threat and high efficacy simultaneously in a news story (as hypothesized with H1) are either nullified or strengthened by adding threat- or efficacy-related uncertainty. Regarding threat-related uncertainty, evidence from risk communication suggests that portrayals of uncertainty about scientific claims on threat severity enhance source trustworthiness and behavioral intentions for risk mitigation (Frewer et al., 2002; Slovic et al., 1984). Also considering the UMT's two routes of uncertainty appraisals, it may be logical to speculate that threat-related uncertainty elicits uncertainty appraisal as hope and triggers surveillance motivations (in part similar to the EPPM's danger control). On the contrary, efficacy-related uncertainty may elicit uncertainty appraisal as danger by doubting the positive outcomes of efficacy

strategies, thereby reducing further actions (like the EPPM's fear control).

This reasoning is supported by past research. News stories referencing uncertainty about bed-bug threat increased information seeking intention than did news stories referencing its certainty, whereas news containing uncertainty about effectiveness of solutions decreased perceived efficacy and increased intention to avoid information, as opposed to news with efficacy certainty (Goodall & Reed, 2013). When uncertainty in news was specified into cancer causes and prevention, presenting moderate uncertainty about both topics increased a sense of information overload, which was in turn associated with lower intention for prevention behaviors (Niederdeppe et al., 2014). Based on our reasoning and past evidence, we posited two hypotheses on the effects of adding either type of uncertainty to a high threat, high efficacy story. We also posed questions about the effects of including both types of uncertainty, as well as the possible, mediation process:

H3: A news story adding *threat-related uncertainty* leads to lower perceived risk, higher perceived efficacy, and higher behavioral intentions, compared with a high threat, high efficacy story.

H4: A news story adding *efficacy-related uncertainty* leads to higher perceived risk, lower perceived efficacy, and lower behavioral intentions, compared with a high threat, high efficacy story.

RQ7: What are the effects of adding *both types of uncertainty* on perceived risk, perceived efficacy, and behavioral intentions, compared with a high threat, high efficacy story?

RQ8: Are the effects of threat-related and efficacy-related uncertainty on behavioral intentions mediated through perceived risk and perceived efficacy?

Method

A randomized online experiment was conducted with 717 adults, who were part of the nationwide panel of Macromill Embrain in South Korea. An invitation email was randomly sent out to 3,872 persons; of the 933 persons who read the email and clicked on the link, 76.8% completed the study, with a small monetary compensation. The final sample included 51% females, aged 20 to 59 (M = 39.5, SD = 11.1). Once consent was obtained, participants were presented with a news story about cancer risk. After they read the story, they were asked a series of questions on outcome variables, demographic information, and manipulation check. The study was approved by the National Cancer Center's institutional review board.

Design and Stimuli

This experiment included seven conditions, corresponding to variations in a combination of threat, efficacy, and uncertainty elements. Four conditions (low vs. high threat × low vs. high efficacy) were designed to examine H1, H2, and RQ6. Another set of four conditions (threat uncertainty included vs. not × efficacy uncertainty included vs. not, with high threat and high efficacy always being present) was designed to examine H3 to 4 and RQ7 to 8. The high threat, high efficacy condition was thus shared in both tests.

The stimuli were constructed based on real news stories (from Study 1) about cell phone radiation as a cancer cause. The stimuli were text only, and the length of stories was held almost constant at about 801 words. The stimuli were pilot tested with 66 undergraduate students prior to the main experiment. Threat and efficacy were manipulated by changing the degree of the EPPM's elements. The high threat message states that people, especially children and teens, are at great risk for brain cancer caused by exposure to cell phone radiation (high susceptibility) and brain cancer and neurological diseases caused by cell

phone radiation are deadly (high severity); this information was absent in the low threat message and instead it introduces a current investigation on people's vulnerability to cell phone radiation (low susceptibility) and its impact on illness severity (low severity). The high efficacy message explicitly states that individuals can keep their health from the risk of cell phone radiation (high self-efficacy) and offers four detailed, specific strategies to avoid radiation exposure (high response efficacy), whereas the low efficacy message states that efforts may be made to reduce phone radiation risk (low self-efficacy), followed by brief, general strategies (low response efficacy).

Uncertainty was manipulated by using tentative language and including information that questions the high threat or the high efficacy information mentioned earlier in the message, guided by past research (e.g., Hurley et al., 2011; Goodall et al, 2012). The message with threat-related uncertainty reports a source saying that individuals' risk likelihood for cancer by cell phone radiation is one of the plausible hypotheses, awaiting causal evidence (uncertain susceptibility) and states that the severity of diseases by phone radiation is yet to be scientifically proven (uncertain severity). The message with efficacy-related uncertainty includes a counterargument to individuals' control over radiation exposure (uncertain self-efficacy) and states that the effectiveness of the suggested solutions lacks scientific evidence (uncertain response efficacy). In the messages without threat- or efficacy-related uncertainty, the given uncertainty information and expressions were absent.

Measures

All measures were assessed on a 7-point scale (1 = *not at all* to 7 = *very much*).

Perceived Risk. For perceived risk, we measured perceived severity and perceived susceptibility. Perceived severity was measured, averaging two items, e.g., "I believe that the cancer I get from exposure to cell phone radiation is deadly" (r = .79, M = 5.10, SD = 1.11). Perceived susceptibility was an average of two items, e.g., "I believe that I am at risk of getting cancer from exposure to cell phone radiation" (r = .84, M = 4.65, SD = 1.31).

Perceived Efficacy. Self-efficacy was measured, averaging two items, e.g., "I am sure that I can keep my health from the risk of cell phone radiation" (r = .71, M = 4.75, SD = 1.13). Response efficacy was assessed by averaging three items reflecting the information in the stimulus, e.g., "Using a hands-free cell phone device can reduce the risk of radiation exposure" (α = .84, M = 5.01, SD = 1.10).

Behavioral Intentions. Behavioral intentions included two types of intentions. Intention to perform preventive behaviors was assessed, averaging three items, e.g., "I intend to use a hands-free cell phone device" (α = .87, M = 5.17, SD = 1.20). Intention to seek information was measured by averaging three items, e.g., "I intend to seek more information about cell phone radiation" (α = .91, M = 4.72, SD = 1.28).

Results

Manipulation Check

At the end, participants were asked to recall the news story and rate four statements (1 = *not at all* to 7 = *very much*): "According to the news story, cell phone radiation is harmful to human body; it is possible to reduce exposure to cell phone radiation; it is not certain that cell phone radiation is harmful to human body; it is not certain that the methods of reducing cell phone radiation exposure are effective." Results from ANOVA (using the four conditions of low/high threat × low/high efficacy) showed that the threat manipulation significantly increased the rating of threat in the story, $M(SD)_{\text{High Threat}}$ = 5.88(1.02), $M(SD)_{\text{Low Threat}}$ = 5.70(1.02), $F(1, 405) = 4.05$, $p = .045$, $\eta_p^2 = .010$; the efficacy manipulation was successful in increasing the efficacy rating, $M(SD)_{\text{High Efficacy}}$ = 5.70(1.12), $M(SD)_{\text{Low Efficacy}}$ = 5.48(1.04), $F(1, 405) = 4.04$,

$p = .045$, $\eta_p^2 = .010$. The manipulation of two types of uncertainty (tested with the four conditions of presence/absence of threat uncertainty × efficacy uncertainty) was also successful, $M(SD)_{\text{Threat Uncertainty}} = 4.56(1.34)$, $M(SD)_{\text{Threat No-Uncertainty}} = 4.37(1.42)$, $F(1, 405) = 3.68$, $p = .056$, $\eta_p^2 = .009$; $M(SD)_{\text{Efficacy Uncertainty}} = 4.68(1.26)$, $M(SD)_{\text{Efficacy No-uncertainty}} = 4.16(1.04)$, $F(1, 405) = 15.13$, $p < .001$, $\eta_p^2 = .036$.

Effects of Threat and Efficacy in Cancer News

This research examined the effects of presenting high threat and high efficacy (H1) and high threat and low efficacy (H2), as opposed to the low threat, low efficacy condition. We conducted a one-way ANOVA with two planned contrasts to test for differences between conditions based on our a priori predictions (see Table 4). The analyses were conducted respectively for six outcome measures. There were significant effects on three of the six outcomes assessed: self-efficacy ($p = .034$), response efficacy ($p = .005$), and intention for preventive behaviors ($p = .027$). Specifically, planned contrast tests showed that the high threat, high efficacy story led to significantly higher levels of self-efficacy, response efficacy, and intention for preventive behaviors, as opposed to the low threat, low efficacy story. It had no significant effects on the other three outcomes. Thus, H1 was partially supported. On the contrary, the high threat, low efficacy story had no significant effects on the outcomes, compared with the low threat, low efficacy story. Therefore, H2 was not supported.

RQ6 concerns the indirect effects of threat and efficacy in news on behavioral intentions via mediators. The bootstrapping approach was employed for a formal test of the indirect, direct, and total effects, using the PROCESS macro (Hayes, 2018). In the analyses, two dummy variables (the high threat, high efficacy condition and the high threat, low efficacy condition) were entered, with the reference category being the low threat, low efficacy condition. Four mediators were entered: perceived severity, perceived susceptibility, self-efficacy, and response efficacy. Analyses were run with intention for preventive behaviors and intention for information seeking, respectively, as the dependent variable. Results

Table 4. *Means, Standard Deviations, and One-Way Analyses of Variance by Threat and Efficacy in Perceived Risk, Perceived Efficacy, and Behavioral Intentions (Study 2)*

	Low threat, low efficacy		High threat, high efficacy		High threat, low efficacy		F (2, 305)	η_p^2
Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Perceived severity	5.16	1.17	5.24	1.07	5.46	1.03	2.04	.01
Perceived susceptibility	4.71	1.29	4.75	1.45	4.85	1.31	0.32	< .01
Self-efficacy	4.47_a	1.15	4.88_b	1.09	4.70	1.17	3.41*	.02
Response efficacy	4.68_a	1.19	5.15_b	1.11	4.73	1.06	5.46**	.04
Intention for preventive behaviors	4.96_a	1.13	5.36_b	1.30	5.00	1.01	3.67*	.02
Intention for information seeking	4.77	1.26	4.73	1.44	4.69	1.19	0.11	< .01

Note. Means with different subscripts differ at the $p < .05$ level by a priori comparisons with planned contrasts (low, low vs. high, high; low, low vs. high, low).
* $p < .05$. ** $p < .01$.

supported the mediation via response efficacy for the effects of the high threat, high efficacy story (see Table 5). The high threat, high efficacy story increased response efficacy, which was in turn associated with greater intention for preventive behaviors and greater intention for information seeking. By contrast, the high threat, low efficacy condition had no indirect effects on intentions.

Effects of Uncertainty Added to High Threat, High Efficacy News

H3 and H4 proposed the effects of adding either type of uncertainty to high threat, high efficacy news. The effects of adding both uncertainty types were posed with RQ7. A

Table 5. *A Formal Test of the Total, Direct, and Indirect Effects of Threat and Efficacy on Behavioral Intentions with Multiple Mediators (Study 2)*

	95% CI
High threat, high efficacy → Intention for preventive behaviors	
Total effect	[**.08, .72**]
Direct effect	[-.13, .39]
Indirect effect (total)	[**.05, .49**]
Specific indirect effect via response efficacy	[**.05, .30**]
High threat, high efficacy → Intention for information seeking	
Total effect	[-.41, .31]
Direct effect	[-.57, .02]
Indirect effect (total)	[-.01, .48]
Specific indirect effect via response efficacy	[**.03, .31**]
High threat, low efficacy → Intention for preventive behaviors	
Total effect	[-.27, .36]
Direct effect	[-.34, .17]
Indirect effect (total)	[-.06, .33]
High threat, low efficacy → Intention for information seeking	
Total effect	[-.44, .27]
Direct effect	[-.54, .04]
Indirect effect (total)	[-.04, .40]

Note. The effect was considered statistically significant if zero was not included within the 95% CIs, presented in bold numbers. Of the four specific indirect effects tested (via perceived severity, perceived susceptibility, self-efficacy, and response efficacy), only the significant effects are reported for parsimony. Bootstrap sample size = 10,000.

one-way ANOVA was conducted with three planned contrasts between the conditions paired in each hypothesis and question (see Table 6). Including uncertainty information in a high threat, high efficacy story had significant effects on four outcomes: perceived severity ($p = .034$), self-efficacy ($p < .001$), response efficacy ($p < .001$), and intention to perform preventive behaviors ($p = .005$). According to planned contrast tests, adding threat-related uncertainty made no significant changes on outcomes, as opposed to the high threat, high efficacy story. H3 was not supported. On the contrary, consistent with H4, adding efficacy-related uncertainty led to lower degrees of response efficacy and intention for preventive behaviors than did the high threat, high efficacy story. There were no significant impacts on the other outcomes. Thus, H4 was partially supported. Regarding RQ7, adding both types of uncertainty had significant effects on reducing perceived severity, self-efficacy, and intention for preventive behaviors, compared with the high threat, high efficacy story.

To test the indirect effects of uncertainty on behavioral intentions (RQ8), we employed the bootstrapping approach, same as in the test on RQ6. The mediators and the dependent variable were the same. But this time, three dummy variables (threat uncertainty, efficacy uncertainty, and both uncertainty) were entered, and the reference category was no uncertainty (i.e., the high threat, high efficacy condition). Results supported significant indirect effects for efficacy-related uncertainty and both uncertainty, but not for threat-related uncertainty (see Table 7). Efficacy-related uncertainty significantly lowered both types of intention, indirectly through reducing response efficacy. Adding both types of uncertainty decreased intention to perform preventive behaviors, mediated through reduced perceived severity and self-efficacy; it also reduced intention to seek information indirectly by

Table 6. *Means, Standard Deviations, and One-Way Analyses of Variance by Uncertainty Manipulation in Perceived Risk, Perceived Efficacy, and Behavioral Intentions (Study 2)*

	High threat, high efficacy		Threat uncertainty added		Efficacy uncertainty added		Both uncertainty added		F (3, 405)	η_P^2
Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Perceived severity	5.24_a	1.07	5.08	1.11	4.98	1.15	4.80_b	1.01	2.92*	.02
Perceived susceptibility	4.75	1.45	4.62	1.30	4.57	1.26	4.58	1.24	0.41	< .01
Self-efficacy	4.88_a	1.09	5.10	1.00	4.63	1.18	4.46_b	1.15	6.84***	.05
Response efficacy	5.15_a	1.11	5.41	0.94	4.84_b	0.98	4.93	1.08	6.23***	.04
Intention for preventive behaviors	5.36_a	1.30	5.46	1.01	5.00_b	1.20	4.98_b	1.26	4.34**	.03
Intention for information seeking	4.73	1.44	4.79	1.42	4.54	1.21	4.72	1.17	0.71	.01

Note. Means with different subscripts differ at the $p < .05$ level by a priori comparisons with planned contrasts (high, high vs. threat uncertainty added; high, high vs. efficacy uncertainty added; high, high vs. both uncertainty added).
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 7. *A Formal Test of the Total, Direct, and Indirect Effects of Uncertainty on Behavioral Intentions with Multiple Mediators (Study 2)*

	95% CI
Threat uncertainty → Intention for preventive behaviors	
Total effect	[-.22, .43]
Direct effect	[-.25, .25]
Indirect effect (total)	[-.12, .33]
Threat uncertainty → Intention for information seeking	
Total effect	[-.30, .44]
Direct effect	[-.19, .39]
Indirect effect (total)	[-.27, .22]
Efficacy uncertainty → Intention for preventive behaviors	
Total effect	**[-.69, -.03]**
Direct effect	[-.34, .16]
Indirect effect (total)	**[-.49, -.04]**
Specific indirect effect via response efficacy	**[-.26, -.01]**
Efficacy uncertainty → Intention for information seeking	
Total effect	[-.56, .18]
Direct effect	[-.23, .35]
Indirect effect (total)	**[-.49, -.01]**
Specific indirect effect via response efficacy	**[-.15, -.01]**
Both uncertainty → Intention for preventive behaviors	
Total effect	**[-.71, -.05]**
Direct effect	[-.32, .19]
Indirect effect (total)	**[-.54, -.08]**
Specific indirect effect via perceived severity	**[-.25, -.04]**
Specific indirect effect via self-efficacy	**[-.19, -.01]**
Both uncertainty → Intention for information seeking	
Total effect	[-.38, .36]
Direct effect	**[.03, .62]**
Indirect effect (total)	**[-.58, -.08]**
Specific indirect effect via perceived severity	**[-.38, -.07]**

Note. The effect was considered statistically significant if zero was not included within the 95% CIs, presented in bold numbers. Of the four specific indirect effects tested (via perceived severity, perceived susceptibility, self-efficacy, and response efficacy), only the significant effects are reported for parsimony. Bootstrap sample size = 10,000.

decreasing perceived severity (with the direct effect being significant and positive).

Discussion

The findings supported the EPPM's (Witte, 1992, 1994) danger control responses to a high threat, high efficacy story by increasing efficacy and behavioral intentions. It is noteworthy that the high threat, high efficacy story had indirect effects on intentions for both preventive behaviors and information seeking, as mediated through response efficacy in specific. By contrast, the fear control responses to a high threat, low efficacy in a cancer news story was not supported in this research. One possible explanation is that risk of cell phone radiation was a relevant and familiar issue to many people and therefore reading a single message referencing its threat could not have been influential enough.

Linked to the UMT, the beneficial impacts of presenting both high threat and high efficacy were nullified when efficacy-related uncertainty was added in the news. The undesirable effects occurred by lowering response efficacy, which in turn was associated with lower levels of intention to perform preventive behaviors and intention to seek information. On the contrary, there were no significant effects of adding threat-related uncertainty in cancer news, as opposed to the high threat, high efficacy story. Appraisals of threat-related uncertainty as hope await further research. Presenting both types of uncertainty seemed undesirable, consistent with past research (Niederdeppe et al., 2014). These differential effects of including uncertainty in a cancer news story confirmed the usefulness of specifying lay people's response to different uncertainty information (Gustafson & Rice, 2020).

GENERAL DISCUSSION

Risk and uncertainty management is an important means through which individuals cope with health threat and concerns. Individuals may manage their risk and uncertainty by engaging in preventive behaviors to address the risk and by seeking (or avoiding) information. The goals of this research were to examine portrayals of threat, efficacy, and uncertainty in cancer news coverage and to investigate the effects of exposure to news containing varying combinations of these elements. To summarize, we found: (1) threat was more prevalent than efficacy in cancer news; (2) uncertainty was much less prevalent, and when included, it was more likely to be threat-related than efficacy-related; (3) a high threat, high efficacy story increased self- and response efficacy, which in turn led to greater intention for preventive behaviors in a sequential process; (4) efficacy-related uncertainty decreased response efficacy, thereby reducing intention for preventive behaviors, whereas the effect of threat-related uncertainty was not found; (5) presenting both threat-related uncertainty and efficacy-related uncertainty in cancer news was undesirable.

This research has several important theoretical and practical implications. We applied the EPPM and UMT to a context of news articles, which are not intentionally crafted for the purpose of campaigns, and examined the degree to which cancer news contained threat, efficacy, and uncertainty. Our findings about imbalanced portrayal of threat over efficacy are consistent with past research on news coverage of other health and environmental risks (e.g., Goodall et al., 2012; Feldman et al., 2017; Turner et al., 2013). The findings imply that the news is successful at communicating threat of getting various cancers, and perhaps evoking fear, but may be less successful at informing people of doable actions to alleviate their risks. Such imbalanced news coverage may cultivate the fatalistic belief of cancer prevention and coping (Jensen et al., 2010; Ramondt & Ramirez, 2017), suggesting a caution for health journalists. It should be noted that news coverage that is not intentionally crafted to change behaviors has the

potential to influence individuals' behavioral intentions; therefore, accountability in journalism is requested for cancer, and more generally for health news coverage.

Second, this research went one step further and empirically examined the effects of exposure to a news story containing various versions of content elements. Relatively less known was about the effects of adding threat- or efficacy-related uncertainty in cancer news. Our findings suggest that adding efficacy-related uncertainty or combining threat-related and efficacy-related uncertainty may be detrimental by nullifying the positive effect of high threat, high efficacy information in news. This result is overall consistent with past findings (e.g., Goodall & Reed, 2013; Niederdeppe et al., 2014). Efficacy-related uncertainty is likely to lead people to a different route of uncertainty appraisal, that is, uncertainty as danger (Rains & Tukachinsky, 2015). Although scientific uncertainty needs to be recognized in cancer news, a caution is given for reporting uncertain cancer prevention behaviors (Niederdeppe et al., 2014). Regarding threat-related uncertainty, further research is needed to examine whether and how its depiction in news is appraised as opportunity (Brashers, 2001, 2007; Rains & Tukachinsky, 2015), triggering surveillance motivations. Public perception of uncertainty and subsequent engagement in behaviors in response to uncertainty information in cancer news still look tangled (Gustafson & Rice, 2020) and await further research, along with a consideration of key moderators including message and audience characteristics (Jensen et al., 2017).

The overall patterns of cancer news coverage may not be entirely problematic in South Korea. However, the finding suggests that one of the two most prevalent types of content in cancer news coverage (i.e., news referencing high threat, low efficacy, and no uncertainty) is as ineffective as the low threat, low efficacy story in motivating efficacy and behavioral coping. This raises concerns about cancer depictions in our natural communication and news media (e.g., Jensen et al., 2010; Riles et al., 2015), and offers important practical implications to health journalists. It is necessary to identify how to cover cancer in news stories in ways that may avoid distortion in illness representation and cancer fatalism but enhance efficacy and behavioral engagement in cancer prevention. There is currently highly overloaded information from various news outlets (Ramondt & Ramirez, 2017; Riles et al., 2015) as well as widely available misinformation and fake news. Journalists' efforts to report and distribute newsworthy and credible information, which has possibly desirable impacts on cancer prevention and control behaviors among lay public, are truly crucial for population health and well-being.

This study has several limitations to be acknowledged. The time frame of data collection in Study 1 was limited to the period from 2008 to 2012, not including an assessment of more recent or longer-range news trends. Replication of the trends needs to be done using more recent data. Furthermore, there has been an exponential growth in online news outlets and redistribution of cancer news via social media, awaiting research on the content of cancer information created or shared in social media (e.g., Shi et al., 2019). Second, this study used dichotomized coding categories. It is likely that we have missed more nuanced tones and implications in news stories. Third, some measures in Study 2 showed negative skewness, possibly reducing variances in the experimental effects. In addition, there are other possible combinations of threat, efficacy, threat-related uncertainty, and efficacy-related uncertainty (16 in total) conveyed in cancer news, which were not examined in this study. Lastly, behavioral intentions are different from actual behaviors although the first has been known as a strong predictor of the latter. Despite these limitations, this research offers a notable snapshot of cancer news coverage in South Korea and sheds light on the impacts of cancer coverage patterns on lay individuals' perceptions and coping.

REFERENCES

Andriole, G. L., Crawford, E. D., Grubb, R. L., Buys, S. S., Chia, D., Church, T. R., Fouad, M. N., Isaacs, C., Kvale, P. A., Reding, D. J., Weissfeld, J. L., Yokochi, L. A., O'Brien, B., Ragard, L. R., Clapp, J. D., Rathmell, J. M., Riley, T. L., Hsing, A. W., Izmirlian, G., … Prorok, P. C. (2012). Prostate cancer screening in the randomized prostate, lung, colorectal, and ovarian cancer screening trial: Mortality results after 13 years of follow-up. *Journal of the National Cancer Institute, 104*(2), 125–132. https://doi.org/10.1093/jnci/djr500

Brashers, D. E. (2001). Communication and uncertainty management. *Journal of Communication, 51*(3), 477–497. https://doi.org/10.1111/j.1460-2466.2001.tb02892.x

Brashers, D. E. (2007). A theory of communication and uncertainty management. In B. Whaley & W. Samter (Eds.), *Explaining communication theory* (pp. 201–218). Lawrence Erlbaum Associates.

Brashers, D. E., Neidig, J. L., Haas, S. M., Dobbs, L. K., Cardillo, L. W., & Russell, J. A. (2000). Communication in the management of uncertainty: The case of persons living with HIV or AIDS. *Communications Monographs, 67*(1), 63–84. https://doi.org/10.1080/03637750009376495

Carcioppolo, N., Jensen, J. D., Wilson, S. E., Collins, W. B., Carrion, M., & Linnemeier, G. (2013). Examining HPV threat-to-efficacy ratios in the extended parallel process model. *Health Communication, 28*(1), 20–28. https://doi.org/10.1080/10410236.2012.719478

Chang, C. (2015). Motivated processing: How people perceive news covering novel or contradictory health research findings. *Science Communication, 37*(5), 602–634. https://doi.org/10.1177/1075547015597914

Cho, H., & Witte, K. (2005). Managing fear in public health campaigns: A theory-based formative evaluation process. *Health Promotion Practice, 6*(4), 482–490. https://doi.org/10.1177/1524839904263912

Clarke, J. N., & Everest, M. M. (2006). Cancer in the mass print media: Fear, uncertainty and the medical model. *Social Science & Medicine, 62*(10), 2591–2600. https://doi.org/10.1016/j.socscimed.2005.11.021

Cohen, E. L., Caburnay, C. A., Luke, D. A., Rodgers, S., Cameron, G. T., & Kreuter, M. W. (2008). Cancer coverage in general-audience and black newspapers. *Health Communication, 23*(5), 427–435. https://doi.org/10.1080/10410230802342176

Colditz, G. A., Sellers, T. A., & Trapido, E. (2006). Epidemiology—identifying the causes and preventability of cancer? *Nature Reviews Cancer, 6*(1), 75–83. https://doi.org/10.1038/nrc1784

Feldman, L. P., Hart, P. S., & Milosevic, T. (2017) Polarizing news? Representations of threat and efficacy in leading U.S. newspapers' coverage of climate change. *Public Understanding of Science, 26*(4), 481–497. https://doi.org/10.1177/0963662515595348

Freimuth, V. S., Greenberg, R. H., DeWitt, J., & Romano, R. M. (1984). Covering cancer: Newspapers and the public interest. *Journal of Communication, 34*(1), 62–73. https://doi.org/10.1111/j.1460-2466.1984.tb02985.x

Frewer, L. J., Miles, S., Brennan, M., Kuznesof, S., Ness, M., & Ritson, C. (2002). Public preferences for informed choice under conditions of risk uncertainty. *Public Understanding of Science, 11*(4), 363–372. https://doi.org/10.1088/0963-6625/11/4/304

Goodall, C., Sabo, J., Cline, R., & Egbert, N. (2012). Threat, efficacy, and uncertainty

in the first 5 months of national print and electronic news coverage of the H1N1 virus. *Journal of Health Communication, 17*(3), 338–355. https://doi.org/10.1080/10810730.2011.626499

Goodall, C. E., & Reed, P. (2013). Threat and efficacy uncertainty in news coverage about bed bugs as unique predictors of information seeking and avoidance: An extension of the EPPM. *Health Communication, 28*(1), 63–71. https://doi.org/10.1080/10410236.2012.689096

Gustafson, A., & Rice, R. E. (2020). A review of the effects of uncertainty in public science communication. *Public Understanding of Science, 29*(6), 614–633. https://doi.org/10.1177/0963662520942122

Han, P. K. J., Zikmund-Fisher, B. J., Duarte, C. W., Knaus, M., Black, A., Scherer, A. M., & Fagerlin, A. (2018). Communication of scientific uncertainty about a novel pandemic health threat: Ambiguity aversion and its mechanisms. *Journal of Health Communication, 23*(5), 435–444. https://doi.org/10.1080/10810730.2018.1461961

Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd Ed.). Guilford Press.

Hurley, R. J., Kosenko, K. A., & Brashers, D. (2011). Uncertain terms: Message features of online cancer news. *Communication Monographs, 78*(3), 370–390. https://doi.org/10.1080/03637751.2011.565061

Jensen, J. D., Moriarty, C. M., Hurley, R. J., & Stryker, J. E. (2010). Making sense of cancer news coverage trends: A comparison of three comprehensive content analyses. *Journal of Health Communication, 15*(2), 136–151. https://doi.org/10.1080/10810730903528025

Jensen, J. D., Carcioppolo, N., King, A. J., Bernat, J. K., Davis, L., Yale, R., & Smith, J. (2011). Including limitations in news coverage of cancer research: Effects of news hedging on fatalism, medical skepticism, patient trust, and backlash, *Journal of Health Communication, 16*(5), 486–503. https://doi.org/10.1080/10810730.2010.546491

Jensen, J. D., Pokharel, M., Scherr, C. L., Kind, A. J., Brown, N., & Jones, C. (2017). Communicating uncertain science to the public: How amount and source of uncertainty impact fatalism, backlash, and overload. *Risk Analysis, 37*(1), 40–51. https://doi.org/10.1111/risa.12600

Jung, K.-W., Won, Y.-J., Kong, H.-J., & Lee, E. S. (2018). Cancer statistics in Korea: Incidence, mortality, survival, and prevalence in 2015. *Cancer Research and Treatment, 50*(2), 303–316. https://doi.org/10.4143/crt.2018.143

Konfortion, J., Jack, R. H., & Davies, E. A. (2014). Coverage of common cancer types in UK national newspapers: a content analysis. *BMJ Open, 4*(7), Article e004677. https://doi.org/10.1136/bmjopen-2013-004677

Kye, S. Y., Kwon, J. H., Kim, Y.-C., Shim, M., Kim, J. H., Cho, H., Jung, K. W., & Park, K. (2015). Cancer risk factors in Korean news media: A content analysis. *Asian Pacific Journal of Cancer Prevention: APJCP, 16*(2), 731–736. https://doi.org/10.7314/apjcp.2015.16.2.731

Lee, J., Kim, Y., & Kim, Y. (2018). How powerful are fear appeals and testimonials in reducing fundamental causes of smoking cessation intention in South Korea? Applying the extended parallel process model to the fundamental cause theory. *Asian Communication Research, 15*(1), 13–48. https://doi.org/10.20879/acr.2018.15.1.13

Mishel, M. H. (1988). Uncertainty in illness. *Image: The Journal of Nursing Scholarship,*

20(4), 225–232. https://doi.org/10.1111/j.1547-5069.1988.tb00082.x

Mishel, M. H. (1990). Reconceptualization of the uncertainty in illness theory. Image: *The Journal of Nursing Scholarship, 22*(4), 256–262. https://doi.org/10.1111/j.1547-5069.1990.tb00225.x

Moriarty, C. M., & Stryker, J. E. (2008). Prevention and screening efficacy messages in newspaper accounts of cancer. *Health Education Research, 23*(3), 487–498. https://doi.org/10.1093/her/cyl163

Niederdeppe, J., Fowler, E. F., Goldstein, K., & Pribble, J. (2010). Does local television news coverage cultivate fatalistic beliefs about cancer prevention? *Journal of Communication, 60*(2), 230–253. https://doi.org/10.1111/j.1460-2466.2009.01474.x

Niederdeppe, J., Lee, T., Robbins, R., Kim, H. K., Kresovich, A., Kirshenblat, D., Standridge, K., Clarke, C. E., Jensen, J., & Fowler, E. F. (2014). Content and effects of news stories about uncertain cancer causes and preventive behaviors. *Health Communication, 29*(4), 332–346. https://doi.org/10.1080/10410236.2012.755603

Powe, B. D., & Finnie, R. (2003). Cancer fatalism: The state of the science. *Cancer Nursing, 26*(6), 454–467. https://doi.org/10.1097/00002820-200312000-00005

Rains, S. A., & Tukachinsky, R. (2015). Information seeking in uncertainty management theory: Exposure to information about medical uncertainty and information-processing orientation as predictors of uncertainty management success. *Journal of Health Communication, 20*(11), 1275–1286. https://doi.org/10.1080/10810730.2015.1018641

Ramondt, S., & Ramirez, A. S. (2017). Fatalism and exposure to health information from the media: Examining the evidence for causal influence. *Annals of the International Communication Association, 41*(3–4), 298–320. https://doi.org/10.1080/23808985.2017.1387502

Riles, J. M., Sangalang, A., Hurley, R. J., & Tewksbury, D. (2015). Framing cancer for online news: Implications for popular perceptions of cancer, *Journal of Communication, 65*(6), 1018–1040. https://doi.org/10.1111/jcom.12183

Shi, J., Wang, X., Peng, T. Q., & Chen, L. (2019). Cancer-prevention messages on Chinese social media: A content analysis grounded in the extended parallel process model and attribution theory. *International Journal of Communication, 13*, 1959–1976.

Shim, M., Kelly, B., & Hornik, R. (2006). Cancer information scanning and seeking behavior is associated with knowledge, lifestyle choices, and screening. *Journal of Health Communication, 11*(S1), 157–172. https://doi.org/10.1080/10810730600637475

Shim, M., Kim, Y.-C., Kye, S. Y., & Park, K. (2016). News portrayal of cancer: Content analysis of threat and efficacy by cancer type and comparison with incidence and mortality in Korea. *Journal of Korean Medical Science, 31*(8), 1231–1238. https://doi.org/10.3346/jkms.2016.31.8.1231

Slater, M. D., Long, M., Bettinghaus, E. P., & Reineke, J. B. (2008). News coverage of cancer in the United States: A national sample of newspapers, television, and magazines. *Journal of Health Communication, 13*(6), 523–537. https://doi.org/10.1080/10810730802279571

Slovic, P., Fischhoff, B., & Lichtenstein, S. (1984). Behavioral decision theory perspectives on risk and safety. *Acta Psychologica, 56*(1–3), 183–203.

https://doi.org/10.1016/0001-6918(84)90018-0

So, J., Kuang, K., & Cho, H. (2016). Reexamining fear appeal models from cognitive appraisal theory and functional emotion theory perspectives. *Communication Monographs, 83*(1), 120–144. https://doi.org/10.1080/03637751.2015.1044257

Stryker, J. E., Emmons, K. M., & Viswanath, K. (2007). Uncovering differences across the cancer control continuum: A comparison of ethnic and mainstream cancer newspaper stories. *Preventive Medicine, 44*(1), 20–25. https://doi.org/10.1016/j.ypmed.2006.07.012

Turner, M. M., Boudewyns, V., Kirby-Straker, R., & Telfer, J. (2013). A double dose of fear: A theory-based content analysis of news articles surrounding the 2006 cough syrup contamination crisis in Panama. *Risk Management, 15*(2), 79–99. https://doi.org/10.1057/rm.2012.13

Viswanath, K., Breen, N., Meissner, H., Moser, R. P., Hesse, B., Steele, W. R., & Rakowski, W. (2006). Cancer knowledge and disparities in the information age. *Journal of Health Communication, 11*(S1), 1–17. https://doi.org/10.1080/10810730600637426

Witte, K. (1992). Putting the fear back into fear appeals: The extended parallel process model. *Communications Monographs, 59*(4), 329–349. https://doi.org/10.1080/03637759209376276

Witte, K. (1994). Fear control and danger control: A test of the extended parallel process model (EPPM). *Communications Monographs, 61*(2), 113–134. https://doi.org/10.1080/03637759409376328

World Health Organization (2018, February 1). Cancer. http://www.who.int/en/news-room/fact-sheets/detail/cancer

Yu, J., & Han, K.-H. (2018). The usage and credibility of information sources for cancer prevention. *Asian Communication Research, 15*(2), 8–24. https://doi.org/10.20879/acr.2018.15.2.8