

Examining Knowledge as a Motivation for Attention to Breast Cancer–Related Information Across Different Media

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This study investigates motivations of attention to breast cancer–related information across different media, including factual knowledge, structural knowledge, and risk perception based on the cognitive learning process. Structural equation modeling is used to test the impacts of factual knowledge and structural knowledge on Singaporean women’s attention to media messages about breast cancer, with risk perception of the disease as a mediating factor. The results indicate that structural knowledge raises women’s perception of risk, which in turn is positively associated with their attention to reports about breast cancer in newspapers, on television, and on the Internet. Factual knowledge about breast cancer has no significant association with women’s perception of risk. In terms of theoretical and practical implications, this study highlights the role of knowledge in affecting individuals’ media attention rather than testing how media attention affects knowledge acquisition, and it suggests that practitioners should put more effort into cultivating women’s structural knowledge about breast cancer.

Keywords: structural knowledge, factual knowledge, risk perception, media attention

Breast cancer is a severe public health issue around the world. According to a report by the Breast Cancer Research Foundation (2012), nearly 1.7 million new cases of breast cancer were diagnosed in 2012 worldwide. The latest report of trends in cancer incidence in Singapore from 2009 to 2013 indicates that breast cancer ranks first among cancers that affect Singaporean women (National Cancer Centre Singapore, 2014). Hence, more research is needed to identify factors associated with breast cancer prevention and treatment, especially in areas that are amenable to intervention, such as encouraging the public to pay attention to information on breast cancer. As an important source of health information, the media play a crucial role in disseminating information on breast cancer prevention and treatment (Wahlberg & Sjoberg, 2000; Yeoh, Chew, & Wang, 2006). Thus, it is necessary to investigate the key factors associated with individuals’ media use on the issue of breast cancer.

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Given the media's importance as an information source, a large body of research focuses on exploring the outcomes of individuals' media consumption, such as knowledge acquisition from media consumption (Chaffee, Zhao, & Leshner, 1994; Eveland, 2001; Yang, Chuah, Lee, & Ho, 2017), attitude change in persuasion (Kiousis & McCombs, 2004; Ryffel, Wirz, Kühne, & Wirth, 2014), and behavior change through campaigns (Abroms & Maibach, 2008; Lovejoy, Riffe, & Lovejoy, 2015). Many studies have examined knowledge as an outcome of media use with a focus on the effectiveness of media in cultivating public understanding of health issues (Noar, 2006; Wade & Schramm, 1969). In this research approach, communication is perceived as a single, directed process with a focus on media effects. However, in the real world, communication is a recurrent process rather than a one-time event, and the effects of media use may influence individuals' media consumption over time. Slater (2007) proposes a reinforcing spiral model, which argues that the relationship between media and its audience is a continuous interaction. In this model, individuals can learn from their media use, and the knowledge they gain affects their subsequent media use. Thus, this study examines media effects as a continual cycle with a focus on how individuals' knowledge affects their information management behaviors.

Despite research in media use and its effects on health issues, few studies focus on how prior knowledge of a certain topic affects a person's media consumption of that topic. To examine the process underlying the impacts of knowledge on media use, this study employs a different angle to investigate the relationship between knowledge and media use.¹ Instead of examining knowledge as an outcome of media consumption, we explore how knowledge affects subsequent media consumption.

Role of Prior Knowledge

Several learning theories have drawn attention to the importance of prior knowledge in individuals' learning. One prominent theory in this area is schema theory, which emphasizes the role of prior knowledge in guiding individuals' continual attention and processing of social information (Bartlett, 1964). A schema refers to the system of organizing and perceiving new information. Fiske and Dyer (1985) interpret schema as "a cognitive structure that contains units of information and the links among them" (p. 839). People use a schema to organize current knowledge. Subsequently, the schema influences attention to and absorption of new knowledge. People are more likely to pay attention to things that fit their schema. Similarly, individuals' prior knowledge of a certain issue is likely to promote their continued attention to the same issue. Building on this foundation, schema researchers highlight that people's learning of new information or knowledge is based on their prior knowledge (R. Anderson, 1984; Bartlett, 1964; Kirschner, 2002; Van Merriënboer & Sweller, 2010).

Many empirical studies have documented that prior knowledge plays a crucial role in learning and acquiring new information. For example, in a study on science learning, Hewson and Hewson (1983) assert that students' existing knowledge is one of the factors affecting their science learning. Studies on tourism report a positive relationship between prior knowledge and information search behaviors (Gursoy & McCleary,

¹ One of the main objectives of this study is to validate the proposed conceptual framework. This study serves as groundwork for future studies, and the cross-sectional nature of the data in this study may limit the robustness of the results.

2004; Kerstetter & Cho, 2004). It is argued that prior knowledge or information stored in an individual's memory allows the individual to formulate more questions, and therefore leads to more information search. Although research has explored the effects of prior knowledge on attention to information, few studies examine the mechanism underlying the relationship. Therefore, this research is proposed as a pilot study to address this issue by examining how individuals' prior knowledge of certain health issues affects their subsequent health information management behaviors (i.e., the extent to which they pay attention to health-related messages).

Factual Knowledge and Structural Knowledge

Previous studies on knowledge about health issues tend to focus on the factual dimension of knowledge, which assesses individuals' ability to recognize certain facts (e.g., Guerra, Dominguez, & Shea, 2005; Yang & Ho, 2017). Many studies on health knowledge measure factual knowledge on the basis of the number of correct responses (Zellner, 2003). For example, Wilkinson, Vasudevan, Honn, Spitz, and Chamberlain (2009) examined individuals' factual knowledge of cancer by asking participants to answer "true," "false," or "don't know" to 10 items that probed cancer knowledge. Dillard et al. (2011) measured factual knowledge of breast cancer by asking respondents six questions about breast cancer and summing the correct responses to yield an overall knowledge score.

While the ability to accurately recognize facts is an important dimension of knowledge, it is by no means the only one (Dorsey, Campbell, Foster, & Miles, 1999; Jonassen, Beissner, & Yacci, 1993). Previous studies have categorized knowledge into three dimensions: declarative knowledge, procedural knowledge, and structural knowledge (Jonassen, Beissner, & Yacci, 1993). Declarative knowledge refers to the concepts or ideas that individuals are conscious of. Procedural knowledge is the comprehension of applying declarative knowledge in specific contexts. In many health communication studies, declarative and procedural knowledge are collectively described as factual knowledge. Despite the benefits of examining factual knowledge, many scholars propose that knowledge should involve more than the ability to correctly answer a certain number of true-or-false statements (Kraiger, Ford, & Salas, 1993). Moreover, Graber (2001) argues that "scholars who measure political knowledge routinely ignore the importance of connotative thinking. They prize people's ability to remember the facts and denotations, without testing whether they understand the significance of the information" (p. 22). She also argues, "The ability to reason effectively depends on the ability to make connections among ideas" (p. 14).

Several human information processing theories posit that memory is constructed of nodes that are interconnected through links (e.g., Collins & Loftus, 1975). Theories of the node-link structure of human memory make a distinction between factual knowledge and structural knowledge (Jonassen, Beissner, & Yacci, 1993). Though scholars employ different terms, most agree that knowledge is not simply the recognition of facts and should be more than correctly identifying certain statements as true or false (Kraiger et al., 1993).

The nature of structural knowledge is postulated in many theories, which conceive of it as a structural arrangement of stored information, such as a schema (Bartlett, 1964). Some scholars assert that most knowledge structure theories can be encapsulated within the realm of schema theory (Alexander, Schallert, & Hare, 1991). People with more developed schemas would perform better in understanding

complex processes (Kahlor & Rosenthal, 2009). Compared with factual knowledge, structural knowledge has more important implications for the comprehension of information as well as the ability to engage in problem solving (Jonassen et al., 1993).

Unlike factual knowledge, which is represented by the awareness of facts in a domain of memory, structural knowledge is represented by the linkages between the facts (Eveland, Cortese, Park, & Dunwoody, 2004). Furthermore, factual knowledge measures the quantity of conceptual nodes, while structural knowledge reflects the organization and strength of the links (Day, Arthur, & Gettman, 2001). The measurements for factual knowledge reduce the relationships between concepts to a simple dichotomous true-false scale, whereas measurements for structural knowledge capture the complexity of relationships between the conceptual nodes. Factual knowledge represents the content, which is the potentially disconnected bits of information represented by the nodes in human memory, while structural knowledge involves the manner in which these nodes are organized in memory (Eveland, Marton, & Seo, 2004). A high level of structural knowledge represents the ability to make connections among concepts and the ability to understand the significance of the information.

A strongly interconnected knowledge structure is central to being an expert, because expert knowledge is argued to contain more linkages among concepts (Fiske, Kinder, & Larter, 1983). For example, when measuring factual knowledge, a statement such as "smoking can cause breast cancer" is coded as correct when participants answer "true" and coded as incorrect if the response is "false." The dichotomization of knowledge tells whether an individual answers correctly but does not tap into the strength of the relationship among the concepts as perceived by the individual. By asking respondents to indicate how breast cancer and smoking are related, researchers will be able to know the strength of the relationship between the concepts as perceived by the individuals, beyond knowing whether the respondents have answered the questions correctly. Considering the conceptual differences between factual and structural knowledge, it is therefore important to examine separately their roles in promoting health information seeking.

Knowledge of Breast Cancer as a Predictor of Risk Perception

On the relationship between knowledge and risk perception, scholars have found that knowledge of certain risk issues has a significant impact on individuals' risk perception (Fagerlin, Zikmund-Fisher, & Ubel, 2005). In those studies, factual knowledge was examined by asking respondents to identify facts. For example, Dillard et al. (2011) find that factual knowledge about breast cancer is positively associated with risk perception of the issue. Furthermore, Facione (2002) reports that people with more accurate information on certain risk issues are more likely to perceive risk. Hence, it can be expected that factual knowledge about breast cancer will be positively associated with a person's perception of the risk of the disease.

In addition to examining factual knowledge, this study explores the impact of structural knowledge on risk perception. As noted earlier, information on a risk issue increases individuals' perception of that risk (Facione, 2002; Fagerlin et al., 2005). Compared with factual knowledge, structural knowledge has more important implications for individuals' comprehension of information (Jonassen et al., 1993). It is reasonable to expect that structural knowledge would play a more important role in individuals' risk perception. In a study on risk perception of breast cancer, Lee, Ho, Chow, Wu, and Yang (2013) demonstrate that a structural

dimension of knowledge is positively associated with women's perception of risk about the issue. Thus, we hypothesize the following:

H1: Factual knowledge of breast cancer is positively associated with women's risk perception of breast cancer.

H2: Structural knowledge of breast cancer is positively associated with women's risk perception of breast cancer.

Linking Risk Perception About Breast Cancer and Media Attention

Previous studies of the relationship between risk perception and media attention generally treat risk perception as an outcome variable (e.g., Agha, 2003; Coleman, 1993; Wahlberg & Sjoberg, 2000). However, in real life, people who perceive risks tend to pay more attention to information related to the risks. The risk information seeking and processing model developed by Griffin, Dunwoody, and Neuwirth (1999) indicates that perceived risk characteristics increase individuals' information seeking. They propose that risk perception plays an important role in developing risk communication, because risk perception could motivate information-seeking behaviors.

Empirical studies of the impact of risk perception on information attention report evidence of a positive relationship (Neuwirth, Dunwoody, & Griffin 2000; ter Huurne, Griffin, & Gutteling, 2009). For example, in a Dutch study on risks about hazardous industrial substances, ter Huurne and Gutteling (2008) find that residents' risk perception encouraged them to seek more information. The researchers concluded that higher risk perception reflects higher uncertainty. To eliminate uncertainty toward risk, individuals tend to acquire more information.

Media serve as general sources from which individuals acquire information on public issues (Wahlberg & Sjoberg, 2000). In Singapore, the media play an important role in disseminating messages about breast cancer (Yeoh et al., 2006). For example, the Breast Cancer Foundation uses different media platforms to provide general information on breast cancer education and support programs. As individuals pay attention to information about breast cancer, their uncertainty about breast cancer is reduced as information acquisition takes place (Shim, Kelly, & Hornik, 2006). Thus, it is reasonable to expect that women who perceive risk of breast cancer will pay more attention to media. We posit the following hypothesis:

H3: Women's risk perception of breast cancer is positively associated with attention to breast cancer messages (a) in the newspaper, (b) on television, and (c) on the Internet.

Moreover, this study explores whether the effects of risk perception on media attention vary across different media sources. By examining the differential effects across different media sources, this study helps identify the platform that women are most likely to turn to for health information when they perceive breast cancer as a risk.

Previous research suggests that people have different levels of information exposure to health

information across media platforms (Emery, Vera, Huang, & Szczypka, 2014). For example, a study on patterns of information behaviors about e-cigarettes across media platforms found that television is the most common channel where people encounter relevant information (Emery et al., 2014). Furthermore, individuals' perception of media credibility influences their information behaviors. The risk information seeking and processing model suggests that people's views about various media affects their habitual information seeking behaviors (Griffin et al., 1999). The Internet is generally evaluated to be less credible than other media platforms due to the lack of professional gatekeepers to monitor content (Flanagin & Metzger, 2007; Kaid & Postelnicu, 2005). In this study, we expect to find differences in women's use of various media platforms for breast cancer information. However, because little is known about how people consume breast cancer information across different media platforms, research is needed to inform public health authorities about the media platforms on which breast cancer information is consumed. Therefore, we pose the following research question to explore which medium women are most likely to turn to acquire information about breast cancer when they perceive this issue as a risk.

RQ1: Does the relationship between risk perception and attention to breast cancer messages vary across different media platforms?

Risk Perceptions as a Mediating Variable

Previous studies on the relationship between knowledge and media attention have yielded contradictory findings. Some studies report a negative relationship between knowledge and media attention (ter Huurne et al., 2009; ter Huurne & Gutteling, 2008). For example, ter Huurne and Gutteling (2008) find that people with more knowledge are less likely to pay attention to information. Meanwhile, other studies report a positive relationship between knowledge and information attention. In a study on cancer information seeking, Shim et al. (2006) find that people with more knowledge about cancer tend to pay more attention to related information. In another study on health literacy, von Wagner, Semmler, Good, and Wardle (2009) report that limited health literacy might reduce individuals' information seeking on cancer. A growing body of research reveals that people with the least knowledge tend to think they know the most, while those with the most knowledge are more aware of their knowledge gaps (Mondak, 1995; Park, 2001). In this case, it is possible that people with knowledge will be more likely to seek information.

Considering those contradictory findings, we expect that there may exist some other factors that influence the relationship between knowledge and media attention. The previous sections have reviewed factual knowledge and structural knowledge with respect to risk perception as the outcome (Dillard et al., 2011; Fagerlin et al., 2005). In addition, we have outlined the relationship between risk perception of breast cancer and news media use (ter Huurne et al., 2009; Neuwirth et al., 2000). Bringing together these elements of the discussion, we propose that knowledge will increase the perception of risk, which in turn may motivate women's attention to media coverage of breast cancer. Considering the causation among knowledge, risk perception, and media attention, the current study presents a first attempt to explore the possible mediating role of risk perception between knowledge and attention to news media coverage of breast cancer. We pose the following research questions:

RQ2: Does risk perception of breast cancer mediate the relationship between factual knowledge and attention to breast cancer news?

RQ3: Does risk perception of breast cancer mediate the relationship between structural knowledge and attention to breast cancer news?

Method

Data for this study were obtained from a nationally representative computer-assisted telephone survey of 802 Singaporean women between ages 30 and 70. The interviews were conducted in January 2011 at a large public university in Singapore. We used the last birthday selection technique for randomization purposes. This technique is suggested to be a probability and noninvasive procedure to obtain a randomized sample (O'Rourke & Blair, 1983). To ensure that the responses were obtained from a wide range of Singaporeans, the interviews were conducted in the three most frequently spoken languages in Singapore (English, Mandarin, or Malay). The response rate was 32.2% based on the American Association for Public Opinion Research formula 3.

Measurements

Three groups of variables were created: (a) media attention (newspaper, television, and the Internet) as outcome variables; (b) knowledge about breast cancer (factual knowledge and structural knowledge); and (c) control variables (age, monthly household income, and education level). Table 1 summarizes the descriptive statistics for the measurements and the factor loading for each latent variable.

Table 1. Descriptive Statistics and Factor Loading for Each Observed Variable (N = 802).

Variable	Factor loading	<i>M</i>	<i>SD</i>
Factual knowledge		12.99	3.18
Structural knowledge		0.55	0.19
Attention to newspaper 1	.82***	6.48	3.25
Attention to newspaper 2	.92***	6.22	3.35
Attention to newspaper 3	.93***	5.63	3.33
Attention to television 1	.74***	5.77	3.42
Attention to television 2	.94***	5.57	3.53
Attention to television 3	.97***	5.02	3.46
Attention to Internet 1	.92***	3.56	3.18
Attention to Internet 2	.97***	3.28	3.06
Attention to Internet 3	.96***	3.06	2.89
Risk perception 1	.55***	2.29	1.17
Risk perception 2	.54***	2.33	1.14
Risk perception 3	.66***	2.25	1.39

Note. The measurement of structural knowledge is a score calculated based on the formula for structural knowledge density. Thus, structural knowledge is a single-indicator latent variable in the measurement model.

*** $p < .001$.

Media Attention Variables

The media attention items were adapted from a study by Besley and Shanahan (2005). Respondents were asked to rate on a scale from 0 (*no attention at all*) to 10 (*very close attention*) how much attention they pay to the following three types of coverage in the newspaper: (a) news stories related to health or medical topics; (b) news stories related to breast cancer prevention; and (c) breast cancer prevention campaigns (Cronbach's $\alpha = .93$). The same three items were used to measure attention to television (Cronbach's $\alpha = .90$) and the Internet (Cronbach's $\alpha = .96$).

Factual Knowledge About Breast Cancer

To measure factual knowledge, we used seven knowledge statements on breast cancer from the Singapore Cancer Society's and the Breast Cancer Foundation's websites (<https://www.singaporecancersociety.org.sg> and <http://www.facebook.com/bcf.pink>, respectively). For each of the statements, respondents were asked to indicate the accuracy of the statement on a 4-point scale, where 1 = *definitely true*, 2 = *likely true*, 3 = *likely false*, or 4 = *definitely false*. The seven statements are: (a) "The risk of breast cancer increases with age"; (b) "Women with no children have a slightly higher risk of getting breast cancer"; (c) "Breast cancer can be inherited"; (d) "A woman with cancer in one breast has a greater chance of getting a new cancer in the other breast or in another part of the same breast"; (e) "Mammography is an X-ray examination of the breast"; (f) "Women from age 40 onward are encouraged to go for annual mammography"; (g) "Women from age 40 onward are encouraged to go for annual clinical breast examination."² The score of the seven responses was computed as the measurement for factual knowledge ($M = 12.99$, $SD = 3.18$, Kuder-Richardson Formula 20 = .53).

Structural Knowledge About Breast Cancer

As mentioned above, structural knowledge refers to the strength of perceived links between information nodes in one's cognitive structure. Although scholars agree that structural knowledge can be used to examine a person's ability to make connections among related concepts, they employ various measures for this concept. We address the measurement issue by borrowing the concept of network density from social network analysis research. Derived from the social network analysis study by Wasserman and Faust (1994, p. 143), the concept of knowledge structure density (KSD), created by Eveland, Marton, and Seo (2004), is operationalized here to examine structural knowledge. In social network analysis, density refers to the degree of connectedness of a network's nodes (Astleitner & Leutner, 1996). Accordingly, structural knowledge is operationalized as KSD, which examines the degree

² For all seven statements, the answer is *likely true* or *definitely true*.

of connectedness among concepts in one's memory. In other words, KSD assesses people's ability to make connections among the concepts within a domain.

To measure knowledge structure density, respondents were first provided a series of concepts from a given domain and then asked to indicate the extent to which they believe these concepts are related. In particular, respondents were asked to rate the degree of connectedness toward links that make sense (Cortese, 2007). For this study, we identified five concepts of breast cancer from the websites of the Singapore Cancer Society and the Breast Cancer Foundation: breast cancer, smoking, alcohol consumption, race, and eating habits. All these factors are extensively mentioned in messages about causal factors related to breast cancer. Among all the links, the following four links make sense. Respondents were asked in telephone interviews to indicate the extent to which the factors in these four links are related. Answers were given on a 5-point scale ranging from 1 (*not related at all*) to 5 (*very closely related*). We then employed the KSD formula to calculate the density as follows:

$$\text{Density} = \frac{\sum kv}{n(n-1)/2},$$

where k is a given link among the concepts; v refers to the value attached to the k th link, which represents the extent to which the two factors in this link are related; and n is the total number of factors in the network. A higher score in KSD denotes a higher level of structural knowledge.³

Risk Perception

Three modified items were created based on Shim's (2008) study. Respondents were asked to indicate the likelihood of the following three situations: (a) "How likely do you think it is that you will develop breast cancer in the future?" (b) "How likely do you think it is that you will develop breast cancer, as compared to the average woman your age?" and (c) "How often do you worry about getting breast cancer?" Answers were measured on a 5-point scale ranging from 1 (*least likely*) to 5 (*most likely*). Cronbach's $\alpha = .70$.

Control Variables

Three demographic items were used as control variables: age, education, and monthly household income. Respondents range in age from 21 to 70 ($Mdn = 47$, $M = 47.30$, $SD = 9.71$). The median education level is O level (equivalent to a high school diploma), and median monthly household income is in the range of S\$3,001 to S\$4,000.

³ In this study, v ranges from 1 to 5, because the respondents were asked to indicate the extent to which the factors were related on a 5-point scale. In the KSD formula, $n = 5$, because five factors are identified from the websites on breast cancer: breast cancer, smoking, alcohol consumption, race, and eating habits. There are four meaningful links among these five factors: (1) breast cancer and smoking; (2) breast cancer and alcohol consumption; (3) breast cancer and race; (4) breast cancer and eating habits. Thus, the value of $\sum kv$ should be a summation of the value attached these four links.

Analytical Approach

The hypothesized model was tested using structural equation modeling, with maximum likelihood estimation in Mplus 6 (Muthén & Muthén, 2012). Following J. Anderson and Gerbing (1988), we employed a two-step analytic approach in this study. We first estimated measurement models using confirmatory factor analysis and then tested structural models. The aim of the analysis is to test whether the hypothesized model fit the data well based on the following goodness-of-fit indexes: the maximum likelihood chi-square (χ^2), relative chi-square (χ^2/df), comparative fit index, Tucker-Lewis index, and root mean square error of approximation. Specifically, a small ratio χ^2/df indicates a good model fit (Bollen, 1989). A Tucker-Lewis index over .95 is considered acceptable (Hu & Bentler, 1995), and a comparative fit index that exceeds .93 is acceptable (Byrne, 1994). A root mean square error of approximation value less than .05 indicates a good fit (Bollen & Long, 1993).

To determine whether the effects of risk perception on attention to breast cancer messages are statistically different among different media platforms, we determined whether the 84% confidence intervals overlap (Payton, Greenstone, & Schenker, 2003). In addition, we estimated mediation effects and tested them for significance with a bootstrapping procedure in Mplus. Following the approach to test mediation effects outlined by Hayes (2009) and Preacher and Hayes (2008), this method yields a more valid estimation by repeatedly drawing bootstrap samples to estimate a percentile-based bootstrap confidence interval. In this study, bootstrap ($N = 2,000$) is performed with 95% confidence intervals. The indirect effect is considered significant if a zero is not included in the 95% confidence interval of the estimates (Preacher & Hayes, 2008).

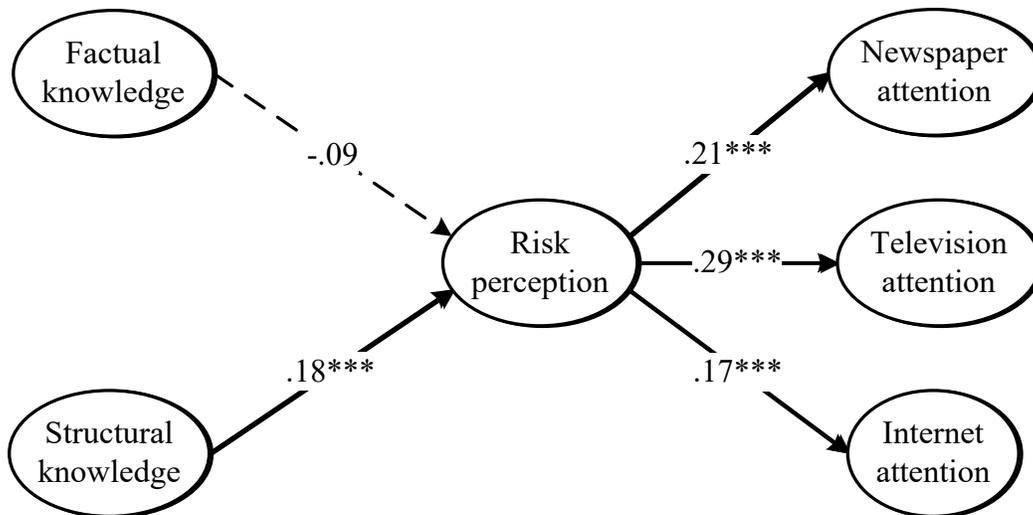
Results

In the estimation of measurement model, we allowed 11 error terms to covary based on a modification index recommendation and theoretical considerations, which improved the fit. We reference studies on structural equation modeling analysis that state that error covariances could occur between items within factors (Brown, 2014; Gerbing & Anderson, 1984; Ho, Detenber, Rosenthal, & Lee, 2014). Moreover, the modifications in the measurement model were retained in the analysis of the structural model. As shown in Table 2, both the measurement and structural models result in a good fit to the data. Moreover, the factor loadings for the latent variables are acceptable.

Table 2. Fit Indexes for the Measurement and Structural Models.

	Measurement model	Structural model
χ^2	152.26	168.60
<i>df</i>	77	83
χ^2/df	1.98	2.03
Comparative fit index	.99	.99
Tucker-Lewis index	.98	.98
Root mean square error of approximation	.035	.036

The results shown in Table 2 indicate that the structural model fits the data well. H1, concerning the impact of factual knowledge on women's perception of risk, is not supported. Structural knowledge of breast cancer is positively associated with women's risk perception ($\beta = .18, p < .001$), supporting H2. Women's risk perception of breast cancer is positively associated with attention to breast cancer messages in the newspaper ($\beta = .21, p < .001$), on television ($\beta = .29, p < .001$), and on the Internet ($\beta = .17, p < .001$). Thus, H3a, H3b, and H3c receive support. Figure 1 summarizes the estimated model.



Note. Dotted lines indicate hypothesized nonsignificant paths. Age, education, and household income served as control variables in the analyses.

*** $p < .001$.

Figure 1. Structural Equation Model With Standardized Coefficients (N = 802).

In answer to RQ1, results indicate that in the path from factual knowledge to media attention, the effects of risk perception on attention to breast cancer messages are not significantly different among newspaper, television, and the Internet, as the 84% confidence intervals overlap. In the path from structural knowledge to media attention, the effects of risk perception on attention to breast cancer messages are significantly different across newspaper, television, and the Internet. Specifically, the 84% confidence intervals for the paths from risk perception to attention to breast cancer messages are [.11, .42] in newspaper, [.42, .74] on television, and [.12, .42] on the Internet. In particular, the effects of risk perception on attention to television news is significantly different from attention to newspaper news and Internet news, while the difference between attention to newspaper news and Internet news is not significant due to the overlapping 84% confidence interval.

In addition, we examine the mediation effects of risk perception in the hypothesized model. The bootstrapped estimates for specific indirect effects are presented in Table 3.

Table 3. Standardized Indirect Effects and Bootstrap Confidence Intervals.

Indirect path	Estimate	95% CI
Factual knowledge → Risk perception → Attention to breast cancer messages in newspaper	-.01	[-.02, .003]
Factual knowledge → Risk perception → Attention to breast cancer messages on television	-.01	[-.03, .005]
Factual knowledge → Risk perception → Attention to breast cancer messages on the Internet	-.01	[-.02, .003]
Structural knowledge → Risk perception → Attention to breast cancer messages in newspaper	.22	[.04, .53]
Structural knowledge → Risk perception → Attention to breast cancer messages on television	.31	[.07, .65]
Structural knowledge → Risk perception → Attention to breast cancer messages on the Internet	.19	[.02, .50]

Note. CI = confidence interval.

In answer to RQ2, the results indicate that risk perception does not mediate the relationship between factual knowledge and attention to breast cancer news, with the bootstrap confidence interval that includes zero. In answer to RQ3, bootstrap results indicate that structural knowledge has significant indirect effects on attention to breast cancer news across the three news media platforms, because the generated bootstrap confidence interval excludes zero.

Discussion

Unlike many studies that focus on how media attention is related to people's knowledge, attitudes, and behaviors, the current study examines whether and how knowledge that people learn is related to their subsequent media use. In particular, this study investigates both factual knowledge and structural knowledge.

First, the results reveal that structural knowledge is associated with women's risk perception of breast cancer, and the risk perception is positively associated with their attention to the relevant news content in the newspaper, on television, and on the Internet. This is in line with the assimilation theory of meaningful learning (Ausubel, 1968). Moreover, the results demonstrate that communication could be a continual cycle rather than a one-time event. Prior knowledge could motivate people to pay attention to relevant content.

Second, we examine the impacts of knowledge on risk perception with an extension of knowledge dimensions. Structural knowledge is found to have a significant association with risk perception, while factual knowledge is found not to have a significant association with risk perception. This finding lends support to the assumption proposed by previous studies that people with more complex knowledge tend to have greater risk perception (Fagerlin et al., 2005).

The distinction between factual knowledge and structural knowledge may account for their different effects on risk perception. Factual knowledge relies on brute facts based on accurate and concrete information about breast cancer, whereas structural knowledge consists of the organization of cognitive elements (Guerra et al., 2005). People with cognitively complexity tend to have more breadth and depth of knowledge on a subject (Burlison & Caplan, 1998; Medin & Ross, 1997). As a result, people with structural knowledge would have a better understanding of breast cancer, such as causes and consequences. In addition, when people think more about how breast cancer concepts relate to one another, they are more likely to understand that the risks associated with those concepts are also related, amplifying their perception of the risk (Lee et al., 2013). For example, when people have basic knowledge that an unhealthy lifestyle can cause breast cancer, they may not perceive this issue as a risk. However, when people have the structural knowledge that breast cancer and an unhealthy lifestyle are highly related, they may take this issue seriously and may be more likely to develop a perception of the risk.

Moreover, risk perception is found to be positively associated with attention to news media coverage of breast cancer, lending support to findings in previous studies (Neuwirth et al., 2000; ter Huurne et al., 2009). A possible explanation for this finding is the risk information seeking and processing model, which proposes that individuals who perceive risk tend to seek related information (Griffin et al., 1999). Mass media are important outlets in Singapore for disseminating messages about breast cancer (Yeoh et al., 2006). Hence, it is not surprising that Singaporean women who perceive breast cancer as riskier would pay more attention to the news in newspapers and on television. This study also reveals a positive relationship between risk perception and attention to breast cancer news on the Internet. As electronic resources are increasingly prevalent, the Internet becomes an important information source for people to acquire health information (Medlock et al., 2015; Rennis, McNamara, Seidel, and Shneyderman, 2015). With Internet connectivity over 99% in Singapore, it is one of the few countries in the world where broadband Internet access is readily available to almost any would-be user anywhere in the country. Therefore, women who perceive breast cancer as a risk would turn to the Internet for information.

More important, this study finds that the relationship between structural knowledge and media attention is strongest for attention to television, which suggests that people are more likely to turn to television news for information about breast cancer when they perceive this issue as a risk. This finding is in line with previous research on how media credibility affects media consumption. Television is generally considered to have higher credibility than the Internet (Flanagin & Metzger, 2007; Kaid & Postelnicu, 2005). To learn about risk issues, people are more likely to turn to highly credible information sources than to sources with low credibility. Moreover, it requires a higher level of literacy to learn from newspaper than from television (Kleinnijenhuis, 1991). Thus, people are more likely to turn to television news for information on breast cancer than to a newspaper or to the Internet.

Risk perception is found to mediate the relationship between structural knowledge and media attention. Prior studies on risk perception offer possible explanations for this finding. In particular, knowledge of diseases plays a role in one's construction of risk. For example, a study on breast cancer reveals that individuals' knowledge of this disease enhances their communication of risk (d'Agincourt-Canning, 2005). Following the psychometric paradigm, the more people know about the disease, the more feeling of dread they will develop toward it, which in turn increases their risk perception (Fischhoff, Slovic,

Lichtenstein, Read, & Combs, 1978). The emotional reaction to risks, such as fear and anxiety, is assumed to affect information-seeking behavior (Neuwirth et al., 2000). It is assumed that a higher risk perception reflects greater uncertainty. Driven by the motivation to reduce uncertainty, people will increase their intention to seek information (Berger & Calabrese, 1974). These studies suggest that individuals' knowledge about risk could enhance their risk perception, which in turn might affect their information management behaviors.

Women with structural knowledge of breast cancer might have a better understanding of the disease, such as its risk characteristics. In Singapore, among the top-ranked cancers, breast cancer has the highest mortality rate in women. This risk characteristic may increase Singaporean women's fear, and ultimately motivate them to pay more attention to breast cancer news reports. Hence, women with in-depth knowledge on breast cancer would rate this issue as a risk, which then motivates them to attend to more related news coverage.

This study contains several limitations that should be addressed in future research. For the measurement of knowledge on breast cancer, more items should be employed to yield a better composite measure. Future research should conduct a pilot study to construct the concept of factual knowledge and structural knowledge on the issue of breast cancer. This study was conducted in a single country, which may limit our power to generalize the findings. Another limitation of the present study is its one-directional approach that merely examines how women's existing knowledge about breast cancer affects their attention to relevant media messages. To examine the mutually influencing relationship between media use and knowledge, longitudinal studies should be conducted to collect data of knowledge and media use at different points of time. Another limitation is that we employed only five factors to examine the knowledge structure density. For the convenience of the telephone survey, we did not include a large number of factors in this study. Future research might employ more items to measure knowledge structure density to strengthen the measurement validity. The low reliability of knowledge measures is acknowledged as a limitation; however, it is acceptable since the measurement of knowledge is an informative construct comprising items measuring different knowledge subdomains. Finally, the cross-sectional data employed in this study make it difficult for us to generalize about causality. Thus, we suggest that future studies employ experimental data or longitudinal data to validate the proposed theoretical framework.

Our study has several theoretical and practical implications. First, several communication studies focus on the effects of media attention on knowledge, but they do not take into account another communication direction based on the cognitive learning process. This study demonstrates that knowledge can contribute to media attention, suggesting that media effects should be seen as a continual cycle. The findings reemphasize the reinforcing spirals model, which suggests that the relationship between media and audience should be examined as a continuous interaction. Consistent with this model, research should not focus merely on how attention to media messages affects audiences as a one-time event but rather on how the outcomes of media effects influence audiences' subsequent media use. Second, our examination of structural knowledge as another dimension of knowledge contributes to research on the relationship between knowledge and media attention by providing a more accurate and comprehensive estimation of knowledge effects.

In terms of practical contributions, our results indicate that people with more structural knowledge of breast cancer pay more attention to news media. Thus, we recommend that more effort be put into cultivating women's knowledge of and literacy on breast cancer. In addition, health campaign messages should incorporate information that can raise women's perception of risk of breast cancer to promote more media attention on this issue to result in a virtual cycle for knowledge acquisition. Finally, this study finds that women who perceive breast cancer risk tend to pay different amounts of attention to the relevant information across different media platforms—implying the distinctive roles of different media in health campaigns. Women are more likely to pay attention to breast cancer news on television than in the newspaper or on the Internet as they develop risk perceptions of breast cancer. Accordingly, to cultivate public health literacy about breast cancer, governments and relevant authorities should conduct more effective campaigns by tailoring publicity and education strategies to different media platforms. The role of television should be elevated in disseminating breast cancer information. To take advantage of the Internet in raising public awareness of breast cancer, efforts should be made to improve the quality and reliability of information on the Internet.

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