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Title	Staying abreast of breast cancer : examining how communication and motivation relate to Singaporean women's breast cancer knowledge
Author(s)	Lee, Edmund W. J.; Ho, Shirley S.
Citation	Lee, E. W. J., & Ho, S. S. Y. (2015). Staying abreast of breast cancer: examining how communication and motivation relate to Singaporean women's breast cancer knowledge. <i>Asian journal of communication</i> , 1-21.
Date	2015
URL	http://hdl.handle.net/10220/25443
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Running head: BREAST CANCER KNOWLEDGE IN SINGAPORE

Staying Abreast of Breast Cancer: Examining How Communication and Motivation
Relate to Singaporean Women's Breast Cancer Knowledge

Edmund W. J. Lee and Shirley S. Ho

Wee Kim Wee School of Communication and Information

Nanyang Technological University

31 Nanyang Link #05-01

Singapore 637718

Edmund W. J. Lee (Master of Communication Studies, Nanyang Technological University) is a PhD student in the Wee Kim Wee School of Communication and Information at Nanyang Technological University. His research focuses on risk communication in the contexts of health, science and environmental sustainability. His work has appeared in the *Journal of Risk Research* and *Science Communication*.

Shirley S. Ho (PhD, University of Wisconsin-Madison) is an Associate Professor in the Wee Kim Wee School of Communication and Information at Nanyang Technological University. Her research focuses on media effects and public opinion in the contexts of science, environmental sustainability, and public health. Her work has appeared in journals such as *Communication Research*, *Public Understanding of Science*, and *Journal of Health Communication*.

Please send all correspondence to Edmund W. J. Lee at elwj88@gmail.com
Address: 31 Nanyang Link, Nanyang Technological University, Singapore 637718.
Tel: +65 6790-5772.

This work was supported by the Nanyang Technological University Research Grant [Grant number M4080259.060].

Abstract

Numerous health communication studies have highlighted the importance of factual knowledge as an antecedent to health behavior but few have explored other dimensions of health knowledge, such as structural knowledge. This study seeks to fill this gap by investigating conceptual differences between these two kinds of knowledge in the context of breast cancer in Singapore, and find out how communication and motivational factors are related to them. Using a nationally representative random-digit-dial survey of women aged 30-70 ($N = 802$), results showed that interpersonal communication and elaboration were associated with both knowledge types. Attention to online health news and the level of risk perception were positively associated with structural knowledge, but not factual knowledge. Theoretical and practical implications for health communication were discussed.

Keywords: breast cancer; mass media; interpersonal communication; elaboration; risk perception; fatalism; knowledge; structural knowledge; Singapore.

**Staying Abreast of Breast Cancer: Examining How
Communication and Motivation Relate to Singaporean Women's Breast Cancer
Knowledge**

Breast cancer is a global health risk and a leading cause of death among women (Chukmaitov, Wan, Menachemi, & Cashin, 2008; Sim, Seah, & Tan, 2009). In Singapore, breast cancer incidences have risen significantly over the past twenty years and it is the most common cancer among Singaporean women (Chuwa et al., 2009; Jara-Lazaro, Thilagaratnam, & Tan, 2010; Straughan & Seow, 2000). Yet, Singaporean women have low cancer knowledge (Ong et al., 2010; Sim et al., 2009) and many hold misconceptions such as believing that radiation from mammography may cause breast cancer or that they are not susceptible if there are no observable risk factors. Even with the ease of accessibility to healthcare services, the relatively low uptake of mammography could be due to the low knowledge level among Singaporean women as women with less cancer knowledge are less likely to go for mammography (Chuwa et al., 2009; Ong et al., 2010).

As knowledge is one of the precursors to health behaviors, it is important to examine what the antecedents of knowledge are. A holistic understanding of the complex knowledge acquisition process will require the examination of both environmental and personal factors (Bandura, 2001; Cortese, 2007). External factors such as media and interpersonal networks are important health sources for Singaporean women as they provide information and guidance (Sim et al., 2009; Yanovitzky & Blitz, 2000). These sources can act as a stimulus for them in engaging in elaborative processing, leading to potential knowledge gains.

Individual-level factors such as risk perceptions and fatalistic beliefs are commonly associated with health outcomes such as screening, prevention behaviors,

and knowledge (e.g. Meiser et al., 2001; Pilarski, 2009; Powe, Hamilton, & Brooks, 2006; Straughan & Seow, 1998). It is thus important to consider their role in influencing women's knowledge level. Risk perception is often associated with information seeking leading to knowledge acquisition (Rimal, Flora, & Schooler, 1999) while fatalistic beliefs may be a barrier to women's learning of breast cancer (Straughan & Seow, 2000).

One of the goals of health communication is to induce health behavioral changes by improving knowledge. Most studies on health knowledge acquisition have focused on how communication and motivational factors influence *factual knowledge*, with very few examining acquisition of other dimensions of knowledge. There are three objectives in this study. First, we aim to extend the dimension of health knowledge to include *structural health knowledge* in the context of breast cancer communication. Second, we seek to examine the potential antecedents of factual and structural knowledge—media use, interpersonal communication, elaborative processing, risk perception and fatalism. Third, we will offer practical insights on public health communication strategies in the context of breast cancer.

Factual and structural knowledge

Before any woman can adopt precautionary health measures, they first must have some form of knowledge about the prevention methods available and understand the risks of not engaging in these behaviors. The lack of knowledge can be an impediment to any health behavior adoption (Pearlman, Clark, Rakowski, & Ehrich, 1999; Viswanath, 2006).

Knowledge is a multi-dimensional concept and scholars have identified three types of knowledge—declarative, procedural, and structural knowledge (Jonassen, Beissner, & Yacci, 1993). Declarative knowledge is synonymous with awareness—

the concepts or ideas that individuals are conscious of. Procedural knowledge is the understanding of applying declarative knowledge in specific contexts. Many research in health communication have focused on studying declarative and procedural knowledge, which collectively can be described as *factual knowledge*. To measure factual knowledge, participants are quizzed on risk factors and understanding of treatment matters (e.g. Gaziano & Horowitz, 2001; Guerra, Dominguez, & Shea, 2005). The focus on factual health knowledge acquisition in health literature is partly driven by the belief that knowledgeable individuals are more likely to deal with health problems than those who have less knowledge.

Despite the benefits of examining factual knowledge, some scholars have argued that the conceptualization of knowledge should be more than answering a series of true-false questions as learning is a dynamic process (Kraiger, Ford, & Salas, 1993). One unexplored area is the conceptualization of knowledge as *structural knowledge* (Diekhoff & Diekhoff, 1982). Structural knowledge is the organization and interrelation of nodes of information or concepts within a domain (Dorsey, Campbell, Foster, & Miles, 1999). More specifically, structural knowledge refers to the measure of the strength of perceived links between concepts in a person's cognitive structure.

Although factual and structural knowledge share similarities, there are several conceptual differences. First, factual knowledge is represented by the *presence* of conceptual nodes in a particular domain while structural knowledge is represented as the *link* between two conceptual nodes (Eveland, Cortese, Park, & Dunwoody, 2004). Second, factual knowledge is a measure of the quantity of conceptual nodes, while structural knowledge reflects the organization and strength of the links (Day, Arthur, & Gettman, 2001). The more conceptual nodes are represented in a knowledge

domain, the greater the potential for achieving higher factual knowledge scores. For structural knowledge, the more organized and structured the nodes are, the greater the indication of individuals' comprehension of the topic and the level of expertise. This is drawn from the literature on schema theory, semantic networks, as well as spreading activation theory (Jonassen et al., 1993), where researchers postulate that knowledge is stored as information nodes and are organized in networks (Collins & Loftus, 1975; McVee, Dunsmore, & Gavelek, 2005; Rumelhart & Ortney, 1977).

The third distinction between the two knowledge types is that measurements for factual knowledge reduce the relationships between concepts to a simple dichotomous "true-false" scale, while measurements for structural knowledge tap on the complexity of relationships between the nodes. When measuring factual knowledge, a statement such as "having a mammogram will increase the chance of finding a lump before it can be felt" is coded as correct when participants answer "*true*" and coded as incorrect if the response is "*false*" (Chukmaitov et al., 2008). The dichotomization of knowledge will inevitably dilute the quality of data—beyond knowing whether an individual answered correctly, health scholars will not know the strength of relationships among the concepts as perceived by the individual. The use of structural knowledge on the other hand gives an indication of the complexity of knowledge. For instance, a woman may correctly identify that having a history of cancer will increase her chances of contracting cancer to be a factually true statement, even though she may not perceive a very strong association between the two. By asking respondents to indicate how contracting breast cancer and having a history of cancer in the family are related, researchers will be able to understand the strength of the relationships between the concepts as perceived by the individuals, above and beyond knowing if they have answered the question wrongly or correctly. This will be

beneficial for improving public communication and education by tailoring strategies for improving specific knowledge types instead of simply increasing the frequency of health information dissemination to the public.

Some scholars have underscored that understanding how knowledge is organized is more important than understanding the amount and type of knowledge that is stored in memory (Johnson-Laird, 1983; Rouse & Morris, 1986). Instead of a static stockpiling of information, learning is a continuous process where individuals structure and organize relationships among nodes (Jonassen et al., 1993). This study argues that health communication scholars should examine structural knowledge as much as factual knowledge. Since factual knowledge is one of the precursors to health behavior change (e.g. Zhang, While, & Norman, 2011) and structural knowledge is often associated with efficacy of problem solving, it is therefore crucial to find out what the antecedents of these knowledge dimensions are in order for health communication strategies to be effective.

Media and breast cancer communication in Singapore

The mass media is an important source of health information for many people (Meissner, Potosky, & Convisser, 1992; O'Keefe, Boyd, & Brown, 1998). In Singapore, print coverage¹ of breast cancer news has remained steady over the past decade and various health agencies have been proactive in using multiple media platforms such as newspapers, television, magazines, and the internet to reach out to women about breast cancer (Yeoh, Chew, & Wang, 2006). For instance, the Breast Cancer Foundation's (BCF) annual Pink Ribbon Walk and its other awareness events in October (designated as breast cancer awareness month) often get much coverage

¹ To assess the amount of print coverage of breast cancer in Singapore in the past decade, we have conducted a search between 2004 and 2013 on Factiva (see Figure 1) using the following search terms: (breast cancer) OR (breast cancer screening) OR (mammography) OR (Pink Ribbon Run). The search was limited to *The Straits Times* and *Today*, which are Singapore's two major newspapers.

from the mainstream media (BCF, 2014b). In 2010, their campaign “Are you obsessed with the right things” featured the use of controversial body painting artwork depicting women’s obsession with other body parts instead of paying attention to growth of abnormal breast lumps gained much publicity due to the daring portrayal of women (Ng, 2010).

[Insert Figure 1 here]

BCF also actively maintain its online presence to reach out to the masses. The main website provides a comprehensive guide to breast cancer risks and prevention methods and it actively uses social media for disseminating information and posting success stories of how Singaporean women triumphed over breast cancer (BCF, 2014a, 2014c). In addition, health agencies such as the Health Promotion Board (HPB) are very proactive in reaching out to women about breast cancer. The HPB launched the National Breast Screening Program in 2002 to encourage women to go for regular mammography and engaged celebrities to be their spokesperson to attract public attention (Yeoh et al., 2006).

As women pay attention to the content on these mediums, factual knowledge acquisition takes place (Shim, Kelly, & Hornik, 2006; Viswanath et al., 2006). This relationship has been established for attention to newspaper (Viswanath et al., 2006), television (Sim et al., 2009), and the internet (Shim, 2008). Apart from influencing factual knowledge gains, we argue that attention to media is positively associated with structural knowledge gains. Attention to message content is the start of information processing or storage, where cognitive load is spent on creating and strengthening links between conceptual nodes (Eveland, 2002; Krugman, Fox, Fletcher, Fischer, & Rojas, 1994). When women pay more attention to breast cancer messages, the perceived relationships among health concepts and breast cancer within their existing

schema may be enhanced, leading to an increased structural knowledge. Thus, we posit that:

H1: Attention to breast cancer news on television is positively related to (a) breast cancer factual knowledge and (b) breast cancer structural knowledge.

H2: Attention to breast cancer news in the newspaper is positively related to (a) breast cancer factual knowledge and (b) breast cancer structural knowledge.

H3: Attention to breast cancer news on the internet is positively related to (a) breast cancer factual knowledge and (b) breast cancer structural knowledge.

Interpersonal communication

Interpersonal communication is another important external influence on women with regard to breast cancer issues (Ogata, Denham, & Springston, 2006). Women's networks consist of immediate families, friends, colleagues and other women facing the same health challenge. Not only do interpersonal networks provide the psychological and emotional support, they are a source of breast cancer information. Studies have found that women's sources of health information typically come from their family members, friends, co-workers, and healthcare providers (Clark et al., 2000; Cline, 2003; Husaini et al., 2001; Rakowski et al., 1990). Even with the ease of retrieving information online, women still prefer to gather breast cancer information from people such as healthcare providers after their initial information search (Balka, Krueger, Holmes, & Stephen, 2010). As healthcare providers or important referent groups may provide new information, discussing breast cancer issues with their social network will enable women to gain more factual knowledge (O'Keefe et al., 1998). Thus, there is a positive association between interpersonal communication and women's breast cancer factual knowledge.

Likewise, women's frequency of discussing breast cancer issues can be positively associated with their breast cancer structural knowledge. Through interactions with people in their networks, women may gain new insights, information and perspectives (Hornik, 2006; Valente & Saba, 1998). This includes assimilating new information nodes that previously were not found in their knowledge domain, or strengthening of conceptual links between nodes. In health communication, interpersonal sources have shown to be effective in influencing behavioral changes (Lee, 2010; Ogata et al., 2006). This may be due to an underlying change in women's knowledge structure after engaging in discussion. For instance, women may initially not perceive the link between health screening and life preservation to be strong and thus do not place a high priority in health screening. After engaging in discussion with various significant others or healthcare providers, this perceived link may strengthened—the change in strength of their knowledge structure may explain their decision to engage in future health behavior changes. Thus, we posit the following:

H4: Interpersonal communication is positively related to (a) breast cancer factual knowledge and (b) breast cancer structural knowledge.

Elaboration

Elaborative processing is the act of linking new pieces of information gathered from the news media with what is already present in memory (Eveland, 2001). Elaboration can happen upon attention to news or from discussions as news attention and interaction with people can generate new ideas previously not known to individuals (Eveland, 2001; Eveland, 2004). When individuals start to connect these new concepts to what they already know, elaborative processing take place.

Early cognitive research has shown that elaboration is linked to greater learning (Hamilton, 1989; Mayer, 1980; Pressley, McDaniel, Turnure, Wood, &

Ahmad, 1987) and recall (Eveland, Seo, & Marton, 2002). The factual knowledge level of individuals is often assessed by the ability to remember facts that they came across (Jensen, 2011). As individuals engage in elaborative processing, they will recall the new information they have encountered either through the media or interpersonal networks. This act of elaborative processing will strengthen memory muscle and result in higher factual knowledge (Cortese, 2007; Eveland, 2001). As women put in cognitive effort in making sense of what they have learned about breast cancer, they will gain more breast cancer knowledge.

As much as elaborative processing has a direct positive association with factual knowledge, it can also shape structural knowledge. Past research has demonstrated a positive association between elaboration and structural knowledge (e.g. Eveland et al., 2002). The act of elaborative processing results in the creation of new links among nodes of information (Eveland, 2001). In the context of breast cancer, the more women engage in elaboration, the more likely they will forge new links between breast cancer and other health related nodes and strengthen existing links in their schema, resulting in a tighter knowledge structure. As such, we posit:

H5: Elaboration is positively related to (a) breast cancer factual knowledge and (b) breast cancer structural knowledge.

Risk perception

Risk perception is a key concept in many health theories as knowing that one is at risk is the first step to risk reduction (Rogers, 1975; Weinstein, 1988). Risk perception is a multi-dimensional term that scholars have equated with attitudinal beliefs, cognitions, and feelings (Coleman, 1993). It is the probability that an individual perceives that he or she will grapple with the health issue sometime in future (Katapodi, Dodd, Lee, & Facione, 2009) and it is identified as one of the

factors in motivating information seeking and knowledge acquisition (Chaffee & Schleuder, 1986).

If individuals perceive themselves to be at risk, they will be keen to seek more information about the risk. This is because negative emotions induced by risk perception are powerful in motivating people to satisfy their information needs (Cameron, 2012; Hovick, Kahlor, & Liang, 2014; Yang & Kahlor, 2013) for the purpose of uncertainty reduction (Brashers, Goldsmith, & Hsieh, 2002). Women with personal and family history of cancer are more likely to seek information (Rutten, Squiers, & Hesse, 2006) as these are physical cues that inform women their likelihood of contracting breast cancer (Katapodi, Dodd, Facione, Humphreys, & Lee, 2010). As women with high risk engage in information seeking, their factual knowledge of cancer will increase (Shim et al., 2006). Dillard et al. (2011) found a positive association between risk perception and cancer knowledge where women with higher risk perception tend to be more knowledgeable about breast cancer.

As the study of structural knowledge in breast cancer is novel, we found no studies examining the relationship between risk perception and structural knowledge. However, we have reasons to postulate that risk perception is positively associated with structural knowledge. Women who identified themselves belonging to the “high risks” group will experience a higher level of anxiety as they watch their family members or close friends die from breast cancer. Thus, they would perceive a stronger link between cancer, death (Green, Richards, Murton, Statham, & Hallowell, 1997) and some of the risk factors associated with breast cancer. As women with higher risk perception tend to seek out information for the purpose of uncertainty reduction, they may associate stronger links between risk factors and breast cancer. Thus, we posit the following hypothesis:

H6: Risk perception is positively related to (a) breast cancer factual knowledge and (b) breast cancer structural knowledge.

Fatalism

Cancer fatalism is the belief that death is unavoidable in the presence of a cancer (Powe et al., 2006), or a belief that health is beyond an individual's control because it is a matter of fate or luck (Straughan & Seow, 2000). Women with high fatalism tend to be at higher risk (Niederdeppe & Levy, 2007). To prevent breast cancer, women with high fatalism may think that they should not know more about breast cancer or the screening methods available (Straughan & Seow, 2000). Studies have shown that the relationship between fatalism and cancer knowledge is inversed—the higher the level of fatalism the lower the factual knowledge (Behbakht, Lynch, Teal, Degeest, & Massad, 2004; Harris, 2003; Powe, 1999). Since Singaporean women are considered educated by international standards (Saxena et al., 2012), they may have a lower level of fatalism as higher education may be indicative of the higher level of breast cancer factual knowledge. As such, we posit that the relationship between fatalism and factual knowledge is inversed.

Currently there are no studies that examine how fatalism is related to structural knowledge but there are reasons to postulate that fatalism is negatively associated with structural knowledge. For instance, fatalism is associated with the perception that cancer is a problem that is uncontrollable as well as the act of information avoidance (Melnyk & Shepperd, 2012; Miles, Voorwinden, Chapman, & Wardle, 2008). For women who avoid information, the perceived strength of the relationships among health nodes in their breast cancer structural knowledge domain is arguably weaker. This suggests an inverse relationship between cancer fatalism and breast cancer structural knowledge. Thus, we posit the following hypothesis:

H7: Fatalism is negatively related to (a) breast cancer factual knowledge and (b) breast cancer structural knowledge.

Method

The data was obtained through a computer-assisted telephone interviewing survey, where a total of 802 female Singaporeans and permanent residents between the ages of 30 to 70 years were recruited as respondents. The data collection lasted for ten days in January 2011 where a telephone survey using random-digit-dialing was carried out at a large public university in Singapore. Each interview lasted for approximately 20 minutes and they were conducted in English, Mandarin and Malay, which are the three main languages in Singapore. We attained a response rate of 33.2% (AAPOR response rate formula 3) with a margin of error of approximately $\pm 3\%$ at the 95% confidence level.

Measures

Demographic measures

Demographic items were treated as control variables and they include *age* ($M = 47.3$, $SD = 9.71$), *education* (*Median* = 5.00 or “GCE Ordinary level”), *marital status* (1 = “not married” and 2 = “married,” 83.4% married), *monthly household income* (ranged from 1 = “SGD 1,000 and below” to 11 = “above SGD 10,000”; *Median* = 4.00 or “SGD3001 to SGD4000,” $SD = 3.19$), *whether respondents have children*, (1 = “Yes,” 2 = “No,” 78.6% indicated they have children) and the *number of children* they have ($M = 1.72$, $SD = 1.21$). Race was entered as a control variable as well. We created four dummy coded categories for race (Malay, Indian, Eurasian and Others) with Chinese as the baseline group. The sample consisted of 76.6% Chinese, 10.2% Malay, 8.4% Indians, 1.00% Eurasians, and 3.60% Others.

Finally, this study also controlled for health insurance coverage (1 = “Yes” and 2 = “No,” 81.4% indicated they have health insurance coverage), women-related diseases insurance coverage (1 = “Yes” and 2 = “No,” 50.9% with no women-related diseases insurance coverage) as well as personal history (1 = “Yes” and 2 = “No,” 95.6% did not have history of cancer) and family history of cancer (1 = “Yes” and 2 = “No,” 65.0% indicating no family history of cancer).

Independent variables

Attention to newspaper/television/internet. Respondents were asked on a 11-point scale (0 = “no attention at all,” 10 = “very close attention”) how much attention they pay to the following 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.” The three items were averaged to form a composite index for attention to newspaper ($M = 5.11$, $SD = 3.11$, Cronbach’s $\alpha = .94$). The same three items were used to measure attention to television ($M = 4.46$, $SD = 3.18$, Cronbach’s $\alpha = .90$) and attention to the internet ($M = 2.30$, $SD = 2.92$, Cronbach’s $\alpha = .96$). The items were adapted from Ho, Peh, and Soh (2013).

Interpersonal communication. To measure interpersonal communication, respondents were asked on a ten-point scale how frequently they discuss issues related to breast cancer (1 = “least frequent,” 10 = “most frequent”) with family members, friends, colleagues and healthcare providers. These measures were adapted from Ho et al. (2013). The responses were averaged to form a composite scale with good reliability ($M = 1.31$, $SD = 1.69$, Cronbach’s $\alpha = .75$).

Elaboration. To measure elaboration, respondents were asked the following five questions on a 10-point scale (1 = “strongly disagree,” 10 = “strongly agree”): (a) “After I encounter news on health and medical topics, I am likely to stop and think

about it;” (b) “I often relate what I learnt from the news on health and medical topics to other things I know;” (c) “When reading or watching the news, I carefully analyze the information given about breast cancer in the news;” (d) “After I encounter news on breast cancer, I am likely to stop and think about it;” and (e) “I often relate what I learnt from the news on breast cancer to other things I know.” The items were adapted from Ho et al. (2013) and were averaged to form a composite scale with good reliability ($M = 6.50$, $SD = 2.00$, Cronbach’s $\alpha = .88$).

Risk Perception. To measure risk perception, respondents were asked: (a) “How likely do you think it is that you will develop breast cancer in the future” and (b) “How likely do you think it is that you will develop breast cancer, as compared to the average woman your age” on a five-point scale (1= “least likely,” 5= “most likely”). The two items were adapted from Shim (2008) and they were averaged to create a risk perception composite index ($M = 2.31$, $SD = 1.02$, $r = .65$, $p < .001$).

Fatalism. Fatalism was measured by three statements on a scale of 1 to 5 (1 = “strongly disagree,” 5 = “strongly agree”): (a) “It seems like almost everything causes breast cancer;” (b) “There’s not much people can do to lower their chances of getting breast cancer;” and (c) “There are so many recommendations about preventing breast cancer, it’s hard to know which ones to follow.” All of the statements were adapted from a study by Niederdeppe and Levy (2007). The items were averaged to create a composite index ($M = 2.70$, $SD = .94$, Cronbach’s $\alpha = .54$).

Dependent variables

Factual Knowledge. Seven knowledge statements on breast cancer were taken from the Singapore Cancer Society (SCS) and BCF’s website. For each of the statements, respondents were to answer if the statement is “1= definitely true,” “2= likely true,” “3= likely false,” or “4= definitely false.” Responses were coded into 1

= “incorrect” and 2 = “correct.” Respondents who indicated “likely false,” “definitely false,” “don’t know” or “refused” were recoded as incorrect. The seven statements were: (a) “The risk of breast cancer increases with age (T);” (b) “Women with no children have a slightly higher risk of getting breast cancer (T);” (c) “Breast cancer can be inherited (T);” (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 (T);” (e) “Mammography is an X-ray examination of the breast (T);” (f) “Women from age 40 onwards are encouraged to go for annual mammography (T);” and (g) “Women from aged 40 onwards are encouraged to go for annual clinical breast examination (T).” The seven items were summed to form a composite scale for knowledge ($M = 3.13$, $SD = 1.78$, $KR-20 = .63$). “T” indicates that the answer is likely true or definitely true.

Knowledge Structure Density (KSD)². The way to calculate structural knowledge is to tap on the concept of KSD. The formula to measure KSD is taken from Eveland et al. (2004a). A person’s density of knowledge structure is how connected are the network’s nodes (Astleitner & Leutner 1995) and it is calculated by all the links in the network and dividing them by the summation of all the possible links (Cortese, 2007).

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

k represents the link between two concepts in the network. v is the value (from 1 to 5) given to the k th link, and n is the total number of concepts in the network. All

² There are several ways of measuring structural knowledge. Some studies asked respondents to list the concepts they could recall and rate how strongly each concept is related with another (e.g. Eveland et al., 2004a). Others like Cortese (2007) gave a specific set of statements to the respondents and asked them to rate the strength of the perceived link of all possible combinations of the concepts. We adopted the latter method in our study as it is more efficient for telephone interviews. The formula for analysis was derived from network analysis that examined how concepts are linked as a way of understanding the relationships in a domain—it is not focused on the normative nature of the links but on how individuals perceive the strength of relationships between the concepts and breast cancer in a knowledge domain (Cortese, 2007; Hussain, 2012).

the concepts related to breast cancer were taken from the websites of SCS and BCF. Respondents were asked to rate on a 5- point scale (1= “Not related at all,” 5= “Very closely related”), to what extent the following concepts were related: (a) “Breast cancer and smoking;” (b) “Breast cancer and alcohol consumption;” (c) “Breast cancer and race;” and (d) “Breast cancer and eating habits.” A higher score suggests that the perceived connectedness among the concepts is high ($M = 2.73$, $SD = .93$).

Analytical approach

Hierarchical ordinary least squares (OLS) regression was used to analyze the data. Variables were entered in the presumed causal order. Control variables (e.g., age, marital status, history of cancer) were entered as the first block. Attention to television, attention to newspaper and attention to the internet as well as interpersonal communication and elaboration were placed in the second block, followed by risk perception and fatalism in the final block. Media and interpersonal communication variables were entered in the block after control variables because people gain information from these channels before motivational factors propel them for future information seeking. The roots of this perspective can be traced to earlier works such as the knowledge gap hypothesis (Tichenor, Donohue, & Olien, 1970), two-step flow (Katz, 1957), agenda setting (McCombs & Shaw, 1972) and also recent works such as reinforcing spiral of the media (Slater, 2007).

Results

The correlations among all the key variables are presented in Table 1. As shown in Table 1, most of the independent variables were significantly associated with the outcome variables at the zero-order level. Results of the regression analysis for breast cancer factual knowledge are shown in Table 2. Among the control variables, results showed that Indians have a significantly lower amount of factual

knowledge as compared to the Chinese (the baseline group) ($\beta = -.12, p < .01$). Other demographic variables such as age, income, children, marital status, education, indication of insurances bought, personal and family history of cancer were not significantly related to factual knowledge. Demographics explained 4.50% of the variance in breast cancer factual knowledge.

[Insert Table 2 about here.]

We posited that media variables such as attention to TV, newspaper, and the internet were positively associated with factual knowledge. Results showed that attention to media variables were not significantly associated with factual knowledge. Thus, H1a, H2a and H3a were not supported. In the same block, both interpersonal communication ($\beta = .13, p < .01$) and elaboration ($\beta = .17, p < .001$) were positively associated with factual knowledge, lending support for H4a and H5a. This block explained 5.10% of the variance in breast cancer knowledge.

For the last block, we posited that risk perception (H6a) was positively associated with factual knowledge but fatalism (H7a) was negatively associated with factual knowledge. Results from the regression analysis showed that both were not significantly related to breast cancer knowledge. This block accounted for .10% of the variance in breast cancer knowledge. The entire regression block explained 9.70% of the total variance in factual breast cancer knowledge.

Table 3 shows the results of the regression analysis for structural knowledge. Respondents who bought general insurances indicated higher level of structural knowledge ($\beta = .11, p < .01$). The results showed that Indian women ($\beta = .10, p < .01$) have a higher level of structural knowledge as compared to the Chinese (baseline group). The demographic block explained 3.20% of the variance in structural knowledge.

[Insert Table 3 about here.]

We put forth H1b, H2b and H3b which hypothesized positive association between media attention (to television, newspaper and internet) and structural knowledge. Results showed that attention to TV and newspaper had no significant association with structural knowledge, thus H1b and H2b were not supported. Attention to internet, however, was positively associated with structural knowledge ($\beta = .08, p < .05$), supporting H3b.

For H4b and H5b, we posited that interpersonal communication and elaboration were positively associated with structural knowledge. Results showed that interpersonal communication ($\beta = .11, p < .01$) and elaboration ($\beta = .14, p < .001$) were positively associated with structural knowledge. This block accounted for 5.50% of the variance in structural knowledge.

We posited that risk perception (H6b) was positively associated with structural knowledge while fatalism (H7b) was negatively associated structural knowledge. Results showed that risk perception was positively associated with structural knowledge ($\beta = .08, p < .05$) but fatalism's association with structural knowledge was not significant. This block accounted for .60% of the variance in structural knowledge. The overall regression model explained 9.30% of the variance in structural knowledge.

Discussion

This study presents how media attention, interpersonal communication, elaborative processing, risk perception, and fatalism relate to both factual and structural knowledge. While no significant association was found between attention to media and factual knowledge, attention to internet was positively related to structural knowledge. Elaborative processing and interpersonal communication were associated

with factual and structural knowledge while risk perception was associated with structural knowledge.

Among the media platforms, attention to internet was positively associated with structural knowledge. This is consistent with past research that found that people who rely on Web news tend to score higher on structural knowledge (Eveland et al., 2004a). One possible explanation may be due to the way people learn when exposed to nonlinear³ Web designs. Eveland and Dunwoody (2002) highlighted that the way websites with hyperlinks are designed mirrors how human memory works (which they termed as *structural isomorphism*). Essentially, websites and human memory are collection of information nodes that are linked to one another (Eveland & Dunwoody, 2001). When the structure of websites is built in such a way where concepts are linked with one another and users can navigate related content by clicking on the hyperlinks, it would facilitate the forging of the connections of mental nodes in the users' mind and thus improve structural knowledge (Eveland & Dunwoody, 2002).

The results of the study highlighted the importance of discussing breast cancer issues and elaborative processing in influencing knowledge levels. Women learn more when they talk to significant others and healthcare providers as pertinent information is often exchanged during discussion (Berger, 2005). Thus, engaging in discussion about breast cancer related issues would facilitate learning of factual information. This is in line with previous literature which have shown that close social groups and healthcare providers are good sources of information (Clark et al., 2000; Green et al., 1997; Husaini et al., 2001; Meissner et al., 1992; Ogata et al., 2006). By participating in breast cancer related discussions with family members, friends and healthcare providers, the connections among other health concepts with breast cancer may be

³ Typically a website is considered *nonlinear* in design when there are in-text hyperlinks, while a linear web design is one where there are no hyperlinks and users have to read the content like a traditional text with a beginning, middle, and concluding segment.

strengthened in women's knowledge structure. For example, by engaging in a conversation with doctors or significant others in their social network, women may be convinced that having regular exercise will help to reduce the risk of contracting breast cancer.

Our regression analysis showed that elaborative processing had the strongest positive association with both knowledge types. Women who actively process and synthesize information tend to have a higher level of breast cancer knowledge. When they process breast cancer information, they will assimilate new information nodes into their knowledge base and this will contribute to an increase in breast cancer factual knowledge—a finding that is consistent with past studies (Eveland, Shah, & Kwak, 2003; Ho et al., 2013). Moreover, by engaging in effortful cognitive processing of breast cancer information, the existing mental connections between health information nodes in a woman's existing schema would also be strengthened. This explains the positive association between elaborative processing and structural knowledge, which is in line with past research on structural knowledge (Eveland, Marton, & Seo, 2004; Hively & Eveland, 2009).

With regard to risk perception's role in knowledge acquisition, this study found partial support for the hypothesized relationships. Women's level of perceived risk was positively associated with structural knowledge but not factual knowledge. Studies have shown that risk perception can be a motivator for health information seeking (e.g., Rimal et al., 1999). Therefore, women who have a high level of risk perception may have greater motivation to seek out breast cancer information. The act of searching for information strengthens the existing links between the various health conceptual nodes and breast cancer in their schema, which accounts for the positive significant association between perceived risk and structural knowledge. The non-

significant association between risk perception and factual knowledge in our regression model suggests that communication variables including interpersonal communication and news elaboration play a larger role in shaping factual knowledge than perceived risks.

Our results did not show that fatalism was associated with both knowledge types. Previous research has shown that fatalism was associated with lower knowledge (Powe et al., 2006), but this is not the case for our sample. One possible reason is that Singaporean women are generally well educated with 95% literacy rate in the country (Saxena et al., 2012). Past studies have found that women with higher education are less likely to have fatalistic belief (Mayo, Ureda, & Parker, 2001; Niederdeppe & Levy, 2007; Spurlock & Cullins, 2006). As Singaporean women are relatively well educated, the level of fatalism in Singaporean women may be low to begin with.

In terms of the relationship between demographic variables and the two knowledge dimensions, the results showed that Indian women have lower factual knowledge than Chinese women, consistent with past research on Singaporean women and breast cancer (e.g. Sim et al., 2009). But when it comes to structural knowledge, Indian women scored higher than their Chinese counterparts. This may be due to a high level of risk perception among Indians, which this study has shown to be related with structural knowledge. Indian women may perceive themselves to be at higher risk of contracting breast cancer as they have a higher rate of obesity, which is a well-known risk factor of breast cancer (Sim et al., 2006; Verkooijen, Yap, Bhalla, Chow, & Chia, 2009).

Theoretical and Practical Implications

This study contributes to theory by expanding on the definition of health

knowledge to include structural aspect of knowledge. In most health studies, knowledge is examined as a response to a series of true-false questions, reducing the concept of knowledge to a simple dichotomous response scheme. Therefore, it is worthwhile to examine the strength of relationships between health concepts as it gives greater details of the complexity of knowledge. For example, knowing if woman answered a question on mammography and health benefits correctly or incorrectly is not as comprehensive as knowing the extent to which women believe that mammography is linked with positive health benefits. This is where examining structural knowledge complements factual knowledge. Future studies should examine other dimensions of knowledge for a more holistic understanding of health knowledge.

One of the key observations from this study is that while factual and structural knowledge are nested under the broad conceptual term called “*knowledge*”, the antecedents of structural knowledge may not be the same as factual knowledge. Past studies have found that gains in the two knowledge types were influenced differently by factors such as organization of websites (Eveland et al., 2004a) and types of discussions people engaged in (Eveland & Hively, 2009). Our findings contributed to the literature by identifying risk perception as a motivational factor that is associated with structural but not factual knowledge.

Structural knowledge is often associated with problem solving and impetus for action (Eveland et al., 2004a; Jonassen et al., 1993) but not factual knowledge (Ajzen, Joyce, Sheikh, & Cote, 2011; Kratzke, Vilchis, & Amatya, 2013). By identifying the potential antecedents of these two knowledge types and understanding their efficacy in influencing behaviors, health agencies and related governmental bodies could be more targeted in their public outreach approach. For instance, to encourage an accumulation of structural knowledge, health agencies could design their websites in

such a way that promotes the building of conceptual links in breast cancer domain. This can be done by integrating hyperlinks to related health concepts within breast cancer sites. By doing so, the perceived connection between breast cancer and the particular health information node could be strengthened. In addition, communication practitioners could emphasize the risk of breast cancer and how it is connected to various aspects of lifestyle and dietary habits so as to increase structural knowledge among women.

Health communication practitioners could aim to engage women's elaborative processing as a way to improve knowledge acquisition. Elaborative processing could be generated through conversations and anticipation—if an individual anticipates to be engaged in a conversation regarding that issue, elaborative processing will ensue (Eveland, 2004). If women anticipate that someone in their social network will engage them in a conversation on breast cancer, this will prompt them to recall what they have learnt from the media and formulate their thought process by making new linkages between concepts. Health communicators can heighten women's anticipatory elaboration by encouraging family members or friends to engage them in a conversation about breast cancer. Moreover, seminars and talks can be organized to disseminate information on the risk factors of breast cancer to women. These platforms will offer opportunities for women to discuss and cognitively process breast cancer issues to enhance their knowledge about breast cancer.

Limitations and Directions for Future Research

Although conceptualizing an alternative knowledge dimension is a contribution to health communication research, there are certain limitations in this study that could be addressed in future studies. Due to the constraints of conducting a telephone survey, this study could only include five concepts for structural knowledge

in our questionnaire—breast cancer, race, eating habits, alcohol consumption, and smoking. Moreover, we selected a pre-determined set of concepts for the respondents in this study. This could potentially reduce the complexity of the knowledge dimension that the concept of structural knowledge seeks to capture. Future research could develop a new set of structural knowledge measures by asking respondents to rate the perceived strength of the relationships of concepts generated from free recall.

While our measurement of factual knowledge is consistent with how past research has measured factual knowledge, we recognize that differentiating “likely true” from “definitely true” may result in an inflation or deflation of knowledge score. Future research may want to rely on a dichotomous true-false response option for factual knowledge items.

Conclusion

Breast cancer is a public health problem and understanding how women gain knowledge about breast cancer has implications for developing communication strategies to improve learning. In terms of theoretical development, this study has introduced and advocated for a more comprehensive understanding of health knowledge. As knowledge is a multi-dimensional item with varying levels of complexity, health communication scholars should make a distinction between factual and structural knowledge, and understand what factors are associated with the two knowledge types. By crafting tailored strategies targeting specific antecedents of factual and structural knowledge, this will greatly maximize learning effects through public health communication efforts.

References

- Ajzen, I., Joyce, N., Sheikh, S., & Cote, N. G. (2011). Knowledge and the prediction of behavior: The role of information accuracy in the theory of planned behavior. *Basic & Applied Social Psychology, 33*(2), 101-117. doi: 10.1080/01973533.2011.568834
- Balka, E., Krueger, G., Holmes, B. J., & Stephen, J. E. (2010). Situating internet use: Information-seeking among young women with breast cancer. *Journal of Computer-Mediated Communication, 15*(3), 389-411. doi: 10.1111/j.1083-6101.2010.01506.x
- Bandura, A. (2001). Social cognitive theory of mass communication. *Media Psychology, 3*(3), 265-299. doi: 10.1207/S1532785XMEP0303_03
- Behbakht, K., Lynch, A., Teal, S., Degeest, K., & Massad, S. (2004). Social and cultural barriers to papanicolaou test screening in an urban population. *Obstetrics and gynecology, 104*(6), 1355-1361.
- Berger, C. R. (2005). Interpersonal communication: Theoretical perspectives, future prospects. *Journal of Communication, 55*(3), 415-447. doi: 10.1111/j.1460-2466.2005.tb02680.x
- Brashers, D. E., Goldsmith, D. J., & Hsieh, E. (2002). Information seeking and avoiding in health contexts. *Human Communication Research, 28*(2), 258-271. doi: 10.1111/j.1468-2958.2002.tb00807.x
- Breast Cancer Foundation [BCF]. (2014a). Retrieved from <http://www.facebook.com/bcf.pink>
- Breast Cancer Foundation [BCF]. (2014b). Awareness introduction. Retrieved from <http://www.bcf.org.sg/awareness/introduction>
- Breast Cancer Foundation [BCF] (2014c). Risk factors and protecting yourself. from <http://www.bcf.org.sg/awareness/risk-factors-protecting-yourself>
- Cameron, K. A. (2012). Commentary—Risk communication in context: Theories, models, research and future endeavors. In C. T. Salmon (Ed.), *Communication Yearbook* (Vol. 36, pp. 363-369). New York: Routledge.
- Chaffee, S., & Schleuder, J. (1986). Measurement and effects of attention to media news. *Human communication research, 13*(1), 76-107.
- Chukmaitov, A., Wan, T. H., Menachemi, N., & Cashin, C. (2008). Breast cancer knowledge and attitudes toward mammography as predictors of breast cancer preventive behavior in Kazakh, Korean, and Russian women in Kazakhstan. *International Journal of Public Health, 53*(3), 123-130. doi: 10.1007/s00038-008-7001-9
- Chuwa, E. W. L., Yeo, A. W. Y., Koong, H. N., Wong, C. Y., Yong, W. S., Tan, P. H., . . . Ho, G. H. (2009). Early detection of breast cancer through population-based mammographic screening in Asian women: A comparison study between screen-detected and symptomatic breast cancers. *Breast Journal, 15*(2), 133-139. doi: 10.1111/j.1524-4741.2009.00687.x
- Clark, S., Bluman, L., Borstelmann, N., Regan, K., Winer, E., Rimer, B., & Skinner, C. (2000). Patient motivation, satisfaction, and coping in genetic counseling and testing for BRCA1 and BRCA2. *Journal of Genetic Counseling, 9*(3), 219-235. doi: 10.1023/A:1009463905057
- Cline, R. J. W. (2003). Everyday interpersonal communication and health. In T. L. Thompson, A. M. Dorsey, K. I. Miller & R. Parrott (Eds.), *Handbook of health communication*. (pp. 285-313). Mahwah, NJ Lawrence Erlbaum Associates Publishers.

- Coleman, C. L. (1993). The influence of mass media and interpersonal communication on societal and personal risk judgments. *Communication Research, 20*(4), 611-628.
- Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological Review, 82*(6), 407-428. doi: 10.1037/0033-295X.82.6.407
- Cortese, J. (2007). *Internet learning and the building of knowledge*. Youngstown, New York: Cambria Press.
- Day, E. A., Arthur, W. J., & Gettman, D. (2001). Knowledge structures and the acquisition of a complex skill. *Journal of Applied Psychology, 86*(5), 1022-1033. doi: 10.1037//0021-9010.86.5.1022
- Diekhoff, G. M., & Diekhoff, K. B. (1982). Cognitive maps as a tool in communicating structural knowledge. *Educational Technology, 22*(4), 28-30.
- Dillard, A., Ubel, P. A., Smith, D. M., Zikmund-Fisher, B. J., Nair, V., Derry, H. A., . . . Fagerlin, A. (2011). The distinct role of comparative risk perceptions in a breast cancer prevention program. *Annals of Behavioral Medicine, 42*(2), 262-268.
- Dorsey, D. W., Campbell, G. E., Foster, L. L., & Miles, D. E. (1999). Assessing knowledge structures: Relations with experience and posttraining performance. *Human Performance, 12*(1), 31-57.
- Eveland, W. P. Jr (2001). The cognitive mediation model of learning from the news: Evidence from nonelection, off-year election, and presidential election contexts. *Communication Research, 28*(5), 571-601. doi: 10.1177/009365001028005001
- Eveland, W. P. Jr. (2002). News information processing as mediator of the relationship between motivations and political knowledge. *Journalism & Mass Communication Quarterly, 79*(1), 26-40.
- Eveland, W. P. Jr. (2004). The effect of political discussion in producing informed citizens: The roles of information, motivation, and elaboration. *Political Communication, 21*(2), 177-193. doi: 10.1080/10584600490443877
- Eveland, W. P. Jr, Cortese, J., Park, H., & Dunwoody, S. (2004a). How web site organization influences free recall, factual knowledge, and knowledge structure density. *Human Communication Research, 30*(2), 208-233.
- Eveland, W. P. Jr, & Dunwoody, S. (2001). User control and structural isomorphism or disorientation and cognitive load? Learning from the web versus print. *Communication Research, 28*(1), 48-78. doi: 10.1177/009365001028001002
- Eveland, W. P. Jr, & Dunwoody, S. (2002). An investigation of elaboration and selective scanning as mediators of learning from the web versus print. *Journal of Broadcasting & Electronic Media, 46*(1), 34-53.
- Eveland, W. P. Jr, Shah, D. V., & Kwak, N. (2003). Assessing causality in the cognitive mediation model: A panel study of motivations, information processing, and learning during Campaign 2000. *Communication Research, 30*(4), 359-386.
- Eveland, W. P. Jr., & Hively, M. H. (2009). Political discussion frequency, network size, and “heterogeneity” of discussion as predictors of political knowledge and participation. *Journal of Communication, 59*(2), 205-224. doi: 10.1111/j.1460-2466.2009.01412.x
- Eveland, W. P. Jr., Marton, K., & Seo, M. (2004b). Moving beyond “just the facts”: The influence of online news on the content and structure of public affairs

- knowledge. *Communication Research*, 31(1), 82-108. doi: 10.1177/0093650203260203
- Eveland, W. P. Jr., Seo, M., & Marton, K. (2002). Learning from the news in campaign 2000: An experimental comparison of TV news, newspapers, and online news. *Media Psychology*, 4(4), 353-378.
- Gaziano, C., & Horowitz, A. M. (2001). Knowledge gap on cervical, colorectal cancer exists among U.S. women. *Newspaper Research Journal*, 22(1), 12-27.
- Green, J., Richards, M., Murton, F., Statham, H., & Hallowell, N. (1997). Family communication and genetic counseling: The case of hereditary breast and ovarian cancer. *Journal of Genetic Counseling*, 6(1), 45-60. doi: 10.1023/A:1025611818643
- Guerra, C. E., Dominguez, F., & Shea, J. A. (2005). Literacy and knowledge, attitudes, and behavior about colorectal cancer screening. *Journal of Health Communication*, 10(7), 651-663.
- Hamilton, R. (1989). The effects of learner-generated elaborations on concept learning from prose. *The Journal of experimental education*, 57(3), 205-217.
- Harris, D. M. (2003). Racial differences in breast cancer screening, knowledge and compliance. *Journal of the National Medical Association*, 95(8), 693-701.
- Hively, M. H., & Eveland, W. P. Jr. (2009). Contextual antecedents and political consequences of adolescent political discussion, discussion elaboration, and network diversity. *Political Communication*, 26(1), 30-47. doi: 10.1080/10584600802622837
- Ho, S. S., Peh, X., & Soh, V. W. L. (2013). The cognitive mediation model: Factors influencing public knowledge of the H1N1 pandemic and intention to take precautionary behaviors. *Journal of Health Communication*, 18(7), 773-794. doi: 10.1080/10810730.2012.743624
- Hornik, R. (2006). Personal influence and the effects of the national youth anti-drug media campaign. *Annals of the American Academy of Political and Social Science*, 608, 282-300. doi: <http://ann.sagepub.com/archive/>
- Hovick, S. R., Kahlor, L., & Liang, M. C. (2014). Personal cancer knowledge and information seeking through PRISM: The planned risk information seeking model. *Journal of Health Communication*, 19(4), 511-527. doi: 10.1080/10810730.2013.821556
- Husaini, B. A., Sherkat, D. E., Bragg, R., Levine, R., Emerson, J. S., Menten, C. M., & Cain, V. A. (2001). Predictors of breast cancer screening in a panel study of African American women. *Women & Health*, 34(3), 35-51. doi: 10.1300/J013v34n03_03
- Hussain, I. (2012). A study to evaluate the social media trends among university students. *Procedia - Social and Behavioral Sciences*, 64, 639-645. doi: <http://dx.doi.org/10.1016/j.sbspro.2012.11.075>
- Jara-Lazaro, A. R., Thilagaratnam, S., & Tan, P. H. (2010). Breast cancer in Singapore: Some perspectives. *Breast cancer*, 17(1), 23-28.
- Jensen, J. (2011). Knowledge acquisition following exposure to cancer news articles: A test of the cognitive mediation model. *Journal of Communication*, 61(3), 514-534.
- Johnson-Laird, P. (1983). *Mental models*. MA: Harvard University Press.
- Jonassen, D. H., Beissner, K., & Yacci, M. (1993). *Structural knowledge: Techniques for representing, conveying, and acquiring structural knowledge*. Hillsdale, NJ England: Lawrence Erlbaum Associates, Inc.

- Katapodi, M. C., Dodd, M. J., Facione, N. C., Humphreys, J. C., & Lee, K. A. (2010). Why some women have an optimistic or a pessimistic bias about their breast cancer risk: Experiences, heuristics, and knowledge of risk factors. *Cancer Nursing, 33*(1), 64-73. doi: 10.1097/NCC.0b013e3181b430f9
- Katapodi, M. C., Dodd, M. J., Lee, K. A., & Facione, N. C. (2009). Underestimation of breast cancer risk: Influence on screening behavior. *Oncology Nursing Forum, 36*(3), 306-314.
- Katz, E. (1957). The two-step flow of communication: An up-to-date report on an hypothesis. *Public Opinion Quarterly, 21*(1), 61-78.
- Kraiger, K., Ford, J. K., & Salas, E. (1993). Application of cognitive, skill-based, and affective theories of learning outcomes to new methods of training evaluation. *Journal of Applied Psychology, 78*(2), 311-328.
- Kratzke, C., Vilchis, H., & Amatya, A. (2013). Breast cancer prevention knowledge, attitudes, and behaviors among college women and mother–daughter communication. *Journal of Community Health, 38*(3), 560-568. doi: 10.1007/s10900-013-9651-7
- Krugman, D. M., Fox, R. J., Fletcher, J. E., Fischer, P. M., & Rojas, T. H. (1994). Do adolescents attend to warnings in cigarette advertising? An eye-tracking approach. *Journal of Advertising Research, 34*(6), 39-52.
- Lee, C. J. (2010). The interplay between media use and interpersonal communication in the context of healthy lifestyle behaviors: Reinforcing or substituting? *Mass Communication & Society, 13*(1), 48-66. doi: 10.1080/15205430802694869
- Mayer, R. E. (1980). Elaboration techniques that increase the meaningfulness of technical text: An experimental test of the learning strategy hypothesis. *Journal of Educational Psychology, 72*(6), 770-784. doi: 10.1037/0022-0663.72.6.770
- Mayo, R. M., Ureda, J. R., & Parker, V. G. (2001). Importance of fatalism in understanding mammography screening in rural elderly women. *Journal of Women & Aging, 13*(1), 57-72. doi: 10.1300/J074v13n01_05
- McCombs, M., & Shaw, D. L. (1972). The agenda-setting function of mass media. *Public Opinion Quarterly, 36*(2), 176-187.
- McVee, M. B., Dunsmore, K., & Gavelek, J. R. (2005). Schema theory revisited. *Review of Educational Research, 75*(4), 531-566. doi: 10.3102/00346543075004531
- Meiser, B., Butow, P., Barratt, A., Gattas, M., Gaff, C., Hann, E., . . . Tucker, K. (2001). Risk perceptions and knowledge of breast cancer genetics in women at increased risk of developing hereditary breast cancer. *Psychology & Health, 16*(3), 297.
- Meissner, H., Potosky, A., & Convisser, R. (1992). How sources of health information relate to knowledge and use of cancer screening exams. *Journal of Community Health, 17*(3), 153-165. doi: 10.1007/BF01324404
- Melnyk, D., & Shepperd, J. (2012). Avoiding risk information about breast cancer. *Annals of Behavioral Medicine, 44*(2), 216-224. doi: 10.1007/s12160-012-9382-5
- Miles, A., Voorwinden, S., Chapman, S., & Wardle, J. (2008). Psychologic predictors of cancer information avoidance among older adults: The role of cancer fear and fatalism. *Cancer Epidemiology Biomarkers & Prevention, 17*(8), 1872-1879. doi: 10.1158/1055-9965.epi-08-0074
- Ng, M. (2010). Ad campaign images provoke, *The Sunday Times*.

- Niederdeppe, J., & Levy, A. G. (2007). Fatalistic beliefs about cancer prevention and three prevention behaviors. *Cancer Epidemiology, Biomarkers & Prevention*, 16(5), 998-1003.
- O'Keefe, G. J., Boyd, H. H., & Brown, M. R. (1998). Who learns preventive health care information from where: Cross-channel and repertoire comparisons. *Health Communication*, 10(1), 25-36.
- Ogata, J. K., Denham, B. E., & Springston, J. K. (2006). Effects of mass and interpersonal communication on breast cancer screening: Advancing agenda-setting theory in health contexts. *Journal of Applied Communication Research*, 34(1), 94-113. doi: 10.1080/00909880500420242
- Ong, C. S., Ooi, G., Tan, X. Q., Lee, J., Koh, G. C. H., & Verkooijen, H. M. (2010). Prevalence of limited cancer knowledge in Singaporeans, its determinants and association with cancer screening. *Preventive Medicine*, 50(5-6), 304-305. doi: <http://dx.doi.org/10.1016/j.ypmed.2010.02.013>
- Pearlman, D. N., Clark, M. A., Rakowski, W., & Ehrich, B. (1999). Screening for breast and cervical cancers: The importance of knowledge and perceived cancer survivability. *Women & health*, 28(4), 93-112.
- Pilarski, R. (2009). Risk perception among women at risk for hereditary breast and ovarian cancer. *Journal of Genetic Counseling*, 18(4), 303.
- Powe, B. D. (1999). An intervention to decrease cancer fatalism among rural elders. *Oncology nursing forum*, 26(3), 583-588.
- Powe, B. D., Hamilton, J., & Brooks, P. (2006). Perceptions of cancer fatalism and cancer knowledge. *Journal of Psychosocial Oncology*, 24(4), 1-13. doi: 10.1300/J077v24n04_01
- Pressley, M., McDaniel, M. A., Turnure, J. E., Wood, E., & Ahmad, M. (1987). Generation and precision of elaboration: Effects on intentional and incidental learning. *Journal of Experimental Psychology. Learning, Memory & Cognition*, 13(2), 291-300.
- Rakowski, W., Assaf, A. R., Lefebvre, R. C., Lasater, T. M., Niknian, M., & Carleton, R. A. (1990). Information-seeking about health in a community sample of adults: Correlates and associations with other health-related practices. *Health Education Quarterly*, 17(4), 379-393. doi: 10.1177/109019819001700403
- Rimal, R. N., Flora, J. A., & Schooler, C. (1999). Achieving improvements in overall health orientation: Effects of campaign exposure, information seeking and health media use. *Communication Research*, 26(3), 322-348.
- Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *Journal of Psychology*, 91(1), 93-114.
- Rouse, W. B., & Morris, N. M. (1986). On looking into the black box: Prospects and limits in the search for mental models. *Psychological Bulletin*, 100(3), 349-363. doi: 10.1037/0033-2909.100.3.349
- Rumelhart, D. E., & Ortney, A. (1977). The representation of knowledge in memory. In R. C. Anderson, R. J. Spiro & W. E. Montague (Eds.), *Schooling and the acquisition of knowledge*. Hillsdale, NJ: Lawrence Erlbaum.
- Rutten, L. J. F., Squiers, L., & Hesse, B. (2006). Cancer-related information seeking: Hints from the 2003 Health Information National Trends Survey (HINTS). *Journal of Health Communication*, 11, 147-156. doi: 10.1080/10810730600637574
- Saxena, N., Hartman, M., Bhoo-Pathy, N., Lim, J. W., Aw, T. C., Iau, P., . . . Verkooijen, H. (2012). Breast cancer in South East Asia: Comparison of presentation and outcome between a middle income and a high income

- country. *World Journal of Surgery*, 36(12), 2838-2846. doi: 10.1007/s00268-012-1746-2
- Shim, M. (2008). Connecting internet use with gaps in cancer knowledge. *Health Communication*, 23(5), 448-461. doi: 10.1080/10410230802342143
- 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(1), 157-172. doi: 10.1080/10810730600637475
- Sim, H. L., Seah, M., & Tan, S. M. (2009). Breast cancer knowledge and screening practices: A survey of 1,000 Asian women. *Singapore Medical Journal*, 50(2), 132-138.
- Sim, X., Ali, R. A., Wedren, S., Goh, L., D., Tan, C. S., Reilly, M., . . . Chia, K. S. (2006). Ethnic differences in the time trend of female breast cancer incidence: Singapore, 1968 - 2002. *BMC Cancer*, 6, 261-211. doi: 10.1186/1471-2407-6-261
- Slater, M. D. (2007). Reinforcing spirals: The mutual influence of media selectivity and media effects and their Impact on individual behavior and social identity. *Communication Theory*, 17(3), 281-303. doi: 10.1111/j.1468-2885.2007.00296.x
- Spurlock, W. R., & Cullins, L. S. (2006). Cancer fatalism and breast cancer screening in African American women. *ABNF Journal*, 17(1), 38-43.
- Straughan, P. T., & Seow, A. (1998). Fatalism reconceptualized: A concept to predict health screening behavior. *Journal of Gender, Culture and Health*, 3(2), 85-100. doi: 10.1023/A:1023278230797
- Straughan, P. T., & Seow, A. (2000). Attitudes as barriers in breast screening: A prospective study among Singapore women. *Social Science & Medicine*, 51(11), 1695-1703. doi: [http://dx.doi.org/10.1016/S0277-9536\(00\)00086-1](http://dx.doi.org/10.1016/S0277-9536(00)00086-1)
- Tichenor, P. J., Donohue, G. A., & Olien, C. N. (1970). Mass media flow and differential growth in knowledge. *Public Opinion Quarterly*, 34(2), 159-170.
- Valente, T. W., & Saba, W. P. (1998). Mass media and interpersonal influence in a reproductive health communication campaign in Bolivia. *Communication Research*, 25(1), 96-124.
- Verkooijen, H. M., Yap, K. P. L., Bhalla, V., Chow, K. Y., & Chia, K. S. (2009). Multiparity and the risk of premenopausal breast cancer: Different effects across ethnic groups in Singapore. *Breast Cancer Research and Treatment*, 113(3), 553-558. doi: 10.1007/s10549-008-9947-y
- Viswanath, K., Breen, N., Meissner, H., Moser, R., Hesse, B., Steele, W. R., & Rakowski, W. (2006). Cancer knowledge and disparities in the information age. *Journal of Health Communication*, 11(1), 1-17. doi: 10.1080/10810730600637426
- Weinstein, N. D. (1988). The precaution adoption process. *Health Psychology*, 7(4), 355-386. doi: 10.1037/0278-6133.7.4.355
- Yang, Z. J., & Kahlor, L. (2013). What, me worry? The role of affect in information seeking and avoidance. *Science Communication*, 35(2), 189-212. doi: 10.1177/1075547012441873
- Yanovitzky, I., & Blitz, C. L. (2000). Effect of media coverage and physician advice on utilization of breast cancer screening by women 40 years and older. *Journal of Health Communication*, 5(2), 117-134. doi: 10.1080/108107300406857

- Yeoh, K. G., Chew, L., & Wang, S. C. (2006). Cancer screening in Singapore, with particular reference to breast, cervical and colorectal cancer screening. *Journal of Medical Screening*, *13*(4), 14-19.
- Zhang, J., While, A. E., & Norman, I. J. (2011). Nurses' knowledge and risk perception towards seasonal influenza and vaccination and their vaccination behaviours: A cross-sectional survey. *International Journal of Nursing Studies*, *48*(10), 1281-1289. doi: 10.1016/j.ijnurstu.2011.03.002