



A review of theoretical models of health information seeking on the web

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Abstract

Purpose – By selectively reviewing theory-driven survey studies on internet health information seeking, the paper aims to provide an informal assessment of the theoretical foundations and research methods that have been used to study this information behavior.

Design/methodology/approach – After a review of the literature, four theory-driven quantitative survey studies are analyzed in detail. Each study is examined in terms of: theoretical framework; research variables that form the focus of the study; research design (sampling, data collection and analysis); and findings and results of hypothesis testing and model testing. The authors then discuss the theoretical models and analytical methods adopted, and identify suggestions that could be helpful to future researchers.

Findings – Taken as a whole, the studies reviewed point strongly to the need for multidisciplinary frameworks that can capture the complexity of online health information behavior. The studies developed theoretical frameworks by drawing from many sources – theory of planned behavior, technology acceptance model, uses and gratifications, health belief model, and information seeking models – demonstrating that an integration of theoretical perspectives from the health sciences, social psychology, communication research, and information science, is required to fully understand this behavior. The results of these studies suggest that the conceptual models and analytical methods they adopted are viable and promising. Many relationships tested showed large effect sizes, and the models evaluated were able to account for between 23 and 50 percent of the variance in the dependent variables.

Originality/value – The paper represents a first attempt to compare, evaluate, and to a degree synthesize the work that has been done to develop and test theoretical models of health information seeking on the web.

Keywords Health information seeking, Theoretical models, Internet, Review, Health, Information searches

Paper type Conceptual paper

Introduction

The internet has become an increasingly important source of health information for the general public. There are supply and demand forces driving this move. On the one hand, the internet, particularly the web, has become a ubiquitous part of our information lives, so that most people have access to and are comfortable with using it to look for health information. On the other hand, health and government organizations are using the web to make available health information to the general public, while healthcare practitioners and consumer health librarians are encouraging the participation of informed patients in clinical encounters. Given its growing importance, there is a need to deepen our understanding of internet health information seeking as a mode of information behavior with its own unique



characteristics. This paper is an initial attempt to take the pulse as it were of the theory-driven empirical research that has been done on this topic. There are four sections following this introduction: a review of the literature; an overview of the studies selected for detailed analysis; a detailed examination of each study; and a discussion of the common themes that emerge and suggestions for future research.

Literature review

To gain a broad understanding of the research that has been done on health information seeking, we draw on three recent reviews of the literature by Anker *et al.* (2011), Renahy and Chauvin (2006), and McMullan (2006).

Anker *et al.* (2011) conducted a review of the general health information seeking literature. Their search of the PsycInfo database identified 648 articles of health information seeking. Full text articles were selected and screened to produce a final set of 129 papers that were published between 1978 and 2010, with PsycInfo returning no records before 1978. Other journal literature databases were not searched, a methodological limitation.

The review found that in terms of the focus and measures used, most studies employed general health information seeking measures ($n = 53$; 41 percent) that asked respondents to self-report if they had engaged in a search for information in the past. Measures of health information seeking content ($n = 30$; 23 percent) were the next most frequently used, and these looked at the topics of the search (e.g. health/fitness, symptoms, treatment). Again these studies predominantly applied self-report scales (e.g. Likert-type responses, checklists of topics), although several studies used an open-ended question and/or content coding scheme. Next most common were measures of preference for health information ($n = 23$; 18 percent) that examined participants' general tendency towards engaging in health information seeking behavior. The next two measures focused on sources: health information sources/channels utilized ($n = 21$; 16 percent) and frequency of source/channel use ($n = 22$; 17 percent), which examined, respectively, specific information channels referenced by seekers and how often each information source was consulted. Roughly as common were measures of satisfaction with health information seeking ($n = 21$; 16 percent) that evaluated the source or information obtained as useful, satisfying, or helpful. Measures of outcomes of health information seeking ($n = 17$; 13 percent) were concerned with the actions that information seekers took as a result of their search. Another source measure assessed information/source credibility ($n = 11$; 9 percent) in terms of attributes such as quality, comprehensiveness, or trust. The least frequently used measures included barriers to seeking health information/self-efficacy ($n = 10$; 8 percent), intentions to seek health information ($n = 8$; 6 percent), and reasons for seeking health information ($n = 5$; 4 percent) (Anker *et al.*, 2011).

In terms of *methods*, studies mainly relied on cross-sectional designs ($n = 94$; 7 percent), employing a survey or structured interview to document health information seeking experiences. Thirteen studies (10 percent) utilized a retrospective review or cohort design. Twelve studies (9 percent) relied on naturalistic interventions/observations that took place in a natural setting and often involved time-intensive methods. Far fewer studies used experiments ($n = 5$; 4 percent), longitudinal designs ($n = 4$; 3 percent), or solely qualitative designs to examine health information-seeking behavior (Anker *et al.*, 2011).

McMullan (2006) and Renahy and Chauvin (2006) focused their literature reviews on internet health information seeking. McMullan (2006) identified three main health application areas of the internet:

- (1) as communication channel (e.g. e-mail);
- (2) as community (e.g. bulletin boards, mailing lists); and
- (3) as content (e.g. websites that provide health information).

She concluded that patients do not see the internet as a replacement for the health professional. For example, a study of 1,322 British internet users (Nicholas *et al.*, 2003) found that people went online after seeing the health professional for confirmation of the information given and to gather additional information. In that study, 97 percent accessed the internet for information about a specific condition, 57 percent were searching regarding a visit to the doctor, and 52 percent had looked for information about nutrition, exercise or weight control. These findings are consistent with those of a study of American internet users, where the majority of those surveyed (91 percent) searched for medical information about a specific condition rather than for information about healthy lifestyles or healthcare services (Fox and Rainie, 2000).

In their review, Renahy and Chauvin (2006) found that the majority of studies examining the prevalence of internet health information seeking by the general population were carried out in the USA. Similar statistics in other countries were fewer and older. For example, in 2000 or 2001, 10 percent of Swiss, 50 percent of Germans, and roughly 26 percent of Australians had conducted this form of internet search (Renahy and Chauvin, 2006). In terms of the content of health information searches, the most common topics concerned specific diseases (23-63 percent of the health information seekers, depending on the study); nutrition and diet; physical condition and sports; and mental health information. Moreover, several studies noted that the end beneficiary of the online information was not the searcher but a relative or friend (see, for example, Fox and Fallows, 2003).

Renahy and Chauvin (2006) also reported that users perceived the internet as a fast way of getting health information, where they could compare information on different websites, and look for information on sensitive topics with apparent "confidentiality". Although a significant proportion of users felt that the Internet was a reliable source (72-87 percent depending on the study), Fox and Fallows (2003) reported that about one-third of their respondents were concerned about information quality. The issue of the quality of the information disseminated on the web is one of health professionals' main concerns.

Renahy and Chauvin (2006) noted that numerous studies examined what users' demographic traits were associated with health information seeking on the internet. Nearly all quantitative studies reported more women were searching for health information on the internet than men. The other two most studied demographic variables were education level and income, where higher levels of each were associated with health information seeking.

Large-scale, primarily survey-based studies continue apace. In the UK, a significant body of work examining health information seeking has been produced by David Nicholas, Paul Huntington, and associates at the Centre for information Behaviour and the Evaluation of Research (CIBER) (see, for example, Huntington *et al.*, 2004; Nicholas

et al., 2003). In France, Renahy *et al.* (2010) continue to survey online health information seeking in the general population. In the USA, large-scale telephone polls are conducted by the Pew Research Center and published online as the Pew Internet and American Life Reports. A recent Pew report (Fox, 2011) stated that health information remains one of the most important subjects that users research online, with 80 percent of internet users gathering health information online. Symptoms and treatments continue to dominate internet users' health searches, but food safety, drug safety, and pregnancy information are among new topics identified in the survey. In Canada, an Ipsos Reid survey on internet usage (Ipsos Reid, 2002) revealed that searching for health information was the foremost online activity in Canada. Most commonly visited websites were:

- sites on diseases, prevention, and cures: 81 percent;
- sites on nutrition: 51 percent;
- sites on prescription drugs: 35 percent;
- sites on exercise: 29 percent; and
- sites on support groups: 13 percent.

Lemire *et al.* (2008) conducted an online survey of 2923 users of an established Francophone health information website based in Québec. They found that frequency of site use was directly associated with: perceived usefulness, importance given to written media for health information, concern for personal health, importance given to opinions of physicians and health professionals, and the trust of site information.

Theoretically grounded studies of health information seeking on the web

The studies reviewed in the last section are useful in identifying factors that influence health information seeking on the web, including demographic variables, health conditions, and website attributes. Data analysis in these studies consisted primarily of producing descriptive statistics that portray the extent and nature of Internet health information seeking, although a number of academic researchers have analyzed the survey data further using inferential statistics and other quantitative methods. Notably, Rice (2006) analyzed several major Pew datasets and found that the strongest influences on health information seeking were gender, employment, specific health reasons, and helping others with health issues.

While descriptive statistics are useful, we suggest that in order to advance our theoretical understanding of the subject, we also need studies that are anchored in a conceptual framework, possibly derived from theories that have been successful in accounting for health, information, or communication behaviors. Within a well-articulated conceptual framework, variables and relationships may then be postulated and defined. By collecting and analyzing empirical data (from surveys or experiments, for example), these relationships may then be investigated using quantitative methods that test hypotheses and identify causal paths. Such statistical techniques would also allow us to determine the strength and predictive power of the relationships as a model of health information seeking.

For this paper, we searched for studies that met the criteria of being theoretically driven and empirically based in the sense we discussed above. Three databases were searched for items that appeared between 2000 and 2011:

- (1) Scopus;
- (2) Web of Science; and
- (3) Dissertations & Theses.

As well, the open web was searched using Google, to find unpublished or in-publication studies. Search results were retained if the studies featured a theoretical framework; examined Internet use as a study variable; employed survey methodology, and tested hypotheses and models. Excluded were studies that focused on health conditions or patient groups. Thus, studies that were qualitative or reported only descriptive statistics; studies of people with cancer, mental health conditions, or other specific health conditions; and studies that focused on age (young or elderly) were excluded.

Using the above search and selection procedure, we identified four survey studies for our analysis. The four were two population survey studies of Korea (Yun and Park, 2010) and Hong Kong (Leung, 2008), and two dissertation-based studies on the gendered use of health information seeking on the web (Marton, 2011; Yoo and Robbins, 2008). Women are the predominant seekers of health information online (Fallows, 2005; Fox, 2005, 2006; Fox and Fallows, 2003; Rice, 2006). Asians are a dominant internet user population demographic in the USA and Asian countries have high rates of adoption of internet use (Spooner, 2001; Zhu and Wang, 2005; Zhu and He, 2002a, b; Rhee and Kim, 2004). Our selection of studies is not intended to privilege one methodological approach over another; rather, by grouping studies of large internet use population groups that employ quantitative approaches and report statistical measures, we hope to be able to attempt some level of comparative analysis of predictive power.

Table I provides background information on the four theory-based quantitative studies that will be examined in this paper. All used survey methodology, with several

| Study | Theoretical framework | Study design | Sample |
|------------------------|---|---|---|
| Yoo and Robbins (2008) | Two expectancy-value models, i.e. theory of planned behavior and uses and gratifications theory | Mailed print survey questionnaire March 2003 | Convenience sample Middle-aged women in US Midwest city (<i>n</i> = 354) |
| Leung (2008) | Expectancy-value approach Embedded media perspective | Telephone survey Late 2006 | Random sample Hong Kong citizens (<i>n</i> = 569) |
| Yun and Park (2010) | Technology acceptance model Health belief model | Web survey December 2007 | Convenience sample Korean citizens (<i>n</i> = 212) |
| Marton (2011) | Behavioural model of information seeking on the web | Web survey, some completed interviews, web tracking, web use journal, browser files November 2000-May 2001 | Convenience sample Women, mostly Canadian (<i>n</i> = 264) |

Table I.
Theoretically grounded studies of health information seeking on the web

survey designs represented, specifically, print, telephone, and web. Convenience sampling is most common. All four survey studies had a sample size of over 200 respondents.

In these studies, variables influencing online health information seeking were formally defined and measured. Relationships between variables were postulated and tested using correlation and multiple regression or path analysis. Two sets of statistics were analyzed to assess the strength and power of the relationships. First, effect sizes were examined using standardized regression coefficients. This coefficient measures the amount of change in the dependent variable when an independent variable increases one standard deviation while other independent variables are held constant, regardless of how they are scaled. Second, predictive power was examined by considering the reported model's coefficient of multiple determination (or R^2), which measures the proportion of variance in the dependent variable explained by the independent variables collectively.

We look at each of these four survey studies in the next section in order to identify the theoretical foundations and empirical findings that could further our understanding of health information seeking on the web.

Four theoretically grounded quantitative studies of health information seeking on the web

Study 1: middle aged women seeking health information on the web (Yoo and Robbins, 2008)

This paper (based on Yoo's, 2004 doctoral dissertation) looks at how and why middle-aged women use health-related websites. Middle-aged women were chosen as the target population in consideration of their key roles as health information seekers not only for themselves, but also as health managers and caregivers for their family members. The theoretical framework was drawn from two expectancy-value models:

- (1) the theory of planned behavior from social psychology (Ajzen, 1985, 1991); and
- (2) the uses and gratifications approach from mass communication research (Palmgreen and Rayburn, 1982; Palmgreen, 1984; Palmgreen *et al.*, 1985; Rubin, 1994; Rayburn, 1996; Ruggiero, 2000).

The theory of planned behavior postulates three determinants of behavioural intention (BI):

- (1) attitude toward behavior (A);
- (2) subjective norms (SN); and
- (3) perceived behavioural control (PBC).

Each determinant is thought to be independently and positively related to behavioral intention (BI). Subjective norms (SN) was dropped from this study because health information seeking was considered an individual pursuit, not a group activity guided by social norms.

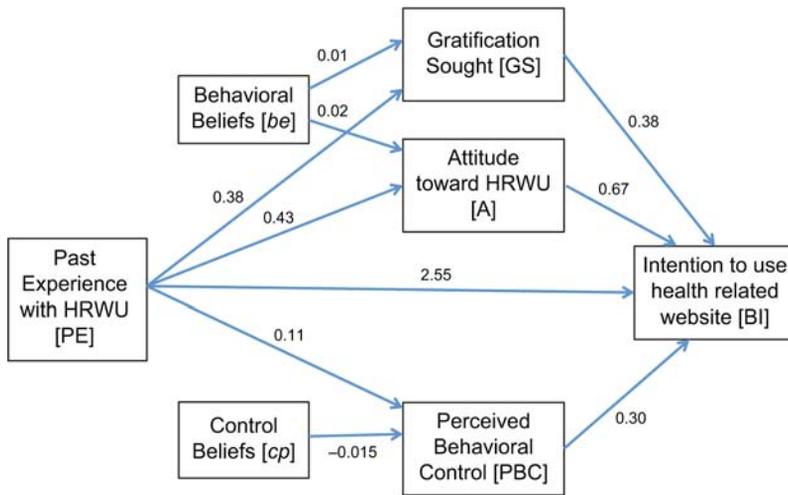
The expectancy-value model of uses and gratifications proposed by Palmgreen and Rayburn (1982) postulates that gratifications sought (GS), and attitude toward behavior (A) are functions of beliefs and evaluations. Two types of beliefs from the theory of planned behavior were included in the conceptual framework:

- (1) behavioral beliefs; and
- (2) control beliefs.

Behavioral beliefs are subjective beliefs that a behavior would produce an expected outcome, and they were operationalized as behavioral beliefs (*be*) toward health-related web use in this study. Control beliefs have to do with the perceived presence of factors that may facilitate or impede performance of a behavior. It is thought that these control beliefs – in combination with the perceived power of each control factor – determine perceived behavioural control (PBC). They were operationalized as control beliefs (*cp*) over health-related web use. A third antecedent variable was added to the framework, i.e. past experience (PE). While PE is not part of Azjen’s theory of planned behavior, several researchers have found it to be a strong predictor of future behavior (Ouellette and Wood, 1998; Sutton, 1998; Taylor and Todd, 1995).

A postal mail survey of middle-aged women’s health information seeking on the web was conducted in March 2003. The sample of middle-aged women, defined as “women old enough to be parents and young enough to have living parents of their own” was obtained from a mid-sized American city through random sampling of approximately 5 percent (700) of students of middle and high schools whose names and parents’ names and contact information were listed in school directories. The sample size of 354 respondents represented a response rate of approximately 51 percent when undelivered surveys were included. The sample comprised women who had children enrolled in middle school or high school, but not women with children enrolled in elementary schools, or women without children (Yoo, 2004). Several sample biases were evident. Respondents had higher household income, education, and employment than the municipal census. Most were White, English-speaking, married; while Asian-Americans were adequately represented, African-Americans were under-represented. The majority (86 percent) used the internet on a daily basis, of which approximately 80 percent had visited health-related websites, with 91 percent having searched for personal health information and 82 percent for their children.

The survey data was used to test a number of hypotheses using hierarchical regression. Entering the three predictors – i.e. attitude (A), gratifications sought (GS) and perceived behavioural control (PBC) – together revealed a positive relationship between each predictor and the BI dependent variable, as shown in Figure 1. All relationships had moderate effect sizes and were statistically significant, with a robust model R^2 of 0.39. The next regression analysis revealed very modest but significant relationships between behavioral beliefs (*be*) and both gratifications sought (GS) and attitude (A), and between control beliefs (*cp*) and PBC, respectively. A separate hierarchical regression analysis examined the mediated effects of A, GS, and PBC on BI. It showed that behavioral beliefs (*be*), A, and GS had significant effects on BI, but not control beliefs (*cp*) nor PBC. Behavioral beliefs (*be*) were found to be directly and indirectly related to BI, but control beliefs (*cp*) had *neither* a direct nor indirect significant effect on BI. These unexpected findings suggest the existence of relationships between PBC, GS, and A. Finally, past experience (PE) was found to be both directly and indirectly related to BI. When all four predictors – i.e. PE, A, GS, and PBC – were examined relative to BI, a large model R^2 was obtained (i.e. 0.50). However, PBC was no longer a significant predictor when PE was added to the regression model.



Notes: All paths shown significant at $p < 0.01$. Numbers are standardized regression coefficients. HRWU: Health-related Web use
Source: Adapted from Yoo and Robbins (2008, p. 581, Figure 3)

Figure 1.
 Middle-aged women seeking health information on the web

To summarize, Yoo’s survey study of middle-aged women seeking health information online developed and tested a regression model that found robust relationships between gratifications sought, attitude towards health-related web use, perceived behavioural control, and behavioural intention to use health-related websites (Yoo and Robbins, 2008; Yoo, 2004). These study variables were drawn from two expectancy-value models:

- (1) the theory of planned behavior from social psychology; and
- (2) uses and gratifications from communication science.

In addition, past experience with health-related web use was also significantly linked to behavioral intent to use health related websites.

Study 2: health information seeking and internet embeddedness in Hong Kong (Leung, 2008)

Leung (2008) referenced Howard’s embedded media perspective (Howard, 2004) and the expectancy-value approach in developing a theoretical framework for researching internet embeddedness in the context of health information seeking. In the expectancy-value approach from communication research, judgments about expected value would affect intentions to use media through their influence on attitudes (Jeffres, 1994). Leung (2008) linked the expectancy values of health information websites to their perceived quality, so that “expectancy values or perceived quality attributes of health information websites will influence people’s use of the Internet for health information” (Leung, 2008, p. 566) Three attributes of the quality of information on health websites were examined in the study:

- (1) reliability;
- (2) relevance; and
- (3) interaction.

Internet embeddedness refers to “not only how much [people] rely on the Internet for health-related information, but also the Internet for information on school, career training, job search, making investments, and developing lasting relations” (Leung, 2008, p. 566).

A random sample telephone survey was conducted in Hong Kong in late 2006. Eligible respondents were PC users with home internet access. The sample size was 1,076 citizens, with a response rate of 55 percent. Slightly more than half (52.9 percent) of survey respondents were Internet users. The 569 internet users formed the study sample. Approximately half were male (51.7 percent) and the mean age category was between 39-40 years of age. No further information was provided concerning sample demographics.

The first research question asked: what specific types of health information do people seek through the internet? Factor analysis (a technique to identify the latent structure or dimensions of a set of variables) yielded a “four-factor health information seeking structure” which included medical treatment, hard to talk about health issues, family health, and health improvement. The study noted that while past research indicated that people were increasingly using the internet for health information, a majority still preferred to use doctors, pharmacists, and nurses as their main sources of information. Another pair of hypotheses predicted that people who scored highly on expected value/quality of online health information were more likely to seek health information from the internet, and were also more likely to perceive the internet as playing an important role in their lives (a factor labeled “internet embeddedness”). Both hypotheses were supported. Data analysis using correlation and hierarchical regression found that “behavior or behavioral intentions in health information seeking was indeed a function of value expectancy or an evaluation of health information websites” (p. 567) and that “subjects who score high on expectancy value/quality of online health information are positively and significantly linked to Internet embeddedness” (p. 568).

More specifically, health information seeking online was very weakly correlated with internet embeddedness (0.16, $p < 0.01$) and internet usage intensity (0.09, $p < 0.05$). Internet usage intensity was correlated with both expectancy value/quality of health information online (0.25, $p < 0.001$), and internet embeddedness (0.23, $p < 0.001$). The strongest correlation observed was between Internet embeddedness and expected value/quality of health information online (0.46, $p < 0.001$). Hierarchical regression found the strongest relationship between one dimension of internet usage intensity (web search) and internet embeddedness. Relevance/context (0.21, $p < 0.01$) and interaction (0.19, $p < 0.01$), two dimensions of expected value/quality of health information websites, but not reliability, were also significantly related to internet embeddedness. The R^2 of this regression model of factors influencing internet embeddedness was 0.23 (i.e. 23 percent of its variance was explained by the factors).

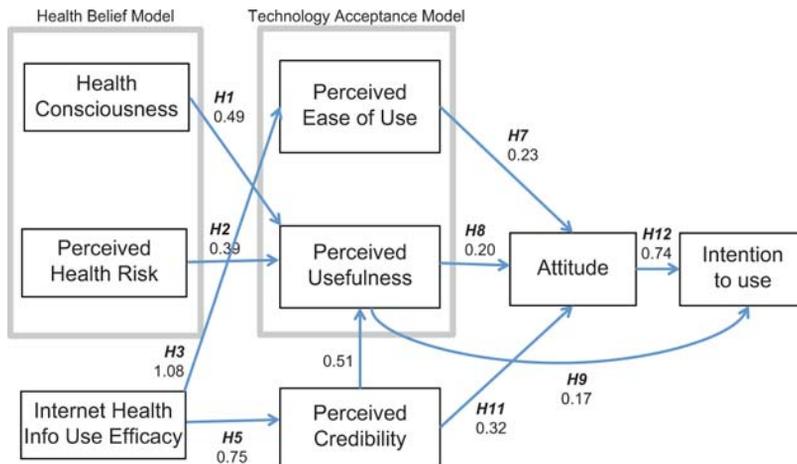
In summary, Leung’s study on internet embeddedness revealed the importance of information source relevance and interaction as significant measures of information source quality in relation to both Internet embeddedness and Internet use intensity. Health information seeking online was only weakly related to Internet embeddedness and Internet usage intensity.

Study 3: seeking disease information online in South Korea (Yun and Park, 2010)

Yun and Park, nurse researchers at two universities in South Korea, examined health information seeking on the web using the Technology Acceptance Model (TAM) (Davis, 1989, 1993). TAM posits that intention to use an information system is predicted by its perceived ease of use and perceived usefulness. Yun and Park extended the TAM framework by introducing four additional variables. Two were derived from the Health Belief Model (Rosenstock, 1974): health consciousness, and perceived health risk. The other two were Internet health information use efficacy, and perceived credibility. As shown in Figure 2, the study's extended TAM model included health consciousness, perceived health risk, and health information use efficacy as antecedents, and perceived ease of use, perceived usefulness, and perceived credibility, as mediating beliefs. Intention to use health websites to obtain disease information was the dependent variable. (The authors retained attitude as a variable in the framework, although TAM had replaced attitude with measures of perceived usefulness and ease of use; Davis, 1989.)

A web survey was posted on two South Korean health information websites in December 2007. South Koreans 20 years of age or older who had searched disease-related health information on the internet in the previous six months were eligible to participate in the online study. A self-selected convenience sample of 212 respondents was obtained. The sample comprised more women than men, predominantly between 30-49 years of age, with a junior college level education, and in employment as office workers.

Path analysis (a technique to evaluate interrelationships among variables by analyzing their correlational structure) was used to identify relationships between the antecedent, mediating, and dependent variables. Twelve hypotheses were also tested. Ten out of the twelve hypotheses were supported empirically. The effect sizes and significant levels for the relationships between study variables in the path analysis



Notes: All paths shown significant at $p < 0.05$ or better. Numbers are unstandardized path coefficients

Source: Adapted from Yun and Park (2010, p. 2863, Figure 1)

Figure 2. Seeking disease information online in South Korea

model were robust, with path coefficients ranging from 0.20 ($p < 0.05$) (*H8*) to 1.08 ($p < 0.01$) (*H3*). As shown in Figure 2, health consciousness and perceived health risk were significant predictors of perceived usefulness, attitude, and intention to use the internet as a disease information resource (*H1* and *H2*). The relationships between internet health information use efficacy and both perceived ease of use (*H3*) and perceived credibility (*H5*) were significant and strong. However, efficacy did not significantly affect perceived usefulness (*H4*, not shown in Figure 2). Perceived ease of use and usefulness also had a positive effect on attitude (*H7* and *H8*), but did not significantly affect perceived usefulness (*H6*, not shown in Figure 2). Hence, perceived usefulness was *not* a good predictor of the dependent variables, attitude and intention to use. Instead, perceived credibility was shown to be a key factor affecting participants' attitude and intention to use internet for disease information (*H11*). Perceived usefulness and attitude also had positive effects on intention to use Internet for disease information (*H9* and *H12*). Overall, the strongest relationships were between Internet health information use efficacy and perceived ease of use, and between internet health information use efficacy and perceived credibility.

It should be noted that the overall goodness of fit of the model, measured by χ^2 , was significant. A significant χ^2 is undesirable in path analysis, as it indicates that the observed data distribution does not conform to one based on the theoretical model. Relative measures of goodness of fit – i.e. goodness-of-fit index (GFI), comparative fit index (CFI), normed fit index (NFI), non-normed fit index (NNFI) and root-mean square error of approximation (RMSEA) – achieved acceptable but not ideal values. Additionally, because only unstandardized path coefficients were reported, effect sizes could not be compared.

Study 4: a multi-method study of women seeking health information on the web (Marton, 2011)

Marton (2011) reported a multi-method doctoral dissertation study of women seeking health information on the web conducted in 2000-2001. The theoretical framework included variables from information science and health science that were thought to directly influence health information seeking on the web. Three sets of antecedent variables were examined. The first set concerned personal characteristics or context and included perceived uncertainty of personal health conditions and care recipient health conditions (later operationalized solely as severity of personal health conditions), and web self-efficacy. Since women seek health information online for their personal use and to care for others (family members), family care-giving role was considered (Connell and Crawford, 1988; Rutman, 1996; Rutten *et al.*, 2006). A second set of variables pertained to the web as an information source and included perceived source access (physical access and cognitive access), and perceived source quality (relevance and reliability). A third set of variables was socio-demographic, and covered age, racial identity, occupation, household income, education, primary language, marital status, and geographic location. The dependent variable was the frequency of seeking health information on the web (FSHIW). Thus, the study addressed the question: what are the relative influences of individual situational factors, information source characteristics, and demographics on the frequency of seeking health information on the web? The web was conceptualized as three facets that reflected the three main modes of seeking health information on the web at that time: content

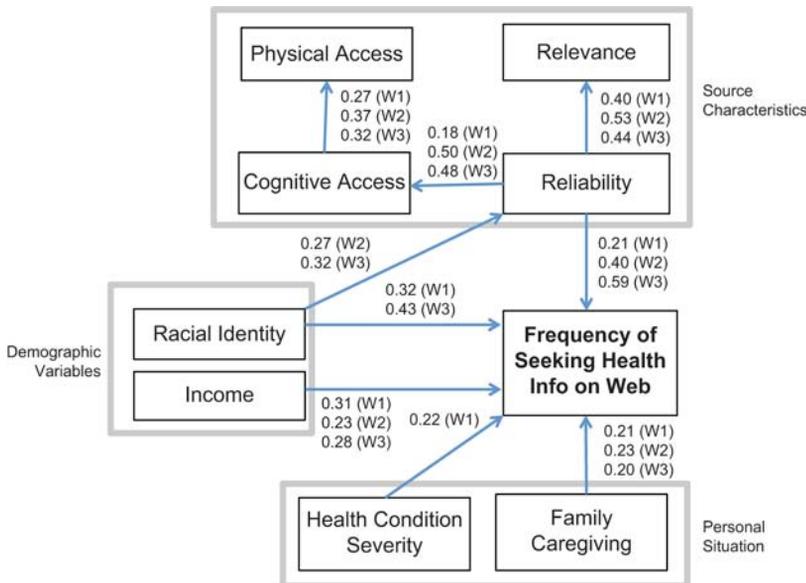
websites; web-based bulletin boards and chatrooms; and web-based listservs and newsgroups.

Data was collected from 264 women from November 2000 until April 2001 using a web survey questionnaire. The convenience sample had several biases: participants were predominantly White, well educated, English-speaking Canadians with internet use experience, although Asian-Canadians were adequately represented. A subset of 27 survey respondents completed at least one additional component of this multi-method study: in-depth interviews, web use journal, and computer files (web use log files, browser history and bookmark files).

Path analysis discovered relationships that were robust and significant for several information source variables:

- perceived source reliability and the dependent variable, FSHIW;
- perceived source reliability and perceived source relevance;
- perceived source reliability and perceived cognitive access; and
- perceived cognitive access and perceived physical access (see Figure 3).

These bivariate relationships for information source variables were found for all three facets of the web. The smallest effect size for this set of relationships was 0.18 (perceived source reliability and cognitive access, content websites facet) and the largest effect size was 0.59 (perceived source reliability and FSHIW,



Notes: All paths shown significant at $p < 0.05$ or better. Numbers are standardized path coefficients. W1: Content sites; W2: Bulletin Boards/Chatrooms; W3: Listservs/Newsgroups. Model R^2 : 0.34 (W1), 0.27 (W2), 0.49 (W3)
Source: Adapted from Marton (2011, pp. 202, 208, 214, Figure 4.1-4.3)

Figure 3. A multi-method study of women seeking health information on the web

listservs/newsgroups facet). Bivariate relationships for personal situation variables were found inconsistently across the three facets of the web, as follows:

- severity of personal health conditions and FSHIW, content websites facet (0.22);
- family care-giving (self-esteem) and FSHIW, content websites facet (0.21);
- family care-giving (children) and FSHIW, bulletin boards/chatrooms facet (0.23);
and
- listservs/newsgroups facet (0.20).

(All effect sizes were standardized regression coefficients significant at $p < 0.05$ or better.)

For the demographic variables, significant relationships were found between racial identity and perceived information source reliability, bulletin boards/chatrooms facet (0.27), listservs/newsgroups facet (0.32); and racial identity and FSHIW, content websites facet (0.32), and listservs/newsgroups facet (0.28). Less surprisingly, income was found to influence the dependent variable FSHIW, for both web-based bulletin boards/chatrooms (0.23) and listservs/newsgroups (0.28). Furthermore, occupation influenced FSHIW, content websites facet (0.31). (All effect sizes were standardized regression coefficients significant at $p < .05$ or better.)

Overall, the bivariate relationships between the information source characteristics exhibited the largest effect sizes and significance levels, followed by demographic variables, and lastly, personal situation variables. In addition to statistical analysis, qualitative interview data, web use journals, and recordings of web use sessions provided a contextualized understanding of the survey data.

There are two interesting findings from this multi-method exploratory study of women seeking health information on the web. First is the importance of user perceptions of information source reliability to seeking health information on the web, which was supported by the analysis of the survey and interview data. This was consistently observed for all three facets of the web, i.e. content websites, web-based bulletin boards/chatrooms, and web-based listservs/newsgroups. Users of web-based communication sites whose perceptions of the reliability of the health information on these sites were high, were, in turn, inclined to regard the content on these web-based information sources as highly relevant, which then predisposed them to spend more time using this type of website. This set of bivariate relationships suggests the existence of a temporal chain of events controlled by user perceptions of information source reliability.

The second finding from analyzing interview data and tracker log files concerned the importance of situational relevance (Wilson, 1973) as an indicator of information source quality. Ruthven (2005) has noted the dynamic nature of user assessments of relevance over time. Borlund (2003) suggested that relevance judgments evolved during the process of interaction with information retrieval systems and classified the manifestations of relevance as topical, situational, and cognitive relevance. Here, it is proposed that topical relevance is inadequate in addressing health information needs for participants, and situational relevance represents a fine-grained sub-type of topical relevance. The concept of situational relevance is consistent with the sense-making framework that posits that problem situations give rise to information seeking (Dervin, 1992). Additionally, it is felt that Saracevic's concept of motivational or affective

relevance (Saracevic, 1996) is likely an attribute of health information since coping is an important dimension of living with health conditions.

Discussion

In general, the approach adopted by the four reviewed studies was able to produce interesting, significant research results. All reviewed studies found support for at least one significant relationship based on testing hypotheses. However, relationship effect sizes and significance levels varied considerably both within and across studies. Model R^2 , where reported, achieved a minimum value of 0.23 (Leung, 2008), indicating that approximately one quarter of the variance was accounted for by the study variables, and a maximum of 0.49-0.50 (Marton, 2011; Yoo, 2004; Yoo and Robbins, 2008), indicating that half of the variance had been accounted for by the study variables. The studies also identified race, income, and employment as key demographic variables. In this section we compare and critique the theoretical frameworks and research methods adopted.

Theoretical frameworks

The studies we reviewed show clearly the usefulness of applying multidisciplinary conceptual frameworks to investigate health information seeking. The theoretical frameworks of the reviewed studies combined elements from theories of human behavior in social psychology, communication research, health behavior, and information science. In particular, there was significant use of the theory of planned behavior, the technology acceptance model, uses and gratifications approach, health belief model, and information seeking models (see Table II). These theories appear to provide a sound foundation to build on. We discuss them below, and note how they were not used singly on their own, but were always expanded by adding variables from cognate models and by including demographic factors.

The theory of planned behaviour (TPB) has been applied to study a wide range of purposeful human behaviors, including health-relevant behaviors. In TPB, behavior is predicted by the intention to engage in that behavior. This intention is determined by three factors:

- (1) attitudes, i.e. the individual's overall evaluations of the behavior;
- (2) subjective norms, i.e. beliefs about whether significant others think the behavior should be undertaken; and
- (3) perceived behavioural control, i.e. the perception of how easy or difficult the performance of the behavior is (Ajzen, 1991).

It is evident that TPB focuses on the individual cognitive determinants of future behavior. TPB assumes that behavior is rational and does not take account of other non-cognitive or irrational determinants of human behavior. Conner and Norman (2005) noted that typical applications of TPB give little attention to the role of emotion, which may be relevant to a range of health behaviors. Although emotions might be considered in TPB as influencing intentions and behavior *indirectly* through their impact on beliefs and attitudes, such an indirect approach might obscure the role and significance of emotions. Another criticism concerns the importance of socio-demographic factors. Again, the theory assumes that these factors are mediated by TPB variables. However, some studies have found a direct, unmediated

| Researchers | Theoretical framework | Independent variables | Dependent variable |
|------------------------|--|---|---|
| Yoo and Robbins (2008) | Two expectancy-value models: theory of planned behavior and uses and gratifications theory | Past experience (PE), behavioural and control beliefs, gratifications sought (GS), attitude (A), perceived behavioral control (PBC) | Intention to visit health information websites |
| Leung (2008) | Expectancy-value approach Embedded media perspective | Health information seeking Expectancy values or perceived quality of health information websites (reliability, relevance/context, interaction) Internet usage patterns | Internet embeddedness |
| Yun and Park (2010) | Technology acceptance model Health belief model | Perceived ease of use, perceived usefulness, attitude, perceived health risk, health consciousness, internet health information use efficacy, perceived credibility | Intention to use health websites to obtain disease information |
| Marton (2011) | Behavioral model of information seeking on the web | Personal health condition, family caregiving, perceived source relevance, perceived source reliability, perceived physical and cognitive access, perceived self-efficacy, demographic variables | Frequency of seeking health information on the web (three facets) |

Table II.
Research variables of reviewed studies

effect of background variables on intentions or behavior (Conner and Norman, 2005, p. 179; Yoo, 2004; Marton, 2011).

In Yoo and Robbins' (2008) study, which was based on TPB, attitude was a significant factor influencing behavioral intention, as predicted by theory. Perceived behavioural control was another predictor, but its effect became non-significant when past experience (of health web use) entered the model, suggesting that past experience could be included in future applications of TPB. A larger issue in Yoo and Robbins' model concerns the omission of subjective norms for the reason that health information seeking is "private, personal, and of low risk, and unlikely to be subject to others' influence" (Yoo and Robbins, 2008, p. 580). In TPB, subjective norms are a function of normative beliefs. Normative beliefs refer to the perceived behavioral expectations of such important referent individuals or groups as the person's spouse, family, friends, doctor, and so on. These normative beliefs when combined with motivation to comply

would determine subjective norms. Given that health information seeking often relates to family care-giving, and is subjected to social pressure, exhortations of healthcare personnel, and so on, it is not clear that subjective norms should be omitted.

Like TPB, the technology acceptance model (TAM) was derived from the theory of reasoned action and is one of most used models in predicting user acceptance of new technology. As with TPB, TAM assumes a very high correlation between intention and actual behavior (Davis, 1989). However, this may not always be the case. A review by Davis *et al.* (1989) of studies comparing intention-to-use and self-report usage data to actual usage data showed correlation coefficients which ranged from -0.23 to $+0.79$ (p. 997). Other authors have also found problems correlating intention and actual behavior (e.g. Srinivasan, 1985; Szajna, 1996). Thus, a limitation of TAM seems to be that while it has consistently predicted behavioral intention to use, it has not always predicted actual use. Another important limitation may be that by focusing only on perceived usefulness and ease of use, TAM provides a relatively narrow lens to look at a behavior as complex as health information seeking. Yoo and Robbins (2008) wrote that “TAM does not seem to be a sufficient model for predicting health-related Web use because of its heavy dependence on just these two factors” (p. 578). Perhaps in recognition of some of these concerns, Yun and Park (2010) expanded their TAM framework substantially, to include perceived credibility, perceived health risk and health consciousness (from the health belief model).

In mass communication research, the uses and gratifications approach provides a framework for understanding the processes by which media users seek information or content selectively, according to their needs and interests. It emphasizes audiences' choices by assessing their reasons for preferring a certain media over others. The personal motivations for media use imply that different media offer different gratifications that are expected by audiences. These gratifications can then be thought of as experienced psychological effects that are valued by individuals. Thus, Palmgreen and Rayburn (1985) proposed a model that weighed gratifications sought against gratifications obtained. Where the latter is higher than the former, their model predicts higher audience satisfaction and higher ratings of appreciation and attention. Two sets of criticisms may be raised. First, the approach is individualistic in considering only the individual psychological gratification derived from individual media use. In ignoring the social context of media use it may not be well suited for studying information behaviors that can have less to do with the pursuit of gratification, and more to do with the social context in which that behavior is enacted. The second criticism concerns the relative lack of attention paid to media content, so that while studies analyze why people choose the media, they ignore what meanings or outcomes users derive from their media use (Ang, 1991).

For over 30 years in public health research, the Health Belief Model (HBM) has been applied to a range of health behaviors and has helped shaped public health policies and the training of health care professionals (Abraham and Sheeran, 2005). Like the models discussed earlier (TPB, TAM, uses and gratifications), HBM focuses on individual cognitive determinants of health behavior. Specifically it examines how individuals perceive illness threat (threat perception), and how they evaluate behaviors to counteract this threat (behavioral evaluation). Threat perception is composed of two beliefs:

- (1) perceived susceptibility to the illness or health problem; and
- (2) perceived severity of the consequences of the illness.

Behavioural evaluation also consists of two beliefs concerning the benefits or efficacy of the health behavior, and the costs of, or barriers to, adopting it. Using these two concepts, the model predicts that an individual is likely to engage in a particular health behavior if she believes she is susceptible to a health condition that she regards as serious, and if she believes that the benefits of the behavior would outweigh the costs. While HBM has been applied to the prediction of health behaviors across a wide range of populations, the model is limited in that “it fails to address the importance of intention formation or the influence that others’ approval may have upon our behavior. It portrays individuals as asocial, economic decision makers and consequently fails to account for behavior under social and affective control” (Abraham and Sheeran, 2005, p. 66).

In information science, Johnson (1997) presented a model of information seeking in his book on cancer-related information seeking. In the Johnson model, information seeking is influenced by “background factors” (demographics and direct experience) and “personal relevance factors” (beliefs about the topic, and salience of information about the topic); as well as by “information carrier factors” (characteristics and utility of information channels selected and used by seekers). Choo *et al.* (2000) synthesized earlier research (Wilson, 1999; Kuhlthau, 1993; Dervin, 1992) in a model that analyzes information seeking as comprising three activities:

- (1) the experiencing of information needs;
- (2) information seeking; and
- (3) information use.

Each of these activities is in turn contoured by the interaction of cognitive, affective, and situational factors. The information seeking activity focuses on the selection and engagement of sources based on users’ perceptions of source accessibility and source quality (typically in terms of relevance and reliability). Marton (2011) draws on this model to develop her framework for health information seeking. Information needs were operationalized as personal health conditions and their severity; information seeking examined perceived source characteristics in terms of access and quality; and information use considered the situational context of family care-giving. Two criticisms of the model may be relevant. First, we may expect information needs to become much more fluid and malleable, changing as information is encountered in the course of searching the web. Second, while people may choose to use websites based on perceptions of their accessibility and quality, the cues and methods by which these judgments are formed could be quite different from those used to evaluate more traditional media.

Overall, the reviewed survey studies of health information seeking on the internet construct their conceptual frameworks by drawing from theories in psychology, communication research, information science, public health research, and related fields. The common focus seems to be on examining individual cognitive determinants of health information behavior, as evidenced in the use of the theory of planned behaviour, the technology acceptance model, and the health belief model. The importance of information source characteristic variables, notably source reliability and source relevance, is evident in all four studies reviewed, as well as in other studies of this behavior (Hong, 2006; Lemire *et al.*, 2008). It is also important to recognize which variables are being excluded in each case. Thus, TPB does not explicitly examine emotional or arousal factors, concentrating more on the rational aspect of a health decision. TAM and HBM do not examine normative influences, although TPB does. We

suggest that it would be useful for future studies to broaden the conceptual repertoire to include social factors and demands (e.g. different forms of care-giving, norms of the community), affective responses (e.g. heightening of anxiety and risk), and situational contexts that influence information needs and desired information outcomes.

Research methods

In terms of research methods, the reviewed studies have much in common. First, all studies employed survey design including a postal mail survey (Yoo and Robbins, 2008), a telephone survey (Leung, 2008), or a web survey (Marton, 2011; Yun and Park, 2010). Second, convenience sampling was the predominant sampling technique. Third, all studies employed one or more types of multiple regression for data analysis, most commonly hierarchical regression (Leung, 2008; Yoo and Robbins, 2008) or path analysis (Marton, 2011; Yun and Park, 2010).

A survey can be an efficient method of collecting data on the characteristics, attitudes and behavior of a general population. At the same time, survey research provides retrospective data, gathered at a single point in time, and the data may have a limited shelf life depending on how swiftly web technology is changing, and how attitudes and conditions of health-related behavior are shifting. Validity of the data also depends on the construction of questionnaire items, and how accurately people understand and truthfully respond to these items.

With regard to sampling, we need to consider questions of sample size and sampling bias. Sample size varied somewhat across the studies, with Leung's random sample telephone survey (Leung, 2008) reporting the largest sample size. Sample size in relation to the number of study variables affects the statistical power of the study. For example, the sample sizes for Yun and Park's (2010) study may suggest insufficient power for path analysis. The use of convenience samples could introduce sample biases. One or more demographic groups may be over- or under-represented. Both doctoral dissertation studies of women seeking health information indicated sample biases pertaining to one or more of the following demographic variables: age, income, education, occupation, and race (Yoo, 2004; Marton, 2011). Leung (2008) did not report data on demographics, which is an interesting omission.

Tables II and III list the main variables in the studies we reviewed, as well as the key measures of effect sizes and model R^2 . It can be seen that each study defined a dependent variable that touches on a different aspect of health information seeking. Yoo and Robbins (2008) examined behavioral intention to visit health information websites. Leung (2008) analyzed internet embeddedness. Yun and Park (2010) studied intent to use the web to find disease information. Marton (2011) looked at reported frequency of seeking health information on the web. Most studies seemed to measure intention rather than actual use, with perhaps the Marton (2011) study being closest to examining actual use.

Three of the four studies provided details on the measurement of study variables, with the exception of Leung (2008). Important constructs such as information source characteristics and beliefs and motivations were measured differently in each study, making comparisons across studies difficult. The use of single-item measures in several studies is also a concern, as it may be more difficult to gauge the reliability of these measures. An interesting observation is that the use of objective measures (based more on factual reporting) seemed to have worked better than the use of subjective

| Study | Statistical technique | Largest effect size (regression coefficient, $p < 0.05$ or better) | Model R^2 |
|------------------------|---|---|--|
| Yoo and Robbins (2008) | Hierarchical and stepwise regression, path analysis | Education and behavioural beliefs (<i>be</i>) (4.85) | 0.30-0.50 Several hierarchical and multiple regression R^2 values; path analysis R^2 not reported |
| Leung (2008) | Hierarchical regression | Internet usage intensity (Web search) and internet embeddedness (0.26) | 0.23 |
| Yun and Park (2010) | Path analysis | Internet health information use efficacy and perceived ease of use and perceived credibility (1.08, 0.75) | Not reported. Model χ^2 was significant, indicating that data distribution did not conform to theoretical model |
| Marton (2011) | Path analysis | Perceived information source reliability and FSHIW, listservs/newsgroups facet (0.59) | 0.34 0.27 0.49 Content websites Bulletin boards/ chatrooms Listservs/ newsgroups |

Table III.
Key statistical measures
of reviewed studies

measures (based more on individual perception). Thus, Yoo and Robbins (2008) found Past experience (with health related web use) to be a stronger predictor of the dependent variable than subjective measures, such as perceived behavioural control and web self-efficacy. Similarly, Marton (2011) found that an objective measure of web self-efficacy, i.e. strength of internet experience, was a significant study variable but one that did not measurably improve/increase the R^2 of her study model. Also, she found that using an objective scale to measure severity of health conditions was more useful than subjective perceptions of the uncertainty associated with those conditions. More generally, we would suggest that future studies include a measure of an actual use variable, with data collected via for example server logs or user diaries.

Looking at Tables II and III together, it could be tempting to identify those study variables that show a large effect size, and use them to construct a more general model. These variables might include, among others:

- perceived source reliability or credibility;
- internet health information use efficacy;
- personal health conditions;
- past experience; and
- attitude.

However, such a move would be premature. We are still in the early stages of theory building, and while we seem to have identified useful conceptual foundations to stand on, more empirical research that are based on theoretical models is required. What might be said at this point is that a general model would need to recognize that health information seeking behavior is the result of the interactions between individual beliefs and attitudes, information source characteristics, personal health conditions, and social roles and contexts. While we examined quantitative studies in this paper, it should be emphasized that qualitative studies are also needed to provide a fuller and richer understanding of health information seeking by specific groups (e.g. people of a specific health condition or race) or in specific contexts (e.g. care-giving, support groups).

Summary

Taken collectively, the studies reviewed underscore the usefulness of a multidisciplinary approach to advance our understanding of online health information behavior. The results of these studies suggest that the conceptual models and analytical methods they adopted are viable and promising. Many relationships tested showed large effect sizes, and the models evaluated had good predictive power. The results establish the importance of individual cognitive determinants of health information seeking, but these determinants are mediated by or act in concert with other important sets of variables pertaining to perceived source characteristics, Internet use efficacy or experience, and socio-demographics. Looking ahead, we would suggest augmenting our conceptual toolbox to include social factors, affective responses, and situational contexts that influence health behavior, and expanding our measurement apparatus to examine not just intention to use, but the actual use of the web for health information.

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