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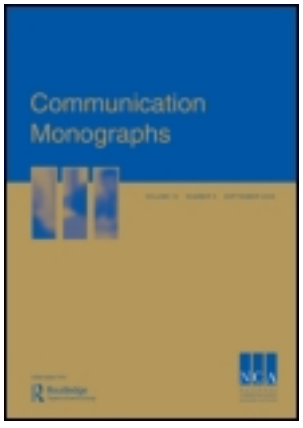

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Information Sources and the Health Information-Seeking Process: An Application and Extension of Channel Complementarity Theory

Erin K. Ruppel & Stephen A. Rains

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Contemporary information seekers can acquire health information from an unprecedented variety of sources. The reported study applied and extended channel complementarity theory to explain the use of multiple information sources in the health-information-seeking process. Channel complementarity was extended to consider four characteristics (i.e., access to medical expertise, tailorability, anonymity, and convenience) of health-information sources. The information-seeking behavior of 3,392 respondents from the 2007–2008 Health Information National Trends Survey was analyzed to test study hypotheses. Results indicate that, sources were used complementarily based on tailorability and anonymity during health-information sources. Additionally, the likelihood of using complementary sources based on all four characteristics changed during the search process.

Keywords: Channel Complementarity Theory; Health Communication; Information Seeking

Information seeking is a key resource for managing one's health (Brashers, Goldsmith, & Hsieh, 2002; Johnson, 1997; Johnson & Meischke, 1993). Brashers (2001, p. 482) notes that, "People seek information to add knowledge they lack or to confirm or disconfirm their current state of beliefs, and they use that information for strategic purposes." In the contemporary information-seeking environment, a variety of sources provide health information. Health providers, family, friends, magazines, newspapers, television, books, and the Internet are some of the sources one can use to acquire health information.

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Although researchers have recognized and attempted to account for the various sources that may be used in seeking health information, many of the models developed (for a review, see Dutta-Bergman, 2006a; Napoli, 2001) and studies conducted (e.g., Dutta-Bergman, 2004b; Johnson & Meischke, 1993; Rains, 2007) focus on factors that motivate individuals to select one particular source from the many available. The use of multiple sources in the process of seeking health information has received less attention from scholars, despite considerable evidence that individuals often utilize several information sources as they gather information to learn about or cope with a health condition (Broom, 2005; Kivits, 2004; McCaughan & McKenna, 2007; Nettleton, Burrows, & O'Malley, 2005).

One theory that considers the broader information-seeking process and the use of multiple sources during this process is channel complementarity theory (Dutta-Bergman, 2004a, 2004c). Channel complementarity theory postulates that use of a particular source is determined by the functions that source serves, and that individuals who use a source for a specific function (e.g., health information) also tend to use other sources that serve that function. Dutta-Bergman (2006a, p. 90) explains, for example, that a "health-motivated consumer who is intrinsically interested in the issue of health is not only likely to read health magazines such as *Prevention* and *Health,* but is also likely to watch health television, and surf health-related websites to gather health information." The various sources are thought to serve different niches and present unique types of information about the topic (Dutta-Bergman, 2004a). Although channel complementarity theory offers a general explanation for why individuals often use multiple sources, the utility of the theory would be increased for scholars and practitioners if it made possible more specific predictions about when a particular type of source is more or less likely to be used within a specific content domain such as health.

The study reported here applied and extended channel complementarity theory (Dutta-Bergman, 2004a, 2004c) to explain the use of multiple sources during the process of acquiring health information. The notion of complementarity was refined in this study to consider four complementary characteristics of health-information sources: (a) access to medical expertise, (b) tailorability, (c) anonymity, and (d) convenience. Each of the four characteristics is particularly important in the domain of health and can be used to make relatively focused predictions about the use of specific source types during information seeking. Gaining insight into how and why specific types of sources are used or not used is essential in order to better understand the health-information-seeking process, and such insight would be an invaluable resource for practitioners attempting to target health-campaign messages. In the following paragraphs, we first review channel complementarity theory and then explain the four complementarity characteristics tested in this project.

Literature Review

Channel Complementarity Theory

Dutta-Bergman's (2004a, 2004c, 2006a) theory of channel complementarity offers a general explanation for why people use multiple sources to acquire information in

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broad categories of content such as sports (Dutta-Bergman, 2004a) or health (Tian & Robinson, 2008a) or to meet a need such as exchanging social support (Dutta-Bergman, 2004c). This theory was developed in response to arguments and theories predicting that the use of some media—particularly new technologies facilitated by the Internet—displaces the use of other media (Dutta-Bergman, 2004a). Although channel complementarity theory draws from several theories (Dutta-Bergman, 2006a), key ideas from selective exposure theory (Zillmann & Bryant, 1985) and uses and gratifications (Blumler & Katz, 1974; Rubin, 1986) provide the theory's foundation. Channel complementarity theory assumes that individuals play an active role in source selection (Dutta-Bergman, 2004a, 2004c, 2006a), that source use is best understood in the context of a specific content domain (e.g., health, politics, etc.; Dutta-Bergman, 2004a), and that systematic differences in source use exist in the population (Dutta-Bergman, 2004c, 2006a).

The central postulate of channel complementarity theory is that "people consuming one particular medium to gather information in one particular area are likely to consume other media that contain information in that specific area" (Dutta-Bergman, 2004a, p. 48). Although sources were initially considered in the theory to be specific media such as email (Dutta-Bergman, 2004c) or television (Dutta-Bergman, 2004a), the theory has been extended to include interpersonal sources such as friends, family, and health-care providers (Tian & Robinson, 2008a). A fair amount of evidence has been found in support of channel complementarity theory (Dutta-Bergman, 2004b, 2004c, 2006b; Tian & Robinson, 2008a, 2008b, 2009). For example, Tian and Robinson (2008a) found that individuals who visited their health-care providers more frequently also paid more attention to health information in television, newspapers, magazines, radio, and the Internet. Similarly, individuals who sought news regarding the topic of science and health from Internet sources were more likely than those who did not to also use radio, print, and television news sources to obtain information about that topic (Dutta-Bergman, 2004a).

Much of the research on channel complementarity theory, however, has been limited to testing the general prediction that individuals who seek information about a particular topic from one source are likely to consult other sources that offer information about that topic. The utility of this theory would be increased if it made possible more specific predictions about how and why individuals use multiple sources within the domain of health-information seeking. A starting point for refining channel complementarity theory is to reconsider the notion of complementarity. Dutta-Bergman (2006a, p. 90) defines complementarity primarily in terms of content, explaining that individuals are "loyal to the content and [use] different media that serve this need for content; content drives the relationship among media types." He also notes, however, that complementarity may exist with regard to characteristics of sources, claiming that "complementarity may also be driven by other characteristics such as modality, accessibility, quality, and so on" (p. 90). Other scholars have argued that the sources from which individuals seek information, and not message content, are sometimes the basis of individuals' health information-seeking decisions (Johnson, 1997).

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Focusing on specific characteristics of information sources offers an opportunity to refine the notion of complementarity and make more specific predictions about source use within the domain of health-information seeking. Consistent with channel complementarity theory, focusing on source characteristics underscores the importance of considering what sources provide or allow the user. Examining source characteristics also emphasizes specific dimensions of sources and allows for predictions about the likelihood that particular types of sources will or will not be used when a plethora of sources offer the same general type of content, such as information about health. We next more closely examine four characteristics that might serve as bases for complementarity in the context of a health-information search.

Source Characteristic Complementarity and Health-Information Seeking

Source characteristics are defined in this project as the relatively enduring structural or technical features of a source. Sources are conceptualized as having multiple characteristics, with the most important characteristics of a source likely depending on the context in which the source is used. As reviewed below, prior research on health communication and information seeking suggests four characteristics, in particular, that are especially relevant to the context of searching for health information: access to medical expertise, tailorability, anonymity, and convenience. Each of these four characteristics is considered to be a relatively objective dimension of sources—although it is possible that a few information seekers might view the same source (e.g., health-care provider) differently with regard to a given complementarity characteristic (e.g., convenience), the research reviewed below suggests that there should be consistency in information seekers' perceptions that warrants treating the four characteristics as relatively objective source features in this project.

The first characteristic of information sources that is important to the domain of health information is the degree to which a source provides access to medical expertise (Lenz, 1984), which involves the possession of medical training and/or licensing such as that possessed by physicians and other health-care providers. Acquiring health information from medical experts is a potentially important objective for many information seekers (Brashers, Hsieh, Neidig, & Reynolds, 2006; Freimuth, Stein, & Kean, 1989; Mishel, 1988). Because of their extensive training, medical experts such as health-care providers are generally a source of authoritative and reliable information about health. Individuals often turn to health-care providers because they perceive those providers as offering credible information and recommendations (Mishel, 1988). The idea that individuals will use sources high in access to medical expertise complementarily is consistent with Dutta-Bergman's (2006a) claim that information quality is a potentially influential factor in complementary source use.

In contrast, sources that provide low levels of access to medical expertise can vary widely in information quality (Lenz, 1984). Although information from medical experts is available in a range of sources such as television news, newspapers, and magazines (Dutta-Bergman, 2004b; Johnson & Meischke, 1992), these sources generally offer less access to medical expertise than do health-care providers.

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There is evidence that health-care providers are perceived to be more important (Pecchioni & Sparks, 2007), trustworthy (Hesse et al., 2005), and credible (Johnson & Meischke, 1992) sources of information and to provide more useful medical information (Diaz et al., 2002) than the Internet, friends and family, or mass media sources. Given the importance of acquiring information from medical experts, sources that provide greater access to medical expertise (i.e., health-care providers) should be used complementarily.

A second important characteristic of health-information sources is their tailorability or the degree to which a source makes it possible to acquire information unique to one's situation. Sources that have the potential to provide information tailored to one's situation are often critical (Cline & Haynes, 2001; Ling, Klein, & Dang, 2006). In one large-scale survey, over 75% of health-information seekers reported that they would like to receive cancer information from personalized materials (Ling et al., 2006). Friends, family, and health-care providers may provide health information that is tailored to the individual. Johnson and Meischke (1992) explain that interpersonal sources such as friends, family, and health-care providers are "better suited to handle special individual needs and questions" than are mass media sources such as television, newspapers, or magazines" (pp. 1880–1881). The Internet also allows tailorability by making it possible for individuals to pursue answers to idiosyncratic health questions via searching the plethora of websites that provide information about health (Cline & Haynes, 2001; Eysenbach, Sa, & Diepgen, 1999; Kivits, 2004) or posing a question to an online social-support group (Wright & Bell, 2003). In contrast, mass-media sources of health information carry preconfigured content and are designed to provide information for the general population or a subgroup of that population (Kreuter, Strecher, & Glassman, 1999). Given the importance of finding information tailored to one's unique situation when acquiring health information, it is plausible that tailorability is a reason for complementary source use. Sources that generally allow higher levels of tailorability, such as one's health-care provider, family, friends, and the Internet, should be used complementarily during the search process.

Third, the degree of anonymity offered by a source should be a basis for complementary source use during the information-seeking process. Anonymity involves the degree to which an information seeker is identifiable to others (Anonymous, 1998). A source that allows information seekers to remain anonymous might be particularly critical when individuals are concerned with maintaining their privacy, such as when a health topic is stigmatized (Berger, Wagner, & Baker, 2005). For example, individuals can access health information via the Internet without disclosing their identities to those from whom they seek information. There is evidence that the relative anonymity provided by the Internet is an important reason why individuals use it to acquire health information (Gray, Klein, Noyce, Sesselberg, & Cantrill, 2005; Hinton, Kurinczuk, & Ziebland, 2010; Tanis, 2008). Similarly, books, brochures, magazines, newspapers, and television allow individuals to access health information without requiring disclosure of their identities to others. Individuals report valuing books (Leach, Christensen, Griffiths, Jorm, & Mackinnon, 2007), brochures

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(McCree, Sharpe, Brandt, & Robertson, 2006), and videotapes (McCree et al., 2006) for the anonymity those sources can provide when seeking health information. Sources that allow greater anonymity, such as television, magazines, newspapers, books, brochures, and the Internet, should be used complementarily.

A fourth important characteristic of sources in the context of health-information seeking is convenience or the relative ease of accessing and using a particular source to acquire health information. Dutta-Bergman (2006a, p. 90) contends that, "The specific [source] chosen for retrieval of health information at any particular time depends on what is available and convenient" and cites source accessibility as one potentially important factor in complementary source use. There is some evidence that individuals place high priority on the convenience of information sources. For example, individuals report that convenience is an important reason for using the Internet to acquire health information (Fox & Rainie, 2000; Gould, Munfakh, Lubell, Kleinman, & Parker, 2002; Gray et al., 2005). Seeking information from one's friends or family also tends to be relatively convenient. Case (2007, p. 153) explains that "decades of reviews and studies document a strong preference among information-seekers for interpersonal sources, who are typically easier and more readily accessible than the most authoritative print sources." Newspapers and magazines are relatively convenient sources of health information because they are archived and can be relatively easily searched to acquire specific health information (Dutta-Bergman, 2004b). In contrast, television has a comparatively short shelf life and is not well archived, making it a relatively difficult source to use for seeking health information (Dutta-Bergman, 2004b). Using books or brochures as an information source might require a trip to one's doctor's office or the library. McCree et al. (2006) reported that books are also seen as inconvenient because of the significant time they take to read. Similarly, seeking health information from one's health-care provider likely requires scheduling an appointment and traveling to his or her office. Sources that are generally more convenient, such as friends, family, the Internet, magazines, and newspapers, should be used complementarily.

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Hypotheses and Research Question

The process of seeking health information varies in both the extent (i.e., breadth and depth) and method (i.e., type of information source) of a search (Lenz, 1984). Consistent with channel complementarity theory's focus on information sources and our predictions regarding source use, we focus on the latter of these two dimensions and examine the sources that individuals use during an information search. We conceptualize the process of seeking health information in terms of the consecutively ordered set of information sources that individuals use to obtain information on a health topic. We advance the following hypotheses and research question to test the four complementarity characteristics proposed in this study.

Channel complementarity theory predicts that individuals use sources with similar characteristics during an information search. In the domain of health information, information seekers should be fairly consistent in their use of sources that offer

greater amounts of (a) access to medical expertise, (b) tailorability, (c) anonymity, and (d) convenience. Prior research applies channel complementarity theory at a general level and assesses the association between the use of a given source and other sources that serve the same purpose (e.g., Dutta-Bergman, 2004b, 2004c, 2006b; Tian & Robinson, 2008a). We expect that complementary source use during the information-seeking process will be evident in the proportion of sources used that are higher in each of the four complementarity characteristics. The proportion of sources used that are complementary with regard to one of the four characteristics should exceed the proportion of complementary sources that would be used by chance alone. That is, if the proportion of sources that are complementary with regard to one of the four characteristics exceeds what would be expected by chance alone, then there is evidence that complementary source use is systematic for that characteristic. Hypothesis 1 reflects this prediction.

> Hypothesis 1: The overall proportion of sources that are complementary in regard to (a) access to medical expertise, (b), tailorability, (c) anonymity, or (d) convenience during a health-information search is greater than would be expected by chance.

A central objective of this project is to apply and extend channel complementarity theory to allow for relatively specific predictions about the use of multiple sources in the process of acquiring health information. Although, as predicted by Hypothesis 1, channel complementarity should be evident at a global level, the motivation to select sources that are complementary should also explain source use at the level of pairs of consecutive sources selected during an information search. As individuals move from one source to the next during an information search, channel complementarity theory suggests that the second source selected in the pair should be complementary to the first. Over the entire search process, then, complementarity would be evident if individuals choose consecutive pairs of sources that are complementary in a given characteristic at a rate greater than would be expected by chance. Testing channel complementarity theory at the level of source pairs provides a more stringent test of the theory extension proposed in this project and has the potential to offer a more nuanced understanding of the health information-seeking process. Accordingly, Hypothesis 2 focuses on complementary source use at the level of source pairs.

> Hypothesis 2: The proportion of source pairs that are complementary in regard to (a) access to medical expertise, (b) tailorability, (c) anonymity, or (d) convenience during a health-information search is greater than would be expected by chance.

Furthermore, examining complementarity at the level of source pairs makes it possible to gain insight into health-information seeking as an evolving process. It is possible that individuals' use of complementary sources changes throughout the search process. Previous research has demonstrated that individuals have changing needs as they navigate the health-information search process. For example, individuals newly diagnosed with cancer report passing through several stages of information needs and management (McCaughan & McKenna, 2007). Similarly, one

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piece of health information can create the need for other types of information (Brashers, 2001; Brashers et al., 2000). Although these studies suggest that information needs and source use might change throughout the search process, it is unclear whether use of complementary sources also changes throughout the search process. For example, individuals might begin their information search using sources complementarily with regard to anonymity but later feel more comfortable seeking information without remaining anonymous. In contrast, individuals might use sources without regard to anonymity early in their information search but realize later in the search process that anonymity is important to them and then use sources complementarily with regard to anonymity. The former scenario would result in a trend toward decreased likelihood of using sources that are complementary with regard to anonymity as the search process continues, while the latter would result in a trend toward increased likelihood of using sources that are complementary with regard to anonymity as the search process continues. In order to investigate the possibility of changes in complementary source use during the search process, we propose the following research question.

Research Question 1: Does the likelihood of individuals using pairs of sources that are complementary in regard to (a) access to medical expertise, (b) tailorability, (c) anonymity, or (d) convenience change during the search process?

Method

Data

Data from the 2007–2008 wave of the Health Information National Trends Survey (HINTS; National Cancer Institute, 2009) were used to test the study hypotheses and answer the research question. HINTS is a nationally representative biennial survey of American adults conducted by the National Cancer Institute. The goal of HINTS is to examine the impact of the health-information environment, including how people access and use health information (Cantor et al., 2009). The 2007–2008 wave surveyed 7,674 individuals. Cantor and colleagues (2009) describe the sampling method and questionnaire development for the HINTS survey.

Because complementary source use minimally requires the use of at least two sources during an information search, we limited the sample to only those respondents who reported searching for health information and using two or more sources. This restriction resulted in a sample of 3,392 respondents.

Instrumentation

All measures were constructed using items from the HINTS questionnaire.

Overall proportion of complementary sources. The questionnaire asked about respondents' most recent search for health information. Respondents were asked, "The most recent time you looked for information about health or medical topics,

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where did you go first?" Respondents were subsequently asked if they had looked anywhere else for information and, if so, were asked to identify the next source they used. This procedure was repeated until respondents indicated that they had not used any more sources. It is noteworthy that respondents could report using the same source multiple times during a search. Possible responses (with the total number of times they were chosen in parentheses) were: Internet ($n = 2640$); doctor or health-care provider ($n = 2151$); books ($n = 1287$); brochures, pamphlets, etc. ($n = 875$); magazines ($n = 838$); family ($n = 716$); friend/coworker ($n = 567$); newspapers ($n = 466$); library ($n = 263$); telephone information number ($n = 117$); complementary, alternative, or unconventional practitioner ($n = 112$); cancer organization ($n = 97$); other ($n = 76$); television ($n = 44$); and health-insurance provider ($n = 28$).[1]

The measures of the overall proportion of complementary sources used were constructed as follows: First, sources were categorized as higher or lower in each of the four complementarity characteristics: *access to medical expertise, tailorability, anonymity,* and *convenience.* Given that the four characteristics were considered to be relatively objective features of sources, sources were assigned as higher or lower in a given characteristic by the authors based on the arguments made in the literature review. The four characteristics were considered to be conceptually independent; a source higher in one characteristic may be higher or lower in a different characteristic. This conceptual independence can be observed in Table 1, which includes a complete listing of the sources categorized as higher and lower in each of the four source characteristics. Sources that were higher in a given source characteristic were assigned a score of 1 for that characteristic, and sources that were identified as lower in a given source characteristic were assigned a score of 0 for that characteristic. The following five sources, representing fewer than 5% of the total sources used, were excluded from all analyses because not enough information was available to code them into one or more of the complementarity variables: cancer organization, library, telephone information number (1–800 number), insurance provider, and other.[2]

Second, the overall proportion of complementary sources used during respondents' searches was computed for each of the four characteristics. These proportions were calculated by dividing the number of sources each respondent used that were higher in a given characteristic by the total number of sources that respondent used during his or her information search. For example, an individual who used the Internet, a friend or coworker, and a health-care provider during his or her information search would receive scores of 0, 0, and 1, respectively, for access to medical expertise. Therefore, an individual who used these three sources in his or her health-information search would receive a score of 0.33 for access to medical expertise. Those same sources would receive scores of 1, 1, and 0, respectively, for convenience. Therefore, an individual who used those three sources would receive a score of 0.67 for convenience.

Proportion of complementary source pairs. Consecutive pairs of sources used during a respondent's information search were coded as complementary or

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Table 1 Complementarity Characteristics of Health Information Sources

Characteristic	Higher	Lower
Access to medical expertise	Doctor/health-care provider Complementary, alternative, or unconventional practitioner	Family Friend/coworker Books Brochures, pamphlets, etc. Internet Magazines Newspapers Television
Tailorability	Family Friend/coworker Internet Doctor/health-care provider Complementary, alternative, or unconventional practitioner	Books Brochures, pamphlets, etc. Magazines Newspapers Television
Convenience	Family Friend/coworker Internet Magazines Newspapers	Books Brochures, pamphlets, etc. Television Doctor/health-care provider Complementary, alternative, or unconventional practitioner
Anonymity	Books Brochures, pamphlets, etc. Internet Magazines Newspapers Television	Family Friend/coworker Doctor/health-care provider Complementary, alternative, or unconventional practitioner

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noncomplementary for each of the four complementarity variables. Source pairs were considered to be complementary on a given source characteristic, and assigned a score of 1, when they were both higher in that characteristic. Source pairs were considered to be noncomplementary, and assigned a complementarity score of 0, when one or both of the sources were lower in the given characteristic.

The proportion of complementary source pairs used during the entire search was then computed for each of the four characteristics by computing the mean of each individual's source pair complementarity scores (i.e., the number of source pairs each respondent used that were complementary on a given characteristic divided by the total number of sources pairs that the respondent used during his or her information search). For example, for access to medical expertise, an individual who used the Internet, then a friend or coworker, and then a health-care provider during an information search would receive a score of 0 (noncomplementary) for the first source pair (i.e., the Internet and a friend or coworker) and a score of 0 for the second source pair (i.e., a friend or coworker and a health-care provider). Computing the mean of these scores, this individual would

receive a score of 0 for the proportion of complementary source pairs in regard to access to medical expertise. For convenience, this individual would receive a score of 1 (complementary) for the first source pair and 0 for the second source pair. Computing the mean of these scores, this individual would receive a score of 0.50 for the proportion of complementary source pairs in regard to convenience.

Control variables. In answering Research Question 1[3], we controlled for seven variables that have been found to predict health-information-seeking behavior in previous research (e.g., Cotten & Gupta, 2004; Hesse et al., 2005): age, education, general health, total number of sources searched, having a primary healthcare provider, Internet use, and sex. Controlling for these seven variables made it possible to account for individual differences among the respondents that might lead to systematic variation in source use and, thus, allowed for increased confidence in the results related to Research Question 1.

Age was measured in years ($M = 53.21$, $SD = 15.93$). *Education* was measured on a 7-point scale ranging from less than high school (1) to postgraduate (7) ($M = 5.01$, $SD = 1.51$). *General health* was measured by asking respondents, "In general, would you say your health is . . ." with possible responses ranging from *poor* (1) to *excellent* (5) ($M = 3.45$, $SD = .95$). The *number of sources* respondents used was calculated as the total number of sources respondents reported visiting during their information search ($M = 3.00$, $SD = 1.52$). The other three variables were dummy-coded as follows: Whether or not individuals had a *primary health-care provider* had possible responses of *yes* (1) and *no* (0). Approximately 84% ($n = 2805$) of respondents indicated that they have a primary health-care provider. *Internet use* was measured by asking respondents if they ever went online (1) or not (0). Approximately 80% ($n = 2699$) indicated that they went online. *Sex* was the final control variable (female = 0; male = 1). Approximately 34% ($n = 1163$) were male, and 66% ($n = 2227$) were female. Two respondents declined to report their sex.

Results

Hypothesis 1: Overall Complementary Source Use

Hypothesis 1 predicted that the overall proportion of sources that are complementary in regard to (a) access to medical expertise, (b) tailorability, (c) anonymity, and (d) convenience during health-information seeking is greater than would be expected by chance. Hypothesis 1 was tested by comparing the mean overall proportion of complementary sources used during respondents' searches to the overall proportion of complementary source use that would be expected by chance. If source use is random with regard to the characteristics we identified, then any source an individual chooses has an equal probability of being either higher or lower in each of those characteristics, and the overall proportion of sources used that are higher in a given characteristic is 0.50.

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The overall proportion of complementary sources used by respondents was compared against the chance proportion of 0.50 using one-sample *t*-tests. The results of these tests indicate that for tailorability ($M = .67$, $SD = .29$), $t\ (3377) = 33.11$, $p < .001$, anonymity ($M = .65$, $SD = .28$), $t\ (3377) = 30.89$, $p < .001$, and convenience ($M = .54$, $SD = .27$), $t\ (3377) = 9.35$, $p < .001$, respondents were more likely to select complementary sources than would be expected by chance. For access to medical expertise ($M = .25$, $SD = .26$), $t\ (3370) = -55.08$, $p < .001$, respondents were less likely to select complementary sources than would be expected by chance. Hypotheses 1b, 1c, and 1d were supported; Hypothesis 1a was not supported.

Hypothesis 2: Complementary Source Pair Use

Hypothesis 2 was posited to provide a more rigorous test of channel complementary theory and predicted that the proportion of complementary source pairs with regard to (a) access to medical expertise, (b) tailorability, (c) anonymity, and (d) convenience used during health-information seeking is greater than would be expected by chance. Hypothesis 2 was tested by comparing the mean proportion of complementary source pairs used during respondents' searches to the proportion of complementary source pairs that would be expected by chance. If source use is random, then individuals have an equal probability of choosing a source that is higher or lower in a particular complementarity characteristic. The same is true for the next source individuals choose. Therefore, for any given pair of two consecutive sources, there are four possibilities (higher–higher, higher–lower, lower–higher, and lower–lower), all with equal probabilities of being chosen at random, and only one of these pairs (higher–higher) is complementary. Overall, then, individuals would choose complementary pairs of sources 25% of the time if such choices were entirely random; a greater proportion of complementary source use would provide evidence that complementary source use is systematic.

The proportion of complementary source pairs reported by respondents was compared to the chance proportion of 0.25 using one-sample *t*-tests. The results of these tests indicate that for tailorability ($M = .39$, $SD = .45$), $t(3229) = 18.30$, $p < .001$, and anonymity ($M = .37$, $SD = .43$), $t\ (3246) = 15.89$, $p < .001$, respondents were more likely to select complementary source pairs than would be expected by chance. For access to medical expertise ($M = .02$, $SD = .12$), $t(3271) = -110.92$, $p < .001$, and convenience ($M = .20$, $SD = .34$), $t\ (3257) = -9.10$, $p < .001$, respondents were less likely to select complementary source pairs than would be expected by chance. Hypotheses 2b and 2d were supported; Hypotheses 2a and 2c were not supported.

Research Question 1: Changes in Complementary Source Use

Research Question 1 asked whether complementary source use varied during the search process. As described in the literature review and method, we focused on consecutive pairs of sources that respondents used in their most recent search for health information. Respondents reported using between 2 and 12 information

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sources. Therefore, respondents used between 1 (if they visited 2 sources) and 11 (if they visited 12 sources) pairs of consecutive sources in the search process. Source pairs were numbered consecutively from 1 to 11 based on when they occurred during a search with greater scores representing source pairs that occurred later in the search process. Each source pair was coded as complementary (and assigned a value of 1) or noncomplementary (and assigned a value of 0) for each of the four types of complementarity. Every respondent, then, had between 1 and 11 source pairs (the predictor variable) and corresponding complementarity scores for each pair of sources (the outcome variables).

Because the outcome variable of complementarity for a given source pair is dichotomous and nested within respondents, logistic multilevel modeling was used to answer Research Question 1. Logistic multilevel modeling makes it possible to test for changes in complementarity within respondents over the search process while accounting for nonindependence caused by the nesting of complementarity scores within respondents (Hox, 2002). Logistic multilevel modeling produces an odds ratio (OR) reflecting the ratio of the odds of using a complementary source pair to the odds of using a noncomplementary source pair. An OR greater than 1 for the predictor variable indicates that source pairs used later in the search were more likely to be complementary than source pairs used earlier in a search. Age, sex, education, whether or not a respondents had a primary health-care provider, Internet use, general health, and number of sources used in the information search process were included in each of the models as control variables.

As illustrated in Table 2, individuals' likelihood of using sources complementarily in regard to tailorability (OR = 1.16, $p < .01$) and convenience (OR = 1.20, $p < .01$)

Table 2 Results of the Logistic Multilevel Modeling Analyses Examining the Likelihood of Complementarity by Source Pair for Each Source Characteristic

	Source complementarity characteristics			
Predictors	Access to medical expertise	Tailorability	Convenience	Anonymity
Age	1.00	0.98*	0.99*	1.01*
Gender (female = 0)	0.84	0.94	0.98	1.03
Education	0.92	0.97	1.03	1.03
Regular health provider (no = 0)	0.73	1.07	0.77*	0.82*
Internet user (no = 0)	0.44*	2.25*	1.84*	1.60*
General health	0.83	0.91*	1.04	1.11*
Number of sources searched	0.79*	0.87*	1.05*	1.36*
Source pair[a]	0.72*	1.16*	1.20*	0.39*

Note. All values reported are odds ratios representing the change in likelihood of complementary source use for a given complementarity characteristic associated with a 1-unit increase in the predictor variable.

[a]Source pair was coded such that greater numbers represent source pairs that occurred later in the information-seeking process. An odds ratio greater than 1 indicates that later source pairs used during a search were more likely to be complementary; an odds ratio less than 1 indicates that later source pairs were less likely to be complementary.

*$p < .05$.

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increased as their searches progressed. In contrast, individuals' likelihood of using sources complementarily with regard to access to medical expertise (OR = 0.72, $p = .05$) and anonymity (OR = 0.39, $p < .01$) decreased as their searches progressed. These results provide evidence that respondents' use of complementary sources changed during the search process.

Discussion

The present study examined the use of multiple sources in the process of seeking health information. Channel complementarity theory was applied and extended by specifying four characteristics of information sources that are relevant to health-information seeking and examining complementary source use with regard to those characteristics during the information-seeking process. The results show that respondents were more likely than chance to use sources higher in tailorability and anonymity overall and in terms of source pairs. Moreover, the use of source pairs higher in tailorability and convenience increased over the course of information searches. The findings and their implications for channel complementarity theory, the health information-seeking process, and health communication campaigns are considered in the following paragraphs.

Complementary Source Use During Health-Information Seeking

Overall, there is some evidence to suggest that health-information sources are used systematically during information searches based on the characteristics indentified in this project. The overall proportion of complementary sources and the proportion of complementary source pairs respondents selected were significantly greater than would be expected by chance for both tailorability and anonymity. These results suggest that tailorability and anonymity are important components of information sources that individuals attend to in the process of acquiring health information. The overall proportion of sources higher in convenience used during the respondents' searches was greater than expected by chance, but pairs of sources higher in convenience were used less than would be expected by chance. This finding suggests that convenience might be a valuable, but not critical, source characteristic that is trumped by more important characteristics as information seekers move from one source to the next. The finding that respondents were less likely than chance to use sources complementarily in regard to access to medical expertise both in terms of the overall proportion of sources selected and at the level of source pairs underscores the notion that the complementarity of some characteristics of information sources is more salient or important than is that of other sources.

There is also evidence that the use of complementary sources by respondents changed during the information-seeking process. Changes in respondents' source use are consistent with prior research demonstrating that individuals value different types of information at different points in their search process or different stages of their illness (e.g., Eheman et al., 2009; McCaughan & McKenna, 2007). As their searches

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progressed, information seekers in this study were more likely to use pairs of sources complementarily in regard to tailorability and convenience but less likely to use pairs of sources complementarily in regard to access to medical expertise and anonymity. It might be that access to medical expertise and anonymity are more valued at the beginning of a search as information seekers try to find expert information and maintain their privacy. As searches progress, tailorability and convenience become more salient. Tailorability might be valuable as a means to clarify general information acquired early in a search, while convenience might become increasingly salient as individuals feel ready to conclude searching.

Implications for Channel Complementarity Theory

The results of this project inform channel complementarity theory in several important ways. This project adds to the growing number of studies that have demonstrated the utility of channel complementarity theory for understanding health-information seeking (Dutta-Bergman, 2004b; Tian & Robinson, 2008a, 2008b, 2009). Moreover, the findings from this study underscore the value of conceptualizing complementarity as a multidimensional construct based on source characteristics. The overall proportions of complementary sources used, proportions of complementary source pairs used, and changes in complementary source use show that health-information sources are used systematically during the information-seeking process based on several of the complementarity characteristics identified in this project. Although prior research provides evidence to suggest that information seekers are likely to exhaust all sources that provide information about a topic (Dutta-Bergman, 2004a; Tian & Robinson, 2008a), considering the specific characteristics of health-information sources makes possible more focused predictions about information-seeking behavior within the domain of health. Knowing that one or more of the four source characteristics is important to information seekers makes it possible to move beyond the general prediction that all sources with health information will be used and predict the likelihood that a specific type of source will or will not be consulted. Finally, the changes observed in complementary source use suggest that complementarity is not a stable objective in a health-information search. Although individuals do, overall, tend to use sources with some characteristics more complementarily than would be expected by chance, complementarity also appears to vary over the course of the information-seeking process.

Implications for Health Campaigns

Through offering insight into how various sources are systematically used to acquire health information, the extension of channel complementarity theory proposed here also has implications for developing and communicating health campaign messages. One or more of the four source complementarity characteristics examined in this project could be implemented in designing a health campaign to more effectively reach individuals who are actively seeking health information. First, one or more of

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the complementarity characteristics could serve as a basis for segmenting information seekers. Granted the findings from this study, anonymity and tailorability seem to be good candidates. Subgroups of information seekers could be identified based on the degree to which one or more of the complementarity characteristics are important to them. Health-campaign messages could be communicated using sources that are relatively high in the salient characteristic. For example, knowing that anonymity is important to some individuals would make it possible to target campaign messages using sources that provide greater levels of anonymity, such as newspapers, magazines, or the World Wide Web and avoid using sources that provide low levels of anonymity, such as interpersonal sources.

Second, our findings regarding changes in complementary source use over the course of the search process can inform the distribution of health campaign messages. By estimating how far along individuals are in their health-information search, it might be possible to determine when certain source characteristics are more or less likely to be used complementarily and allow for more effective message distribution. For example, knowing that convenience becomes increasingly important as searches progress offers a potential strategy for most effectively integrating high-convenience sources such as newspapers and magazines into a health campaign. Future research might build from the findings regarding changes in complementary source use by examining the use of complementary sources in specific situations such as before or after a visit to a health-care provider or in preparation to make a health-related decision.

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Limitations

Three limitations of this project warrant consideration. First, although the use of a national dataset suggests that our findings should apply to a wide range of individuals, the sample was generally older and therefore might not capture the search processes used by younger individuals. Recent emphasis on active information seeking by patients and patients' increasing involvement in their own health management (Ballard-Reisch, 1990) might mean that younger individuals are more practiced in the health information-seeking process and are therefore more aware of the types of sources they desire from the beginning of their search process or are better able to discern what sources will best fit their needs. If this is the case, then younger individuals might be more likely to use sources complementarily or might exhibit different patterns of complementary source use than we observed in the current sample.

Second, respondents reported on a search for health information, but we do not know the nature of the information they were seeking. Factors such as the specificity of the information individuals were looking for or the seriousness of the health issue could affect the extent to which respondents used source characteristics complementarily. Although the data do not allow us to explore these possibilities, the findings from this study provide a better understanding of general trends in complementary source use and might serve as a foundation from which more specific search goals could be explored.

Third, the four characteristics examined in this study were considered to be relatively objective dimensions of sources, and accordingly, individual sources were categorized by the authors as higher or lower in a given characteristic based on previous research regarding health-information seeking. It would be worthwhile to replicate the categorization of sources illustrated in Table 1 using ratings made by health-information seekers. Although we expect commensurate results, accounting for information seekers' perceptions would make it possible to move beyond dichotomizing sources as either higher or lower in a given characteristic and might even make it possible to predict more effectively the outcomes of complementary source use.

Future Directions

In this project, we identified four source characteristics that serve as a basis for complementarity. It seems likely, however, that other characteristics might warrant consideration. Future research should identify other facets of information sources that are relevant to channel complementarity theory. Furthermore, we do not know the extent to which the characteristics examined in this study generalize to contexts other than health-information seeking. For example, anonymity might be less important in searches for information that is less sensitive than health information. The applicability of the characteristics we identified to other contexts should be examined.

Additionally, a good deal of variance existed in respondents' use of complementary or noncomplementary sources. This variance suggests that, in addition to changes related to the search process itself, complementarity is likely affected by other factors. Use of complementary sources might be related to individual characteristics such as health consciousness (Dutta-Bergman, 2005) or the mindfulness of individuals' source choice (Timmerman, 2002). Certain factors might also make a particular type of complementarity more or less salient in a given information search. For example, anonymity might be particularly salient for individuals with a stigmatized illness (Berger et al., 2005). Therefore, we might expect such individuals to use higher anonymity sources complementarily. Future research should examine factors that contribute to individuals' choices to use complementary sources.

Finally, it would be worthwhile to explore the outcomes of complementary source use. It seems plausible that individuals who use a greater proportion of sources that are complementary with regard to a given characteristic are using sources more strategically and capitalizing on that characteristic to acquire information in a particular manner or format. Consequently, complementary source use may be associated with perceptions of search effectiveness and success.

Conclusion

The availability of various sources of health information in contemporary society makes it important for researchers to consider how individuals find and use information about health. This project offers insights into the use of multiple sources during the health-information-seeking process by extending channel complementarity

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theory to consider four characteristics of health-information sources. Although the findings from this study offer some support for the extension of channel complementarity theory, continued research is essential to further refine the theory and understand more fully the process of acquiring health information.

Notes

[1] The Internet is technically not mutually exclusive from several of the other sources; it is possible, for example, for one to read a magazine that is posted on the World Wide Web. In analyzing the sources used by respondents, we assumed that respondents distinguished the Internet from other sources, and as a result, reports about Internet use were not confounded with other sources. If, for example, participants read a magazine using the Web, we assumed that they would have reported that a magazine was their source. Granted the fact that 36% of the respondents completed the questionnaire via telephone interview and had the opportunity to seek clarification regarding the questionnaire items, we believe that this assumption is reasonable.

[2] With additional information, these excluded sources could be coded based on the four complementarity characteristics. For example, knowing if a telephone information number presented automated information or had a person answering questions would make it possible to code this source based on each of the four characteristics.

[3] Because Hypotheses 1 and 2 were tested using one-sample *t*-tests, the inclusion of control variables in these hypothesis tests was not possible.

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