

Seeking Treatment Options: Consumers' Search Behaviors and Cognitive Activities

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ABSTRACT

As people increasingly search the Internet for health-related topics like treatment options, it is important to understand how they construct their searches, and how they understand the results. In this paper, we report results from an exploratory lab study with 40 cross-sectional participants and follow-up interviews with eleven of them about their use of search engines to find treatment options. While corroborating prior research concerning basic consumer health information search behaviors (e.g., query length and evaluation of results), our findings also extend the current understanding of health information searching by suggesting that the process of seeking treatment options is shaped by consumers' propensity for familiar and confirming information as well as their desire to seek novel information. Furthermore, our findings suggest an under-investigated idea of the importance of a *search timeline*: that is that a consumer is likely to look for confirming or novel information depending on where they are in a particular timeline during their search. The results indicate that search systems can better support consumers in finding novel information about treatment options, but that it would be best to introduce novel information *after* satisfying consumers search for general and familiar information.

Keywords

Consumer health information, health information search, cognitive activities, information behavior, treatment options.

INTRODUCTION

Search engines are important gateways from which people with health concerns gain knowledge about health conditions or receive verification or comfort from people with similar conditions. Thus, searching on the Web is a means for people to cope with the uncertainties of illnesses (Brashers, Goldsmith, & Hsieh, 2002). Consumers search for many different health subjects. A non-exhaustive list, based on the popularity, includes specific diseases or medical problems, medical treatments or procedures,

doctors or medical facilities, health insurance, food and drug safety, environmental health hazards, pregnancy and childbirth, medical test results, and long-term care (Fox, 2011). Medical treatments and procedures appear as the second most popular topic that consumers search for, with 56% of adult Internet users in the U.S. having looked for this topic.

Searching for treatment options online is a manifestation of consumer activism and the patient empowerment movement. Supporting treatment options search is consistent with the current call for patient role change from a passive recipient of healthcare service to an active participant in healthcare decision-making and management (Anderson & Funnell, 2005).

To better support consumers' needs for seeking treatment options, and also to better empower them in the conversation with health care providers and eventually the decision-making concerning their own care, it is necessary to understand how general consumers search for treatment options (Lambert & Loisel, 2007). Knowledge of consumers' needs can shed light on how current search systems, including Web search engines, succeed and fail at providing information in the context of facilitating consumers' examination of treatment options.

While extensive studies have been conducted about consumers' behavior in seeking information about specific diseases, such as cancer (Arora et al., 2006), and diabetes (Longo et al., 2010), as well as their general behaviors of interacting with information retrieval (IR) systems, such as query behavior and the evaluation of health information, (Eysenbach & Kohler, 2002; Spink et al., 2004), little is known about how they search for a specific type of health topic and the cognitive activities involved. This study sets out to fill this gap by examining how consumers explore treatment options from both the behavioral and cognitive perspectives. An improved understanding of behaviors and cognitive activities involved in one of the most widely performed health information searching scenarios will be beneficial for the design of search systems intended to support health information searching.

RELATED LITERATURE

Existing research on consumer health information search tends to cluster around three major facets or elements: goals

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(why do people search), behaviors (what do people do when they search), and judgments (how they evaluate information or information sources). This literature review is structured around those three elements.

Goals

Consumers often have one or multiple goals or purposes to fulfill when they begin their search for health information. For example, in a study of patients with Multiple Sclerosis (MS), Hepworth, Harrison, and James (2003) found that patients had a wide variety of information needs, ranging from finding out how to manage their symptoms to getting support from social groups. Brashers and colleagues (2002) further pointed out that consumers might even have conflicting goals, such as reducing their uncertainty at the same time that they must maintain optimism in the face of an illness.

Purposes influence what information consumers look for and their overall search process. For example, Cartwright, White, and Horvitz (2011) found, by analyzing health-related queries from Web search engines, that consumer goals include both looking for evidence to verify particular health concern and testing hypotheses to find a best suitable explanation (e.g., diagnoses) or solution (e.g., treatments) for a health concern.

Purposes have an impact on when consumers decide to finish searching. Feufel and Stahl (2012) found that most people, particularly those with low health literacy, stopped once they found an answer that answered a question to their satisfaction, but not stop searching based on any particular quality assessment. Stopping a search once an answer is found may be caused by the fact that the study was conducted in a lab setting. However, it is also a reflection of participants' search goals: finding a relevant answer versus finding not only relevant but also high quality answer. This study points to the fact that consumers do not necessarily have optimal health search goals or they are not aware of what a "good" goal should be. Training may be needed to improve consumers' ability to set up goals (Feufel & Stahl, 2012).

Although consumers often begin with one or multiple search goals in health information searching, the goals may also change in the search process as a result of the user-system interactions (Xie, 2000). For example, Cartwright et al. (2002) observed that some people began searching without intending to self-diagnose, and yet ended their search by self-diagnosing.

Behaviors

Looking from the sense-making lens (Dervin, 1992), information can be considered as something that is created by the participants through their actions in seeking, reading, and describing it. In the search process, consumers go from a purpose or goal, to performing their search to realize that goal. Information search behaviors have been examined at different levels. The basic level was consumers' behavior of using systems to searching for health information. Common

findings about system use from prior studies include: Consumers typed in short queries, with the average query length ranging from one to three terms (Spink et al., 2004); consumers had difficulties in articulating their needs using keywords and misspelled search terms (Zeng et al., 2006); and they examined few search results, particularly when they look for factual information (Zhang, 2013).

At a more general level, search behaviors refer to consumers' approaches to health information. One of the behaviors that caught researchers' attention is information avoidance. Brashers (2002) found that patients became overwhelmed and began avoiding information about their condition, even when doctors tried to communicate what they felt was vital information to the patients. People also tend to avoid information when the information retrieved does not support their current views; but, surprisingly, they are more willing to look at dissonant information if they cannot do anything to influence the outcome (Case, Andrews, Johnson, & Allard, 2005). Sometimes, regardless of the information, consumers often reached a point at which they constrained their information seeking to manage their time and cognitive efforts (e.g., Leydon, Boulton, Moynihan, Jones, & Mossman, 2000).

Researchers have also pointed out that whether consumers avoid or seek information may be due to their personalities. Miller (1995) found that some people monitor for information, while others tend to want to "blunt" or avoid information. Beisecker and Beisecker (1990), by examining verbal interaction of patients asking doctors for information, found that patients' pre-existing attitudes are a major factor in their communication.

Judgment

Judgment primarily refers to consumers' evaluation of information or information sources. Relevance or usefulness may be the first and foremost criteria based on which consumers select health information (Beisecker & Beisecker, 1990). For example, Zhang (2012) reported that, when young adults looked for health information, they tended to look for search keywords in titles or URLs on the search result page to determine whether to check out a result.

As mentioned, some consumers stopped search when find an answer to their satisfaction (Feufel & Stahl, 2002). However, numerous studies suggested that consumers cared about the credibility of information (Rieh, 2002). For example, Sillence and colleagues (2007) suggested consumers engage in active evaluation of information sources, gauging the trustworthiness or credibility of the site based on indicators such as author, author affiliation, and website design.

Differently, Eysenbach and Kohler (2002), by using two different methods, interviews and observation, found that consumers tend to talk about credibility concerns more than they demonstrate applying those concerns. This result may well reflect a discrepancy between what people said and

what they actually did. It may also be a manifestation of a lack of knowledge on the part of consumers in practically evaluating information and information sources, or on the part of the system to support such cognitive activities. As expressed by Beisecker and Beisecker (1990), a consumer's expressed desire for quality information, for various reasons, may not always translate into successful techniques for finding it.

As the review suggests, current research has discovered much about consumers' health information search behavior in general (behaviors) as well as the cognitive processes involved (purposes and judgment). However, there remains a lack of understanding about consumers' behaviors and cognitive activities involved in searching for treatment options, an important use of the Web for health information. In order to better understand consumers' search processes and their understanding of the information they find about treatment options, we addressed two research questions:

- (1) What behaviors do consumers exhibit when they search for treatment options online?
- (2) What cognitive activities are involved when consumers search for treatment options; particularly, how do consumers find, select, and evaluate information when searching for treatment options?

RESEARCH METHODS

We used a mixed-methods approach, using participant observation and post-session interview in a lab setting. We recruited forty participants by a message sent to the mailing list of a large research university in southwest of the U.S. Each participant was compensated \$15.

Platforms

Two interfaces were used in this study: 1) a classic Web search engine interface, and 2) a Scatter/Gather-enabled search interface. Both interfaces were built based on the Bing API. That is, when a person types in keywords in either interface, the keywords were sent to Bing and retrieved results from Bing. The classic interface resembled general Web search engines; it featured a basic search box to type in keywords and the search results were presented in a list ranked by relevance. In the Scatter/Gather interface, the search box is also very basic. But in the second interface, the results were grouped into seven clusters by default, a number that could be adjusted and each cluster had a set of 10 keywords to represent its content. The clusters were ranked by size, that is, the number of results contained in each cluster (Gong, Ke, & Khare, 2012).

Data Collection

The data collection took place in a private lab. Each session lasted for 1-1.5 hours. Upon arrival, a moderator gave the participants an overview of the study and asked each participant to read and sign an informed consent. They first completed a questionnaire reporting their demographics as well as experience with Web search and health information

search. Then, the moderator used a predetermined random list to assign the participants to either of the two interfaces. As a result, 20 participants used the classic search interface and 20 used the Scatter/Gather interface.

Each participant, using either interface, completed four health-related search tasks, which were drawn from prior studies (Mu, Ryu, & Lu, 2011; Zhang, 2009). The first task asked the participant to find out about side effects of Creatine; the second asked about what to do when a person has a heart attack; the third asked about the association between two conditions: diabetes and hypertension; and the fourth asked the participant to find out about treatment options for migraines. This paper will focus on reporting data associated with participants' completion of the fourth task, which we will refer to as the treatment options task thereafter. The task description was as follows:

Imagine that you recently began suffering from migraines. You heard about two possible treatments for migraine headaches, beta-blockers and/or calcium channel blockers, and you decided to do some research about them. At the same time, you want to explore whether there are other options for treating migraines without taking medicines, such as diet and exercise.

The order in which the tasks were presented was randomized. Before the search began, participants watched a video tutorial demonstrating the basic functions of the interface to which they were assigned. During the search, when they checked out a website from the result list, they were prompted to rank the relevance and usefulness of the site on a 7-Likert scale (1- not relevant, 7-relevant; 1-not useful; 7- useful). An automated system logged the search queries, websites visited, and participants' ratings.

As soon as participants completed each task, the moderator asked them to complete a short questionnaire assessing mental effort (how much mental effort they used to complete the task) and satisfaction (how satisfied they were with their performance). Camtasia software captured the search process of each participant in video format.

After completing all four tasks, the moderator showed participants a playback of the video recording of their search of the last task and asked each participant to comment on their own behaviors, such as selection of keywords, rationale for reformulating queries, and selection of particular search results. In total, 11 participants gave accounts about their behaviors of searching for treatment options for migraine. The other participants completed interviews about the other three tasks, which we will not report in this paper.

Data Analysis

Four types of data were collected: (1) participants' demographics and experience with health information search; (2) transaction logs about session length, queries submitted, sites visited, participants' rating on relevance and usefulness of the sites visited; (3) participants' rating on the mental efforts required to complete each task and

their satisfaction with performance; and (4) playback interviews.

The first three types of data were imported into SPSS for statistical analysis. Queries and sites visited were imported into Excel sheets. Query reformulation instances ($Q_n \rightarrow Q_{n+1}$) were analyzed using the coding schema developed by Rieh and Xie (2001), which outlined four types of conceptual changes: specification, generalization, parallel movement, and replacement with synonyms.

At the same time, open coding practice was performed to allow new categories to emerge. Two independent coders coded all the query reformulation instances and the inter-coder reliability was 98.5%. The preliminary data analyses suggested that the two interface groups did not differ in demographics (including age, gender, computer experience, and health information search experience), nor in any of the behavioral measurements (including session length, number of query submitted, conceptual changes in query reformulation, and sites visited) (Zhang, Broussard, Ke, & Gong, 2013). Because the focus on the current paper is participants' behavior and cognitive activities while searching for treatment options for migraines, the groups that used two separate interfaces were pooled together.

The two authors and one graduate student transcribed the 11 playback interviews. The two authors then analyzed the transcripts using a qualitative content analysis method. The analysis focused on identifying participants' cognitive activities involved in the search process, including query formulation, and the examination, selection, and evaluation of search results. These data helped answer the second research question. One coder (the first author) coded all the data (11 transcripts) and the second coder (the second author) coded 36% of the data (4 transcripts).

Several discussion sessions were held between the two coders to compare codes and the themes identified. The final code list consisted of 42 codes about attitude, credibility, search process, selection of results, memory, and user rating.

FINDINGS

Characteristics and perceptions of the Participants

Of all 40 participants, age ranged from 18 to 55, with 10% being less than 20, 77.5% between 20 and 30, and 12.5% between 30 and 55. Sixty-two percent of the participants were female and 38 percent were male. Table 1 shows the participants' web experience, medical search experience, and frequency of searching for health information.

Perceptions of the task

Participants' perceptions of the task seeking treatment options are shown in Table 2.

	N	Mean	SD
Web experience	40	13.2 (years)	4.5
Health search experience	40	3.7 (years)	1.4
Health search frequency	40	2.8 (times/month)	.9

Table 1. Consumers experience with web search and health search

Overall, participants felt the treatment options for migraine task to be somewhat familiar, somewhat difficult, and they expended a medium amount of effort on the task. They were generally satisfied with the results of the task. The scale used was a 5-Likert scale, with 1 being the least familiar, extremely easy, minimum effort, or least satisfied, and 5 being the most.

Search Behavior

The following aspects of consumers' search behaviors were examined: session length, basic query behavior, and websites visited. The data were based on the analysis of the video recorded search sessions and of the transaction log.

Session length

Participants took, on average, 10.25 minutes to complete the task searching for migraine treatment options.

Basic query behavior

In completing the task, on average, participants used 4.2 queries (SD = 2.1). The average query length was 3.8 terms (SD = 1.7). Participants misspelled words at times, for example by using "migrain," to search. But participants were at ease correcting their misspellings by selecting automatic suggestions given in the interface.

Websites visited

Participants visited a number of different websites. The name of the sites and the frequency of visits are shown in Table 3.

In total, participants visited 224 results while conducting the task to seek treatment options for migraines. These results originated from 66 unique websites. Among these sites, medical-specific sites (such as WebMD, livestrong, mayoclinic, migraines.org, and migraines.com), and general-purpose sites (such as ehow, buzzle.com, and Wikipedia) appeared to be the most popular sites, with each being visited more than 10 times. In total, these popular sites accounted for close to 60% all the visits.

Perceptions	Familiar	Easy	Effortful	Satisfied (with results)
Ave. rating	2.3	2.5	2.7	4.2

Table 2. Participants' perceptions of the task

Website Name	Number of Visits	Accumulative %
WebMD	26	11.6%
Ehow, Livestrong	22*2 sites	31.3%%
Migraines.org	19	39.7%
Wikipedia,	18	47.8%
Mayoclinic	17	55.4%
Migraines.com	10	59.8%
Medicinenet.com	7	62.9%
About.com, Buzzle.com	5*2 sites	67.4%
PubMed	4	69.2%
Healthboards.com, NYTimes, Womenshealth.gov	3*3 sites	73.2%
abcnews, ayushveda.com drugs.com, medlineplus healyourheadachenow.com netplaces.com, yahoo.com relieve-migraine-headache.com	2*8 sites	80.4%
Other	1*44 sites	100%
Total	224	
Note: The websites visited by one participant were missing		

Table 3. Websites visited during search

Several sites, including the medical-specific sites, medicinenet.com and healthboards.com; the evidence-based site, PubMed and womenshealth.gov; and the general-purpose sites, about.com, nytimes, and buzzle.com, were checked out several times by the participants. Together with the most visited sites, they accounted for 73.2% of all the visits.

Half of the sites visited twice by the participants were general-purpose sites, such as abcnews, netplace, and Yahoo.com, and the other half were medical-related sites. About 66.7% of the unique websites (44 websites) were visited only once by the participants. These sites were lumped into the “Other” category in the table. The sites included a number of news websites (e.g., abcnews, foxnews, medicalnewstoday) and a number of sites with migraine or headache in the URLs (e.g., headachedrugs.com, headaches.org, migraine-away.com, migraineheadachesaid.com, migrainerelief.net, migraineresearchfoundation.org, migrainetreatment.org, and sufferingfrommigraine.com).

Cognitive Activities

Participants’ cognitive activities were analyzed from four aspects: query formulation and reformulation, examination of search results, judgment of sources, and the development of cognitive activities over time. The results were based on the analysis of the queries that participants submitted in the search and the transcripts of the post-session playback interviews.

Type of reformulation	Number (% of total)
Specification	22 (24.7)
Generalization	9 (10.1)
Parallel move	25 (28.1)
New concept	27(30.3)
Rephrase	6 (6.7)
Total	89 (100%)

Table 4. Query reformulations

Query formulation and reformulation

Query is a major means through which people interact with search systems. Thus, participants’ queries are a reflection of their cognitive activities or intentions in the search process.

Table 4 shows the types of query reformulations in terms of the semantic changes. In total, participants reformulated queries 89 times (Mean = 2.2). It seems that they were equally likely to switch to a new concept (e.g., “home remedies for migraines,” → “calcium channel blockers.”), replace a concept in the previous query to make the current query partially overlap with the previous one (e.g., “beta blockers migraines” → “calcium channel blockers migraines”), or make a query more specific (e.g., “treating migraines” → “treating migraines with beta blockers”). Only in a few instances, participants intended to make a query for more general or rephrase the previous query. A rephrase is a simple rewording or rephrasing of the same search, such as from “treatment for migraines” to “migraine treatments”. A rephrase also could be corrections, as of a misspelling.

Selecting search results

When asked about results, participants expressed uncertainty in selecting sites and expected that they would need to perform some trial and error. For example, one participant, when asked whether he was satisfied with his results, responded:

...it was hard to know where I want to go first, what is going to be the best use to be because it is hard with search engines because all you have is a little blurb under it and you don’t know what you are going to get from the website. Sometimes I would go to a website, thinking it would be a really good one and it wasn’t so good.

In addition to recognizing the selection of results as a trial-and-error process, participants also pointed out that they followed a set of heuristics. A common heuristic was that they would select the results at the top, assuming that results ranked high are more relevant. So many participants simply “went in order.” In the 11 post-session play-back interviews, participants discussed selecting a top result 13 times. For example, one participant explained:

I am kind of conditioned to it. It is not just because it is at the top, it also because that the best results I got from Google or yahoo usually are at the top. If I click on page 3 [of the results], it is like totally off the topic. That’s the

main reason why I clicked on it. [A few times] I decided go down, but I kind of realized when it gets lower, it was getting off.

Participants also showed a strong trend toward selecting familiar websites. Familiarity often brings comfortableness. When asked why they had selected a particular result, a typical response was, “Because I know the website” or reversely “If it is like a website that I’ve never heard, I probably just skip over that, use it as a last resort.” Another participant gave a more elaborated answer, when asked if they were satisfied with their results:

I think it was better, because the first search [result] was Wikipedia, the website I'm familiar with. I feel more comfortable seeing that, usually, because I am used to it, I am accustomed to Google search very frequently. Usually when I start a search, the first link that appears on the page might be Wikipedia. So I think this search is quite comfortable to me.

Another important cognitive activity that participants performed in selecting results was comparing multiple sources to validate information found. One participant illustrates his/her reasoning when asked about selecting multiple sites:

I guess because it was reinforcing what I would have done and there wasn't anything glaring in there. My instinctual reaction to an ice pack or something was right.

Judgment of sources

Participants also talked about evaluating sources, mainly in terms several criteria: design, readability, completeness, and credibility, with the design being mentioned by the most participants. Very few participants mentioned relevance, and when asked about it, most indicated that it was not a concern, which may be because participants assumed that relevance is a necessary condition for a website to appear on the search results list.

For design, they expressed preference for clarity, simplicity, and clean design of websites (both the search interface and the specific webpages). This preference seemed to be connected with usability as participants explained that clean and well-structured design would help them find information easily. More specifically they preferred sites that followed design principles such as breaking up text with space or providing images and diagrams. For example, one participant commented:

[This site] was well organized. I get really annoyed with websites that do not clearly mark or organize their articles because it is really overwhelming to look at a huge chunk of text, having to read though all of it to find something you want.

Participants also cared about the readability of the information on a site. They did not like to see technical language or “jargon,” as one participant commented:

I like to get to the point, the concise information, and it seems like it was readily available, I mean [the

information on Livestrong.com] was easy to understand. On the Robbins, it wasn't readily understandable. It's more jargon.

Completeness of information is another factor that participants considered when examining information. Some participants mentioned that when searching for treatment options, they like to see both pros and cons (side effects) of a treatment being listed, along with clear explanations. For example, one participant commented:

If I'm a patient of the migraine, I would be more uncomfortable at this time, seeing all these side effects get there. I feel like, oh, am I going to die? So many side effects, and I can't see the explanation of these side effects and what might the side effects that appear more possibly, and what might be the side effect that not frequently appear. I hope it can provide more information, not just simply listing all these words.

Some went further, pointing out that they like to know various aspects of a treatment. One participant gave an example in the interviews:

Even though I trust the websites, I will do a umo therapy, I question everything I can. So I ask what is umo therapy, does it have side effects, is it expensive, regular questions that I can think of. Then if I feel it is practical, I will try it.

Credibility was also of concern to a few participants. Credibility seems to originate from different sources. For some participants, credibility originated from experience. For example, several participants mentioned that they trusted WebMD or the Mayo Clinic because they had been there before. For a few others, the judgment of credibility originated from the content. For example, one participant explained that he checked out the eHow website because of its familiarity, whereas decided that it is not credible after reading the content.

Search timeline - Cognitive development

Time has an impact on cognitive needs and cognitive activities that participants demonstrate during the search. A common pattern was that participants went from the general, or the broad, to the specific when they tried to explore treatment options. At the beginning of a search, participants often wanted to situate their understanding, to get “basic definitions,” or “general information” about treatment options, and then go on to exploring more specific information about each option. Correspondingly when selecting sites, they were more likely to begin with a site containing user-generated content, perhaps because these sites are often written without much technical language. One participant explains why they began with a general search:

I think I should know more about what a beta-blocker is first and then read about how the drug works, just because it may make it easier for me to understand the terminology better later on.

Later in the search (in the middle of the search timeline), participants often developed a feeling that sites visited were too general – not specific enough about different aspects of one or multiple options. One participant explained the observed trend that participants often were not satisfied with simple results once they were further into their search process.

It didn't really give as much information as I thought it would. The article was pretty short, like I wish I would've gone to more like side effects of each of those things. It didn't really tell the cons of the drug, which is important when you are trying to choose a medication. It was OK relevant because it didn't really give me any **more** information about beta-blockers than I've already seen. The site is kind of let down because the article was short.

The other common pattern was that participants went from seeking for confirming information to looking for novel information, with some ending their search by validating the information. At early stage of the search, participants tended to seek information that could confirm their preconceptions concerning a treatment. One participant commented that information confirming what she would have done for a migraine is comforting:

This site was positive because it was reinforcing what I would have done and there wasn't anything glaring in there. My instinctual reaction to use an ice pack or something was right.

As the search moves on, participants tended to look for novel information to learn something new. As one participant commented:

Sometimes you just kind of search, kind of play with the search engines and see what is out there. Something about magnesium here... and butter something, yeah, there we are, all these herbal remedies for migraines. That surprised me, I never heard of butterbur and feverbur, I never heard of these herbs. So I learned a lot, [so it is a good thing].

When participants approached the end of their searches, they expressed a need for final validation. For example, one participant commented:

I was still doing the same thing. I never stick to one person, one website only. They are all biased in some way.

Sometimes, participants would visit the same sites at the end of their search. For example, a participant explained a revisit to a website at the end of the search that he/she was double checking to see a side effect was remembered correctly. Another form of validation, at the end of a search, was that participants tried to examine whether they had missed anything, as one participant described:

I was just kind of looking around, trying to see if I missed any information.

DISCUSSION

Our first research question was: what behaviors do consumers exhibit when they search for treatment options online? In many ways, participants' behaviors when searching for treatment options were consistent with consumers' health information search behaviors reported in numerous prior studies (e.g., Spink et al., 2004; Zeng et al., 2006; Zhang, 2013). That is, people submitted short queries, misspelled keywords, and selected results exclusively from the first page of search results.

Nevertheless, our study contributes to the understanding of websites that users visit during the study. First, the websites visited by the participants demonstrated a long tail distribution, with about 30% of the websites accounting for more than 80% of the visits that participants made to websites. Second, although the majority of the sites visited by the participants were medical-specific sites, such as WebMD, Livestrong, and Mayo Clinic, they still relied heavily on general sites, with close to 30% of the visits being paid to such sites like Wikipedia, ehow, about, and buzzle. One reason may be that these sites, particularly Wikipedia, are ranked high in search engines. The other reason may be that the language in these sites is easier to understand than it is in most medical-specific sites. Because of participants' heavy use of these sites, in future studies, it is worthwhile to study what roles these general-purpose sites play in supporting people's seeking of health information. Third, evidence-based trustworthy sources put together by the National Library of Medicine (NLM) and the National Institutes of Health (NIH), such as MedlinePlus, PubMed, and womenshealth.gov, were rarely used by the participants, accounting for only 4% of the total number of visits. Efforts should be made to promote the use of such sites. Fourth, when a site's name (or URL) contains the medical condition that consumers search for, it seems more likely to be selected by the consumer. In this study, about 20% of the 66 unique sites visited by the participants contained the term "migraine".

Our second research question was: what cognitive activities are involved when consumers search for treatment options? The first aspect of the cognitive activities that we examined was query formulation. The results suggested that, in the search process, participants focused on making a query more specific, changing part of the concepts in the previous query, or switching to new concepts altogether. These semantic changes indicate that, when searching for treatment options, people often begin with general concepts, then zoom onto one treatment and explore different aspects of the treatment. After getting sufficient knowledge of the treatment, they move on to explore another treatment option.

The second and third aspects of the cognitive activities examined were selecting search results and making judgment of sources. We found that participants placed a strong emphasis on familiarity when selecting sources, which is consistent with the findings of Power, Inglis,

Ronie, & Large (2011) that users often use “real-world” branding, i.e., an identity that they recognized from their experiences, as an indicator of trustworthiness. It was also observed that, in the post-session interviews, only a few participants rationalized their selection of sources by referring to credibility check, which is consistent with their behavior that they mostly clicked on the top handful of results presented in the interface. The lack of concern over credibility may be due to the fact that the task was only a simulated task, not representing participants’ real needs. But it may also be because the Web is not a final destination for participants seeking to make a decision about treatment, but rather it is simply a place for people to find out more about particular options, so an exactitude of credibility may be of little concern to them; they want the “low-hanging” overview information or to use search engines to get familiar with treatment options, but rely on other sources, such as doctors, for final decisions (Sillence et al., 2007).

A meaningful contribution of this study to the understanding of cognitive activities involved in health information search is the identification of users’ cognitive development over the course of a search session for treatment options. It was found that users tend to seek general treatment options or general definitions of treatments at the onset of the search and gradually move onto seeking more specific information concerning aspects of a treatment. This finding is consistent with participants’ query reformulation behavior where the majority of reformulations were intended for more specific information, information concerning different aspects of a treatment, and new information.

The second cognitive pattern identified was that, at the onset of the search, users tend to seek familiar information that is consistent with their existing knowledge status. When the search moves on, they begin to expand their knowledge by seeking novel information, even information that conflicts with results they have already viewed. This may suggest an attempt to overcome confirmational bias. At the end of the search, consumers again search for confirming information to validate the new knowledge they learned. This ending behavior has two goals: first, to be sure the sources they used are not wrong; and second to double check that they haven’t missed anything. The identification of the timeline of the cognitive development suggests that search engines need to accommodate such developments during a search.

Limitations

This study has a few limitations. First, the task is a simulated task and do not reflect the participants’ real needs. Although our interviews suggest that participants behaved in typical ways, in future studies, researchers shall observe users searching for their real needs. Second, due to the exploratory nature of the study, we only assigned one treatment option task to the participants, thus participants’ behavior may be affected by the nature of the task. In future

observational studies, we will increase the number of treatment option search tasks to diminish its impact on search behavior.

Additionally, a lab setting is not a natural environment for treatment search. The most important aspects of our findings (the importance of a timeline while searching on cognitive behavior and the support for a bias toward familiarity) would likely be similar under other conditions. However, further, more longitudinal studies of consumer behavior in their own homes or other personal locations would be beneficial. In this vein, a closer look into how participants’ prior experience affects their behavior or engagement with a topic would greatly benefit future studies.

CONCLUSION

Seeking for treatment options is one of the most popular health information search scenarios. To inform search systems to better support this activity, we conducted this exploratory study. We found that users demonstrated similar search behaviors as they search for other health information, that is, short queries, misspellings, and checking out only top results. However, the examination of the cognitive activities involved in the search process indicates that consumers had distinctive cognitive patterns as they searched for treatment options. Even with a 10-minute search, consumers may be looking for confirmation, avoiding inconsistent information, or looking for novel information. The current model of search engines, which provides a list of popular results, does not fully serve consumers, who may have varying needs depending on where they are at a particular time within the search process. Search system designers may think about supporting consumers in their behaviors to learn and confirm knowledge to help consumers to move toward a less overwhelming search experience. Presenting sites to consumers in a way that makes obvious qualities like completeness and specificity of the information would help consumers to complete their searches more successfully.

Also, this study, in conjunction with existing research, indicates that the use of online sources does not reflect consumers’ expressed opinions about the trustworthiness or usefulness of the information found there. Rather, search engine ranking and the familiarity of a site to the user tend to play the most significant role in source selection. The importance of rank and familiarity suggests that people may use information sources as suggested to them at given points in time whether or not they deem those sources to be low quality.

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