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Understanding the Use of Online Health Information Technology by People With and Without Visual Disabilities

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UNDERSTANDING THE USE OF ONLINE HEALTH INFORMATION TECHNOLOGY BY PEOPLE WITH AND WITHOUT VISUAL DISABILITIES

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I HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER MY SUPERVISION BY John Kegley ENTITLED Understanding the Use of Online Health Information Technology by People With and Without Visual Disabilities BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF Doctor of Philosophy.

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ABSTRACT

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The Internet has become a platform that many users, governments, corporations, and other organizations hope to leverage in order to support a dynamic and effective physician-patient partnership. However, many researchers have identified significant shortcomings with the current online health information domain. This research examined the use of online health information technology (HIT) by individuals with and without visual disabilities. Two studies were conducted to understand online health information searching behaviors of individuals with and without disabilities. The impact of providing relevant search keywords to participants, and the impact of stress appraisals upon health information search behavior and HIT website usage were the primary constructs evaluated.

The first study examined the impact of the provision of focused keywords on participant health-related search performance. It was hypothesized that in trials where keywords were provided, there would be improved search accuracy, efficiency, and quality of responses. In addition, it was hypothesized that when people appraised the task as a challenge compared to threat, they would have improved search accuracy, efficiency, and quality of responses. The first study utilized a repeated measure design with randomization of treatment conditions for keyword provision (provided or not) for four distinct health-information related search tasks. The findings revealed that the provision of keywords and stressor appraisals influence participant performance of health-related, online search tasks. Challenged individuals who receive keywords, and threatened individuals who do not receive keywords demonstrate what is typically considered to be more effective online search performance. The second study examined the unique health-related search behaviors employed by individuals with visual disabilities using screen reader software. The findings revealed that there are substantial improvements in web design and online health information architecture that can be implemented to improve the user experience, accessibility, and comprehensibility of this critical data source for individuals that use screen readers. The results of both studies show that users typically demonstrate fairly shallow searches (selecting information from the first page of search results), lean toward a single search engine (Google.com), and are able to find reasonably accurate health information. However, for participants with visual disabilities, there remain several obstacles to effective health information website selection and navigation due to poor labeling of images, hyperlinks, and page arrangement, and conflicts between embedded code and screen reader software.

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INTRODUCTION

The Internet is used more frequently as a delivery method for health information; however, many individuals with and without disabilities are experiencing issues in finding accurate, comprehensive, and understandable search results online (Brophy & Craven, 2007; Hirji, 2004). The additional constraints associated with using screen reader software for individuals with visual disabilities can further increase the difficulty of accessing and effectively understanding medical data via the web (Eysenbach & Kohler, 2002; Lazar, Allen, Kleinman, & Malarkey, 2007). The current research sought to better understanding how individuals with and without visual disabilities use the Internet to search for, evaluate, and understand online health information.

The two current studies were guided by the integration of several lines of research including: user behavior with health information on the Internet (Eysenbach & Kohler, 2002; Farvolden, Cunningham, & Selby, 2009; Hansen, Derry, Resnick, & Richardson, 2003; Morahan-Martin, 2004), individual difference variables and their linkage to performance (Gildea, Schneider, & Shebilske, 2007; Schneider, 2008), and the accessibility and usability of Internet web pages for individuals with visual disabilities (Brophy & Craven, 2007; Davis, 2002; Lazar, Allen, Kleinman, & Malarkey, 2007; Shebilske, Narakesari, Alakke, Douglass, & Faulkner, 2009). The current research investigated the relationship between the user, interface, and domain to better understand how the web is employed to access and understand health-related information. The findings of the present research may inform recommendations for improving the dynamic interaction for individuals with and without disabilities with the Internet in general, and the health information web domain in particular.

Health Information Technology

Health Information Technology (HIT) has become a primary focus for improving the healthcare delivery system used in most industrialized nations (Follen, Castaneda, Mikelson, Johnson, Wilson, & Higuchi, 2007). Electronic medical records, long-term care management software, and online medical databases have altered the ways practitioners, clients, and organizations approach healthcare initiatives and the ways that relevant patient information is disseminated. HIT has been associated with substantial improvements in quality of care, flexibility of patient and professional access to information, and reduction of operating costs and treatment errors (Follen et al., 2007). The benefits of developing a physician-patient partnership, including web content and self-seeking information behaviors by patients, have been reported in several studies (Kahana & Kahana, 2001; Wald, Dube, & Anthony, 2007). Primary care physicians have traditionally served as the main portal for patients seeking information regarding a specific condition or disease (Farvolden et al., 2009). However, with the increasing availability of home Internet access and the large number of e-health websites, individuals now have an extremely large quantity of health-related information that varies greatly in terms of quality.

The advantages of online HIT have not been lost on governments and corporations that seek to leverage existing medical resources in response to continued population growth. Hirji (2004) reports that Canadian patients experience problems scheduling appointments, endure significant emergency room delays, face a lack of needed personnel and equipment in rural areas, and report inadequate doctor-patient communication. As such, patients have turned to the Internet as a supplement for the information that they receive from their physicians. Health information queries using search engines (e.g., Google or Yahoo) are the third most popular use of the Internet behind email and consumer research (Fox & Fallows, 2003). Public and private organizations recognize the need to capitalize on the wide-spread availability of health information online to offload some of the responsibilities of medical professionals and improve patient health through Internet-based interventions and web-enabled information sharing (Farvolden et al., 2009). Wald et al. (2007) reported that quality online HIT can lead to better informed patients, a sense of knowledge sharing between patient and physician, and more effective use of clinical time.

E-health websites can provide many services that previously required a visit to a physician or treatment center. Screening and detection of illnesses can now be facilitated through online self-tests or symptom checklists presented directly to individuals over the web (Farvolden et al., 2009). Individuals can also personalize their treatment through the flexible nature of the Internet in the following ways: no appointments need to be made for streaming information, there is no travel requirement, users can register with a website and their custom settings and preferences are saved each time patients log on or off, and 24 hour/7 day a week availability can foster pro-health behaviors regardless of the time, day or night, an individual may need support or instruction (Huang & Penson, 2008; Morahan-Martin, 2004). Social networking and peer and professional support are also important functions afforded by the web that a telephone call or a visit to a physician cannot easily duplicate. These interpersonal networks have been shown to be especially effective for assisting with the treatment of addictions and mental disorders, as well as diet and exercise maintenance (Farvolden et al., 2009). The tele-presence and anonymity provided by the web allows users to search out information and social support more freely than in the physical world where distance and potential for embarrassment can be an issue (O'Grady, 2005).

Patients also turn to the web because there is an expressed frustration with the lack of information from their physician; they either have questions that are never answered or forget to ask them during an office visit (Morahan-Martin, 2004). Individuals have expressed that reviewing health information online gives them a sense of confidence and empowerment in becoming more actively involved in their own treatment (Huang & Penson, 2008). Telemedicine, which is an Internet-based intervention used when distance is an issue for the patient, has also been used to increase flexibility for clients and physicians as data can be quickly shared, evaluated, and re-distributed through web and videoconferencing capabilities (Bower, Barry, Reid, & Norrie, 2005). Telemedicine provides clients a constant link to medical providers that is more dynamic than previous lines of communication and interaction. Individuals are able to schedule appointments, ask questions, enter health-related information into online databases, have a stronger connection with physicians, and have more control of their own schedules since the Internet is available around the clock (Bower et al., 2005).

Limitations of Health Information Technology

Despite the wealth of potential benefits from online HIT, a number of issues with the medium have been reported both with how consumers search for and use information, as well as the HIT websites themselves. Research has reported that participants asked to answer a health-related questionnaire using the Internet typically employed less than optimal search techniques and failed to evaluate the credibility of the sources they chose (Eysenbach & Kohler, 2002). Participants routinely used general search engines rather than established health organizations' websites in their queries. Also, a large majority of subjects (65%) only used one search term rather than combining relevant keywords to create a more effective search operator. Individuals were also overly reliant on the first page of returned links from a search engine, focusing on the top ten results for their queries 97.2% of the time. Finally, when asked in post-task interviews what organization had published the websites where they had acquired their health-related answers, subjects were only able to recall that information for 20.9% of their responses (Eysenbach & Kohler, 2002).

Other researchers have reported that Internet users often apply sub-optimal search strategies, specifically focusing on the varying performance between novices and experts. Holscher and Strube (2000) found that experts incorporate more advanced search techniques, such as Boolean operators, modifiers, and phrase searches, than do novice users. Experts in both the subject domain and Internet search techniques are much more likely to visit a relevant website first rather than a general search engine. Novices are more likely to use query reformulations, exhibit backward-orienting behaviors (e.g., repeatedly going back to the same web page to double check that they did not miss important information), and are more likely to use trial-and-error search strategies. Thus, searching behavior among Internet users seems to be driven by domain knowledge and level of experience searching for information online.

Domain experts have been shown to be much more likely to perform pre-search planning and select relevant databases and websites as their initial search point rather than using general search engines (Bhavnani, 2002). However, domain experts searching outside their area of expertise will default to a novice search strategy of using general search engines, apply a trial-and-error approach, lack a defined goal sequence, and access less than reputable websites in their search. Monereo, Fuentes, and Sanchez (2000) found that experts in strategic searching use a dynamic planning review and evaluation monitoring process to ensure the iterative results of their search strategies mesh well with the constraints of the search and the goal of the task. In contrast, novices incorporate a trial-and-error approach often using the first search tool they think of and rarely use process planning or specific keywords. Thus, novices are willing to accept online health information without much regard to the quality of the source (Bhavnani, 2002; Monereo, Fuentes, & Sanchez, 2000). These findings indicate that individuals with little to no experience with the health information domain are likely to be fairly complacent in their search strategies.

The public may have little experience with the health information domain, and unfortunately the information presented on several English and Spanish-language websites varies substantially in terms of coverage and accuracy for common health issues (Berland et al., 2001). The highest combined coverage and accuracy score was 63% and was associated with breast cancer information. The lowest combined score was 36% coverage and accuracy for childhood asthma. Thus, there appears to be quite a significant gap in terms of finding information that minimally and accurately addresses online health information questions. This finding highlights the lack of regulation among health information websites despite attempts by the American Medical Association and the Health on the Net foundation (www.hon.ch) to establish a set of standards for online HIT (Morahan-Martin, 2004).

In addition, there are several obstacles to accessing and using online health information (Gilmour, 2007). One of the primary issues involves the lack of Internet access for certain demographic groups, such as minorities, the poor, individuals with disabilities, and less educated individuals (Dobransky & Hargittai, 2006). As these groups typically experience a lower quality of healthcare in general, the Internet provides a means of leveling the playing field through effective telemedicine initiatives and improved information seeking capabilities. However, cost remains a prohibitive barrier to access, and the benefits of e-health applications fail to reach many of the people they seek to assist. Another obstacle for users lies in the readability and presentation of health-related materials (Gilmour, 2007; Hirji, 2004). Estimates of the average health literacy reading level required to understand e-health websites have ranged from 11^{th} grade to the collegiate level, which is far beyond the average American reading level of 7^{th} – 8^{th} grade (Gilmour, 2007; Huang & Penson, 2007). The formatting of health information was also found to be less than ideal with a general lack of useful visual cues for organizing material in such a way as to emphasize key points and illustrate complex concepts using graphs and charts (Gilmour, 2007).

The aforementioned constraints create problems for all users, but individuals with disabilities face increased difficulty in their attempts to search for e-health information. Typically, individuals with disabilities are far less likely to own a home computer and use the Internet in general (Dobransky & Hargittai, 2006). Even in cases where connectivity is not an issue, individuals with disabilities face difficulties in the way that their assistive technologies (AT) interact with and render websites. The Internet is a massively complex domain that is constantly in flux, and the ATs that individuals depend on to access the web often require re-configuration or new technologies altogether to function properly. This process can often be expensive in terms of equipment and labor costs for skilled professionals to visit the home to adjust or update the AT.

Virtual mobility, round-the-clock access, and anonymity are all positive aspects that could benefit individuals with disabilities as much as, or more than, individuals without disabilities. However, these individuals are often prevented from achieving this maximal benefit due to the inaccessibility and poor usability of the Internet in general, and of health-information websites in particular (Gilmour, 2007; Brophy & Craven, 2007). Davis (2002) found that only 19% (95 of 500) of health information websites were minimally accessible according to W3C Priority 1 standards. Priority 1 criteria are essential for a website to be minimally accessible for blind or low-vision individuals who use screen readers to access the Internet (http://www.w3.org/TR/WAI-WEBCONTENT/full-checklist.html). As such, the vast majority of e-health sites in Davis' study would be inaccessible and un-usable for individuals who rely on screen readers to navigate the Internet. A separate review of the accessibility of web-based health resources found that several high-profile health databases (PubMed, Ovid MEDLINE, MEDLINEplus, and CANCERLIT to name a few) suffered from substantial inaccessibility issues for individuals who use AT (McCord, Frederiksen, & Campbell, 2002).

Given the benefits and drawbacks to online HIT, it is critical to maximize users' potential for finding quality information. As the Internet, and the health information web domain in particular, is still a fledgling technology, it is essential to better understand how individuals access and use the information that they are seeking online. The present research sought to improve awareness of how online health information is searched, selected, reviewed, and ultimately used by individuals with and without visual disabilities.

Benefits and Limitations of Assistive Technology for Individuals with Disabilities

Screen readers are the primary AT for individuals who have very low vision and require auditory feedback to effectively use the Internet (The Alliance for Technology Access, 2004). Screen readers use a text-to-speech conversion process via the computer's sound-processing equipment to render the visual information presented on-screen into an audio format that low vision and blind individuals can perceive. Most screen readers are accessible through a keyboard interface, and keyboard shortcuts have been integrated into most systems to allow for rapid organization and navigation of data. The rate, frequency, and loudness of the verbal output can also be configured by users to better enable them to customize their experience to best match their capabilities and constraints (Lazzaro, 2001; The Alliance for Technology, 2004).

Despite the high utility of screen readers, users still face many drawbacks with their application to the web. Lazar, Allen, Kleinman, and Malarkey (2007) have focused specifically on the challenges that blind or low vision individuals experience as they interact with the Internet using screen readers. Lazar et al. (2007) studied 100 blind users through an *in-vivo*, time diary technique in which participants reported the frustrations they encountered while using the web. The top five causes of frustration that were identified included: 1) page layout resulting in confusing screen reader output, 2) conflict between the screen reader and the website, 3) incorrectly designed or poorly labeled forms, 4) missing alternative text descriptions for images, and 5) misleading links and conflicts between applications and screen readers. These frustrations resulted in reduced user satisfaction and productivity, as individuals were forced to find work arounds or alternative methods for completing their desired tasks. Many of the websites included in the study met minimum accessibility standards; however, they still proved to be difficult to use based on confusing page layout and ineffective information structuring (Lazar et al., 2007). These frustrating experiences led to significant user dissatisfaction and prevented direct performance of necessary actions. Lazar et al. reported that 30.4% of the total time low-vision users spent on the computer was wasted.

Fortunately, the most common sources of frustration can be resolved via a multi-dimensional approach that should include web developers, software designers, AT engineers and programmers, and the users themselves. Lazar et al. identified several specific solutions. One such solution was to provide easy to understand and logical labeling of forms and tables. Also, it is recommended to use consistent and logical ordering of a webpage to reflect advertisements, links, content, and pictures. Ensuring Portable Document Format (PDF) files are accessible with screen readers and providing meaningful alternative text for images is critical. Labeling hyperlinks so that they are context specific and easy to understand can greatly assist in fluid page navigation. Testing web content and any embedded applications (i.e., Sun Microsystems' Java and Adobe Flash) before activation to check that it is accessible with screen readers reduces technology conflicts. It is recommended that users be allowed to disable auto-refresh and timeout procedures as blind individuals require more time to navigate a webpage than sighted individuals. Building in the capability for pop up boxes or click and drop-down menus to be deactivated is important as these features intrude on the user experience and may serve as a distraction. Finally, standard web navigation functionality should be intact and consistent (i.e., back, forward, home, and refresh buttons operate as they normally would). Most of these fixes are very easy to accommodate given awareness for such problems and a willingness of organizations to spend the time and resources to be certain the web is usable for everyone.

Research has investigated Internet skills of screen reader users. Shebilske, Narakesari, Alakke, Douglass, and Faulkner (2009) studied the Internet skills of individuals who use screen readers. This study examined a national insurance company website by evaluating participants' ability to navigate tables, identify headings on a page, fill in form fields, identify and interact with images, and identify and use hyperlinks. Once participants' skills were assessed, they were asked to perform various relevant tasks on an insurance website. Shebilske et al. (2009) supported and extended the findings of Lazar et al. (2007) by empirically replicating the same sources of frustration (i.e., confusing page layout, conflict between screen reader and web page, ineffective page design, no alternative text for images, mislabeled hyperlinks, issues reading PDF documents, and screen reader software crashes). The findings suggested that user skill plays a moderating role in how impactful the most common frustrations can be when individuals using screen readers interact with the web. Because multiple frustrations emerge both for *in vivo* and *in vitro* studies, the influence of individual differences in stress responses may also contribute to how people use the Internet in conjunction with screen readers and other assistive technologies.

Individual Differences and the Linkage to Performance

Individual differences in stress responses may influence how individuals with and without disabilities interact with the Internet. A perspective on how individuals interact with their environment (both internally and externally) to respond to potentially stressful encounters can be found in Lazarus' (1999) research. Lazarus' theory of transactional stress focuses on the development of stressor appraisals (which can range from challenge to threat) by individuals in response to personally-relevant situations. These appraisals are the result of two evaluative processes that are predominately cognitive in nature: primary and secondary appraisals. Primary appraisal is concerned with how impactful a person finds a situation to be in terms of personal relevance, self-concept, and whether or not the event aligns or conflicts with his or her goal set. Thus, events that pose little self-importance will typically not be stressful for an individual as they do not allow for self-esteem maintenance, goal completion, or protecting well-being. In this case, Lazarus would label the appraisal as benign.

When an event is deemed relevant to the individual, the person also engages the process of secondary appraisal. Secondary appraisal involves the estimation of how able a person believes he or she will be able to adequately cope with a situation. Several factors influence how one evaluates his or her ability to effectively cope with a situation, including expected blame or credit, resources currently available to bring to bear in the situation, and the perceived degree of future impact of the event (Lazarus, 1999). Personally relevant situations that are deemed as exceeding personal resources result in threat, while personally relevant events that are viewed as being potentially manageable result in challenge. Threat and challenge appraisals exist along a continuum. It is important to note that appraisals are reshaped dynamically to meet the changing constraints of the situation.

A body of literature demonstrates a link between stressor appraisals and task performance (Blascovich, Seery, Mugridge, Norris, & Weisbuch, 2003; Blascovich & Tomaka, 1996; Dientsbier, 1989; Gildea, Schneider, & Shebilske, 2007; Schneider, 2008). Gildea, Schneider, and Shebilske (2007) found that training performance on a complex task was significantly better for individuals who were challenged rather than threatened by the task. Blascovich et al. (2003) reported high predictive validity of athletic performance based on physiological indicators of challenge or threat, with better performance for those who were challenged during a related task pre-season. These findings demonstrate that cognitive appraisals impact performance, and may be especially important in personally relevant tasks such as searching for health information using the Internet, and may contribute to better understanding the phenomenon of online HIT usage.

Understanding how individuals who vary in their level of ability navigate websites will enable a more robust description of the domain and the types of activities and skills that are required to effectively use the Internet to find important health information online. In order to design improved assistive technologies, train more relevant and useful skills, and create more intuitive websites, it is important to first understand how individuals actually use the medium. As such, the purpose of this research was to understand how persons with and without visual disabilities currently use the Internet to answer health-related questions.

Health Information Search Task

The present research was guided by past research. The Hansen et al. (2003) health information search task is a means of generating meaningful Internet search behaviors within the online health domain. Hansen et al. (2003) conducted their research in a middle- and high-school setting with a sample consisting of 12 students ranging from 12 to 17 years of age. The students were given a set of six health-related questions that required the use of the Internet to locate the appropriate answers (see Appendix B). Participants typically used a general search engine rather than beginning with a specific website (i.e., using Google.com to search for information about Alcoholics Anonymous meeting locations rather than going directly to the organization's website). Participants also scanned the first page of a website 70% of the time rather than searching deeper within the site for more specific information. Finally, participants chose search results from the top ten links 82.5% of the time, and search times averaged 5 minutes and 41 seconds per question. These results are similar to those reported by Eysenbach and Kohler (2002), and suggest that most individuals use shallow and potentially sub-optimal search strategies when looking for health information online.

The current research expanded on past findings by examining how advance organizers (e.g., targeted search keywords) influence both objective and subjective outcome variables involved in the process of searching for online health information in an effort to expand elements of the research conducted by Hansen et al. (2003) and Eysenbach and Kohler (2002). This research investigated the efficiency of the inclusion of relevant keywords on Internet search behaviors for health information. Finally, an evaluation of the influence of using a screen reader on health-related Internet search results was also presented. A formal hypothesis was developed for Study 1, whereas a small sample size consisting of individuals with visual disabilities was utilized for a qualitative research design for Study 2.

It was hypothesized that individuals who were provided with relevant search keywords for health-related web searches would demonstrate significantly better performance on the modified Hansen et al. (2003) search task. Further, stressor appraisals were expected to influence the relationship between search behaviors and performance metrics. Specifically, various performance metrics were expected to improve with the provision of keywords, especially for those individuals who were challenged rather than threatened by the task. These performance benefits were expected to include shorter search times, fewer searches required to obtain necessary health information, fewer websites visited, more accurate answers to health-related questions, and higher quality recommendations for online sources. This prediction was based on the results of several studies which demonstrate that individuals often use less than optimal search strategies, do not make use of multiple search keywords, and often use trial-and-error approaches to web searches (Bhavnani, 2002; Eysenbach and Kohler, 2002; Hansen, Derry, Resnick, and Richardson, 2003; Holscher and Strube, 2000; and Monereo, Fuentes, and Sanchez, 2000). Thus, the provision of keywords was expected to enable participants to begin their search with a more precise and extensive set of search terms that would facilitate faster location of pages with the requisite information (Brunsman-Johnson, 2011).

Study 1 served as a test bed to ensure that the experimental methodologies were sound and the planned comparisons could be effectively completed using the proposed sample of person who vary in visual ability. However, during initial work with screen reader users, it was discovered that online search strategies and online behaviors fundamentally differed between participants with and without visual disabilities when performing the Hansen et al. (2003) task. The current research documented those differences using a common task between participant populations (with and without visual disabilities) by adopting a mixed quantitative and qualitative design. Due to the limited availability of screen-reader users in the local participant pool, no direct quantitative statistical tests will be performed to ascertain the significant differences between participant samples.

METHOD

Study 1

Participants

Participants were 60 undergraduate students without visual disabilities taking an introductory psychology course at a midwestern university. Of these, 36 were female (60%) and 24 were male (40%) with a mean age of 20 years (age range: 18-43). Of those participants who provided ethnicity, 56.7% selected White, Non-Hispanic; 26.7% selected Black, African-American; 1.7% selected Hispanic; 3.3% selected Asian-American; 8.3% selected Other. Volunteers were awarded course research credit in their undergraduate psychology courses, and were treated in accordance with the "Ethical Principles of Psychologists and Code of Conduct" (American Psychological Association, 1992).

Materials

The Stressor Appraisal Scale (SAS) measures both primary and secondary stressor appraisals as they relate to whether an individual views a given event as challenging or threatening. Seven items measure primary appraisals (task demands) and three items measuring secondary appraisals (resources; Schneider, 2008). The SAS has demonstrated psychometrically sound estimates of both reliability and validity (Gildea, Schneider, & Shebilske, 2007; Schneider, 2008). The full scale can be found in Appendix A.

The Hansen et al. (2003) search task includes six questions that require participants to use the Internet to answer health-related questions (see Appendix B). The current study incorporated three of the six Hansen et al. items (1, 2, and 5) regarding diet and medication, and an item was added relating to diet in order to have a balanced design with two items for diet and two for medication items. The following item was added, "Your grandmother was recently diagnosed with high blood pressure. Using the Internet, find some information for your grandmother about what foods and drinks she should **not** consume." The modified, four-item version of the Hansen et al. task can be found in Appendix C. The Post-Task Questionnaire asked participants to complete a survey regarding whether any of the four factors associated with quality mentioned above (authorship, references, disclosure of ownership and/or sponsorship, and recency of information) were taken into account in the recommendation of websites for the modified Hansen et al. (2003) items (see Appendix D). This information provided a measure of the subjective importance of each of the four criteria to participants in association with the objective quality ratings assigned by the experimenter to recommended websites.

Demographics and level of experience with computers and the Internet were also obtained.

Performance Measures

Camtasia (http://www.techsmith.com/camtasia.asp) is a screen and audio capture software that enables recording and playback of the user experience. The software was used to document such information as the search techniques used to find information online and the websites that individuals selected to review. Each participant's workstation had partitions on the front, left, and right sides and was equipped with an IBM PC-compatible computer. The workstations were also equipped with Internet connectivity and web-browsing capability using Microsoft Internet Explorer 8. A standard PC keyboard and mouse was used.

Performance was assessed through tracking and evaluating search time, number of searches performed, number of websites visited, time spent on-task, accuracy of provided answers, and quality of recommended sources for health search task answers. The real-time appearance of each computer screen was recorded via Camtasia software. Answers to all questions were maintained in a Microsoft Word document to enable increased accessibility and usability by participants and ease of response documentation. Online health information evaluation behaviors were reflected in the answers that participants provided (search time, number of searches, number of websites visited, and accuracy) and through review of the screen capture recordings and the content of the websites (quality of source score) individuals recommend as an informative source for their hypothetical family members. Participants were not informed in advance of the criteria used to score their responses in order to acquire data that is as reflective as possible of how individuals would normally search the Internet outside of the laboratory. The search time and accuracy of answer data were participant-centered, while the quality of source scores was based on the content of the web pages. This naturalistic data collection informed methodologies on how to improve actual search techniques and strategies used by individuals in their everyday Internet pursuits. Ordering of the search task items and presentation of keywords were counter-balanced to minimize ordering- and carry-over effects (see Appendix F).

Accuracy of responses were evaluated using a 5-point scale (0 – 4 range) with the following options: 0 = no responses/no correct information, 1 = 1 correct piece of information, 2 = 2 correct pieces of information, 3 = 3 correct pieces of information, and 4 = 4 or more correct pieces of information. Search task items were developed in an effort to ensure that 4 or more correct pieces of information would comprise an accurate and comprehensive participant response. Higher scores reflect better accuracy. Given that health-related constructs often have many appropriate and inter-related pieces of information, accuracy was assessed using an additive approach. This method was employed to allow for the complexity of the health information domain where multiple bits of information can be combined to develop a more cohesive understanding of a condition and its associated treatment.

Quality of source was evaluated on the following criteria: authorship (author of the material is clearly listed with some description of their credentials), references (citations and/or links to original research publications are provided), disclosure of ownership and/or sponsorship, and recentness of information (Childs, 2005; Childs, 2004; Harland & Bath, 2007; Maloney, Ilic, & Green, 2004). These four dimensions are the most consistent factors described across publications in the quality of online source literature that can be scored objectively by a non-expert in the health domain. The four dimensions of quality were rated using a 5-point scale (0 – 4 range). Scores of "0" resulted from the absence of authorship information, no available citations, no clearly identified owner/sponsor of the website, and for websites that have not been updated within the past 12 months. Websites that clearly provide information regarding authorship, references, ownership/sponsorship, and have been updated less than 12 months ago received a "+1" score for each of the four dimensions. Thus, participant-recommended sites that received a 0 total score had low observed quality and websites with a total score of 4 had very high-observed quality. The final three dependent variables included: number of websites visited, total time spent on task, and number of web searches performed. These performance measurements were compiled through screen capture review of participants' internet search performance.

Procedure

Participants were briefed on the nature of the study, completed the consent form, and the demographics form. Participants then completed the four Hansen et al. (2003) health information search tasks. Participants were afforded up to forty minutes (10 minutes maximum per search) to complete the four search tasks. Participants were asked to report the source where they found their web search answer. The SAS was administered prior to each search task to evaluate how initial reactance and keyword exposure may have been influenced by appraisals. Finally, participants were lastly administered the post-task questionnaire regarding what factors played into the selection of source websites where their answers originated. At the end of the experiment, participants were debriefed.

RESULTS - STUDY 1

Accuracy of Search Task Responses

To test the hypothesis that keyword provision (provided, not provided) and appraisals (challenge, threat) would interact to influence performance metrics, a series of two-way ANOVAs were computed. Table 1 presents the means and standard deviations for each performance metric, by experimental condition and stressor appraisal. The first performance metric to be examined was accuracy of participant response. Accuracy was evaluated using a 0 to 4 point scale that corresponded to the number of correct pieces of information included in participants' answers.

For the diabetes search task item, keyword provision did not significantly affect the accuracy of participant responses, $F(1, 56) = .01$ $p = .94$. Stressor appraisals did not affect accuracy, $F(1, 56) = .01$, $p = .94$. They did not interact to affect accuracy, $F(1, 56) = .28$, $p = .65$. For the high blood pressure search task item, neither keyword provision, $F(1, 56) = .25$, $p = .61$, nor stressor appraisals affected accuracy, $F(1, 56) = 2.06$, $p = .16$. The interaction effect was non-significant, $F(1, 56) = 3.17$, $p = .08$, but was trending toward significance. Table 1 shows that although participants were generally accurate (averaging above 3 when 4 was the highest accuracy score), when not provided a keyword and challenged, they appeared to have relatively lower accuracy responses compared to when they were threatened, which was unexpected.

For the Paxil search task item, neither keyword provision, $F(1, 56) = .39$, $p = .54$, nor stressor appraisals had a significant effect on accuracy, $F(1, 56) = .032$, $p = .86$. Their interaction did not affect accuracy, $F(1, 56) = .271$, $p = .61$. Again, for the smoking cessation search task item, neither keyword provision, $F(1, 56) = 1.51$, $p = .22$, nor stressor appraisals , $F(1, 56) = 3.14$, $p = .08$, significantly affected accuracy. However, the main effect of stressor appraisals on accuracy was marginal. Table 1 shows that threatened participants tended to have more accurate responses than challenged individuals. The interaction of keyword and appraisals on accuracy was non-significant, $F(1, 56) = .31$, $p = .60$.

Quality of Source Recommendations for Health-Information Websites

Quality of sources were evaluated with a two-way ANOVA, with keyword provision and stressor appraisal group as the independent variables (see Table 2). For the diabetes search task item, keyword provision marginally affected quality of source recommendations, $F(1, 55) = 3.05$, $p = .08$. Participants who were provided keywords tended to recommend higher quality sources than did those who did not receive keywords. Stressor appraisals did not affect quality of recommendations, $F(1, 55) = .005$, $p = .94$. There was no interaction of keyword with appraisals on quality of sources for the diabetes item, $F(1, 55) = .046$, $p = .83$. For the high blood pressure item, neither keyword provision, $F(1, 55) = 1.02$, $p = .31$, nor stressor appraisals of challenge or threat, $F(1, 55) = 1.12$, $p = .29$, affected the quality of sources recommended. However, the interaction effect was significant, $F(1, 55) = 4.66$, $p < .03$, indicating that quality scores are influenced by the interaction of both keyword provision and challenge and threat appraisals. Threatened participants who received no keywords had significantly lower quality recommendations compared to challenged participants who received no keywords and threatened participants who received keywords.

For the Paxil search task item, neither keyword provision, $F(1, 56) = .20$, $p = .66$, nor stressor appraisals affected the quality of recommendations, $F(1, 56) = .15$, $p = .70$. There was no interaction effect for quality of responses, $F(1, 565) = .01$, $p = .94$. For the smoking cessation item, keyword provision, $F(1, 55) = .27$, $p = .60$, nor stressor appraisals of challenge or threat affected quality of recommended sources, $F(1, 55) = .34$, $p = .56$. There was also no interaction effect for quality of sources, $F(1, 55) = .23$, $p = .64$.

Number of Websites Visited for each of the Search Tasks

The average number of websites participants visited during each search task was evaluated with a two-way ANOVA, with keyword provision and stressor appraisal group as the independent variables (see Table 3). For the diabetes search task item, neither keyword provision, $F(1, 56) = 0.06$, $p = .81$, nor stressor appraisals affected the number of websites visited, $F(1, 56) = 0.95$, $p = .34$. However, the interaction effect was significant, $F(1, 56) = 8.60$, $p < .01$. The number of websites visited was significantly influenced by the interaction of keyword provision and challenge and threat appraisals. Challenged participants who did not receive keywords visited significantly fewer websites compared to both challenged participants who did receive a keyword and threatened participants who received no keywords.

For the high blood pressure search task item, keyword provision moderately affected the number of websites participants visited, $F(1, 56) = 2.92$, $p = .09$. Participants who received keywords tended to visit more websites than those who received no keywords. Stressor appraisals of challenge or threat did not affect the number of websites visited, $F(1, 56) = .31$, $p = .58$. There was no interaction of keyword provision and stressor appraisals on the number of websites visited for the high blood pressure item, $F(1, 56) = .458$, $p = .50$. For the Paxil search task item, keyword provision trended toward significance, $F(1, 56) = 2.75$, $p = .10$. Challenged participants who received keywords visited fewer websites than did those who received no keywords, especially compared with challenged participants who did not receive keywords. Stressor appraisals of challenge or threat did not affect the number of websites visited, $F(1, 56) = 1.94$, $p = .17$. The interaction was not significant, $F(1, 56) = 2.56$, $p = .11$. For the smoking cessation search task item, neither keyword provision, $F(1, 56) = 1.66$, $p = .20$, nor stressor appraisals of challenge or threat affected the number of websites visited, $F(1, 56) = 1.25$, $p = .26$. The interaction was not significant, $F(1, 56) = .01$, $p = .94$.

Time on Task for each of the Search Tasks

The average amount of time (in seconds) that each participant spent completing the search tasks was evaluated with a two-way ANOVA, with keyword provision and stressor appraisal group as the independent variables (see Table 4). For the diabetes search task item, keyword provision was found to significantly affect the amount of time on task, $F(1, 56) = 5.82$, $p < .05$. Stressor appraisals did not significantly affect time spent on tasks, $F(1, 56) = .006$, $p = .94$. There was also a significant interaction, $F(1, 56) = 8.67$, $p < .01$. Challenged participants who received keywords spent significantly longer reviewing diabetes-related websites than did both challenged participants who did not receive keywords and threatened participants who did receive keywords.

For the high blood pressure search task item, neither keyword provision, $F(1, 56) = 1.38$, $p = .24$, nor stressor appraisals of challenge or threat affected time on task, $F(1, 56) = .00$, $p = .99$. However, the interaction effect trended toward significance, $F(1, 56) = 2.79$, $p = .10$. For the high blood pressure item, challenged participants who did not receive keywords spent less time on task than did challenged participants who were provided keywords. There was no effect for threatened participants regardless of whether keywords were provided.

For the Paxil search task item, neither keyword provision, $F(1, 56) = .086$, $p = .77$, nor stressor appraisals of challenge or threat affected time on task, $F(1, 56) = .014$, $p = .90$. Also, there was no interaction effect, $F(1, 56) = .537$, $p = .47$. For the smoking cessation search task item, neither keyword provision, $F(1, 56) = .371$, $p = .54$, nor stressor appraisals of challenge or threat affected participant time on task, $F(1, 56) = 1.54$, $p = .22$. There was no interaction effect, $F(1, 56) = .022$, $p = .88$.

Number of Web Searches Performed for each of the Search Tasks

The average number of web searches performed for each search item was evaluated with a two-way ANOVA, with keyword provision and stressor appraisal group as the independent variables (see Table 5). For the diabetes search task item, neither keyword provision, $F(1, 56) = 2.49$, $p = .12$, nor stressor appraisals of challenge or threat affected the number of web searches performed, $F(1, 56) = .11$, $p = .75$. There was also no interaction effect, $F(1, 56) = .87$, $p = .36$. For the high blood pressure search task item, neither keyword provision, $F(1, 56) = .21$, $p = .65$, nor stressor appraisals of challenge or threat affected the number of web searches, $F(1, 56) = .11$, $p = .75$. There was no interaction effect, $F(1, 56) = .87$, $p = .36$.

For the Paxil search task item, keyword provision was not significant, $F(1, 56) = 1.03$, $p = .31$, nor was there an interaction effect, $F(1, 56) = .10$, $p = .79$. Stressor appraisals did affect the number of web searches performed, $F(1, 56) = 5.70$, $p = .02$. Challenged participants performed significantly more web searches for Paxil-related health information compared to threatened individuals. For the smoking cessation search task item, neither keyword provision, $F(1, 56) = 1.72$, $p = .20$, nor stressor appraisals of challenge or threat, $F(1, 56) = 1.79$, $p = .18$, affected the number of web searches that participants performed. There was no interaction effect, $F(1, 56) = 0.30$, $p = .59$.

DISCUSSION – STUDY 1

The first study examined the influence of the provision of targeted keywords and stressor appraisals, challenged vs threatened, on individuals' search strategies and behaviors while using health information websites. It was expected that providing keywords and being challenged would improve performance, and that these conditions would interact to further enhance people's ability to gather health-related information.

Accuracy of Search Task Responses

There was no significant effect of keyword provision or stressor appraisals on the accuracy of the diabetes and Paxil search tasks. There was a marginal interaction effect for the high blood pressure (HBP) item, suggesting that threatened and challenged individuals respond differently when provided keywords for this condition. Threatened participants who did not receive keywords provided marginally more accurate responses compared with all other groups, while challenged participants who did not receive keywords had the least accuracy. For threatened individuals, keywords may have engendered a rapid and shallow, "match and advance" approach that could have led to reduced accuracy. Threatened participants with access to keywords could therefore successfully match keyword-associated constructs with those found in web searches without the need to apply deeper processing for the high blood pressure related information.

Stressor appraisals trended toward significance for the smoking cessation item; threatened individuals tended to outperform all other groups in terms of accuracy of responses. This finding, when taken in combination with the marginally significant interaction for the HBP item, suggests that threatened participants who do not receive keywords were more accurate than challenged individuals (with or without keywords) and threatened participants (with keywords). While this finding is counter-intuitive to previous literature regarding stress appraisals and performance, it could be logical to assume that threatened individuals experienced a greater motivation to provide accurate responses either to demonstrate skill or because the hypothetical referent facing HBP or smoking-related health issues resonated more with these specific participants. This may be due to threatened individuals being more impacted, either themselves or a close friend/family member, by the highly common conditions of high blood pressure or smoking addiction in the general population. These motivations, coupled with no capability to quickly "match and advance" their answers by using keywords, perhaps required threatened participants to engage in more active and robust processing of HBP and smoking health information, leading to their improved accuracy scores for those particular items.

Quality of Recommended Sources

There was a marginally significant interaction effect for the diabetes item indicating the presence of a keyword improved quality of sources recommended by participants. Keywords may have focused the selection of sources that reflected more of the core search terms associated with diabetes. Perhaps keywords facilitated more in-depth evaluation of source quality by serving as a scaffold for review and comparison of the associated constructs identified by the keywords. Increasing the saliency of core constructs and considerations related to diabetes may have supported more critical evaluation of supporting data used to judge source quality, such as the recentness and pedigree of the source, and being compiled or written by authors with relevant licensure, certifications, or relevant training/career experience.

There was a significant interaction between keyword presence and stressor appraisals for the HBP item. This finding suggests that for challenged individuals, keywords led to selection of lower quality sources and, for threatened individuals, a keyword led to substantially higher quality source recommendations. This inverse relationship is interesting and may point to a possible relationship for threatened participants where keywords support dismissal of less reputable sources and reinforces the selection of higher quality websites; whereas, to a lesser degree, challenged individuals may feel as though they are comfortable enough with the task to disregard keywords and utilize their own internal evaluation criteria for quality rather than relying on the constructs identified by the keywords. At least for the diabetes and HBP domains, targeted keywords play a role for threatened individuals with the provision of focused search terms leading to much higher quality recommendations.

Number of Websites Visited for Search Task Completion

There was a significant interaction between keyword provision and stressor appraisals for the diabetes search item. Threatened individuals that did not receive a keyword visited substantially more websites than did threatened individuals that did receive a keyword. The opposite trend appears for challenged participants, with keywords prompting substantially more website visits than those with no keywords. "Match and advance" search techniques could have occurred for threatened individuals that received keywords (e.g., checklist style matching of keywords on a website at a surface level), while challenged participants may have utilized keywords for the diabetes item as a means to energize their search and expand their evaluation criteria, leading to more websites visited overall.

For the HBP item, keyword provision trended toward significance in terms of the number of websites visited. For both challenged and threatened individuals, the presence of keywords served to increase the number of websites visited. Keywords, for the HBP domain, may therefore have served as a set of criteria for assessing the utility of a website for accuracy, comprehensiveness, and trustworthiness. Given the higher prevalence of poor quality websites associated with HBP-related content in general, keywords may have provided the impetus to perform a more rigorous evaluation and pursuit of quality information in order to sufficiently address the constructs introduced and related to the keywords. There were no significant relationships between the variables of interest and performance on the Paxil and smoking cessation items.

Time on Task for each Search Item

The diabetes item demonstrated a significant main effect of keyword provision and a significant interaction effect for time on task. Once again, as with number of websites visited for the diabetes item, threatened individuals demonstrate shorter total search behaviors when presented with keywords and challenged participants engage in substantially more extensive search behaviors when provided a keyword (keyword – M = 434 seconds, 7.2 minutes; no keyword – M = 279 seconds, 4.65 minutes). Challenged participants may feel increased comfort with the task and are willing to further explore the diabetes construct to foster a deeper understanding of the issue rather than threatened participants that may be choosing to employ a more shallow and rapid "match and advance" strategy once they identify a source that reflects the item requirements and keyword-primed content well enough.

There was a marginally significant interaction effect for the HBP item. Again, as with the Diabetes item, participants that were challenged *and* were provided keywords demonstrated substantially longer time on task than if they received no keywords. Threatened participants that were provided keywords showed slightly less time on task than those whom were not provided with keywords. This suggests that for challenged individuals, keywords supported them in exploring websites a bit and included more intensive and elaborative review of the health information content. Threatened individuals utilized keywords to more quickly match the primed constructs with available material on websites before feeling as though they had satisfied task requirements. There were no significant findings for either the Paxil or smoking cessation items in terms of time on task differences between conditions.

Number of Web Searches Performed for each Search Task Item

There were no significant differences for the average number of web searches performed for the diabetes, HBP, or smoking cessation items. These findings echo previous research that indicates most people employ a very shallow web search strategy that almost always involves only one-to-two searches at most. The majority of individuals only view the first page of search results (Hansen, et al., 2003) and select an answer from those results; that finding is reflected here as well. Stressor appraisals were found to have a significant effect on the number of web searches performed for the Paxil item. Challenged individuals completed significantly more web searches for Paxil-related health information compared with threatened individuals. This finding, despite low variance observed in searches, (Total: $M = 1.25$ searches; Challenged: $M = 1.40$ searches; Threatened: $M = 1.07$ searches) echoes Schneider, Rivers, and Lyons (2009) in which it was observed that challenged individuals exhibit approach and elaboration behaviors, while threatened individuals exhibit task avoidance and less elaboration in their task behaviors.

The results from Study 1 revealed several findings with potential implications for how people interact with and consume online health information. Stressor appraisals and keyword provision demonstrated moderate influence on the accuracy of participant responses. Threatened individuals who did not receive keywords outperformed all other groups in terms of accuracy of responses. This result may be related to recent research suggesting stress and anxiety can lead to more focused attentional allocation to increase task-related processing and motivation to cope with the situation (Vater, Roca, & Williams, 2015). For quality of sources recommended by participants, keyword provision and stressor appraisals of challenge or threat interacted to influence responses. Threatened individuals who were provided keywords recommended higher quality websites, while challenged individuals who were provided keywords recommended the poorest quality sources. Keywords therefore seem to be utilized differently in quality of source estimations depending on the level of challenge or threat that participants experience for the diabetes and HBP search tasks.

Regarding the number of websites visited, keyword provision and stressor appraisals demonstrated a significant interaction for the diabetes search item. There was an inverse relationship for websites accessed in that threatened individuals that did not receive a keyword and challenged individuals that were provided keywords accessed the highest number of websites. Again, keywords seem to be utilized uniquely based on one's stress appraisal of the situation. Threatened users may increase search efforts and mental processing in response to not having keywords in their repertoire, while challenged individuals seemed to be energized by keywords and increased their search efforts accordingly. Time on task results demonstrated similar patterns, in that challenged participants provided keywords spent the most time completing their searches.

Challenged participants that did not receive keywords spent the least amount of time on task. This could suggest that keywords provide focal cues indicative of a need for more in-depth processing and personal motivation and exploration for challenged participants. The alternate relationship exists for threatened participants as keywords reduced the amount of time on task, and the lack of keywords led to increased search times. Finally, there was a significant difference found between the number of web searches performed for the Paxil item. Challenged individuals performed significantly more searches than did threatened individuals regardless of keyword provision.

STUDY 2 METHOD

Study 2 was conducted to examine the unique health information-related search behaviors of individuals with visual disabilities on the same modified Hansen et al. (2003) tasks employed in Study 1. Keyword presentation was alternated for the items in Study 2; however, a purely qualitative approach was utilized due to very few available participants that use screen readers. General comparisons between Study 1 and Study 2, as well as novel approaches to online health information search techniques for screen reader users, are presented below.

Participants

Participants were two undergraduate students with visual disabilities who utilize a screen reader, and were enrolled in introductory psychology courses at a midwestern university. Of these, one was female and one was male with a mean age of 19.5 years (age range: 19 - 20). Their ethnicity was White, Non-Hispanic. Volunteers were given course research credit in their undergraduate psychology courses, and were treated in accordance with the “Ethical Principles of Psychologists and Code of Conduct” (American Psychological Association, 1992).

Materials

All materials were identical to those used in Study 1. In addition, Study 2 utilized JAWS for Windows screen reading software (http://www.freedomscientific.com/products/fs/jaws-product-page.asp). JAWS enables on-screen text to be read out loud for individuals with visual disabilities.

Procedure

The procedure for Study 2 was almost identical to Experiment 1. The same performance metrics were collected for Study 2 as in Study 1. Due to the limited availability of blind screen reader users, a qualitative-based investigation of online health search behaviors and techniques was adopted for Study 2. Participants were asked to perform the four search tasks using the same items and keywords provided to participants in Study 1. Participants were instructed to use talk-aloud and describe their search techniques and any problems or unique phenomenon encountered during their web searches. The researcher unobtrusively observed participants as they performed the four search tasks. A post-task interview was conducted with participants at the conclusion of their study session.

RESULTS - STUDY 2

Given the limited number of screen-reader users available, a qualitative approach was employed to understand the data obtained in Study 2. The observations made by researchers and discussions held with the participants with visual disabilities are summarized below to provide insights into how this sample of individuals access, review, and utilize online health information. Recommendations for more effective information architecture and web design for individuals with visual disabilities are also presented in this section.

An interesting general consideration is the fact that screen reader software, when not used with headphones, broadcasts all search results audibly; as such, with personal or potentially embarrassing health conditions or illnesses, screen reader users face a unique dilemma in the question of whether or not they should postpone searches until they are in a private location or have access to headphones. This realization can be less than ideal in situations when someone requires immediate or important health-related guidance to make decisions about their wellness. Even in situations where headphones are available, low vision individuals rely heavily on their aural perception to navigate and interact with the environment. Thus headphones are not always optimal because the user may need to "disconnect" from the moment and/or dual attend to their environment and critical search results. Without headphones, there is the potential of having health information search content broadcast to people nearby, or even foregoing searches until a later time that could be too late for immediate support of one's health needs. One of the participants stated that, “It’s hard because I don’t want to have everyone hear what I’m searching for, but I also don’t want to feel like I need to plug in my headphones and sort of disconnect from what’s going on around me when I’m in public.” It is important for creators, designers, and custodians of online health information, as well as medical professionals, to understand that this phenomenon exists and plays a role in how screen reader users access and utilize, or fail to utilize, digital wellness content.

Several interesting observations regarding online search behaviors and techniques emerged during this research. The foremost observation made by researchers was the high frequency employment of keyboard shortcuts during search task completion. Participants made extensive use of popular shortcuts, such as: Control key + C/V/Z keys to copy, paste, and undo commands, and less well-known keyboard combinations such as the Alt key + Tab key to toggle between active windows, Alt + left and right arrow keys to move forward and back between webpages, Ctrl + enter key to add a prefix (www.) and a suffix (.com) for completing webpage addresses, and the Insert key + Enter key to move to the body text on a webpage. Almost all searching and scanning behaviors were performed with keyboard shortcuts despite navigation within a webpage often being problematic due to unlabeled or poorly labeled page elements, such as images, hyperlinks, page divisions, and text containers (e.g., introduction, body text, conclusion, etc.). Shortcuts that should direct users to a particular section or page element were often not accurate or not labeled and would transfer to an undesired section of the page or do nothing at all.

Extraneous links, including images, advertisements, and related stories or material, proved to be obstacles to effective searching and identification of relevant health information. On several occasions, users believed they were copying specific text but instead were inadvertently capturing and pasting in images, links, and other visible but not appropriately tagged material into their responses. Users also mistakenly clicked on these extraneous links and images routinely as they traversed the health information webpages. On one instance, an advertisement pop-up video automatically played when accessing a new webpage and required a browser and JAWS reboot because the code embedded within the video conflicted with JAWS.

One of the participants stated, “It would be really great if there could be more cooperation between hardware and software companies to ensure that their products work smoothly with JAWS. It’s sometimes easier to shut everything down and restart when I encounter a major error. That results in lost work and progress though, which is really frustrating and time consuming.” These poorly or unlabeled links, images, videos, and advertisements were definite obstacles to screen reader users. Extensive use of keyboard shortcuts and the real need for accurate, comprehensive, and reliably implemented alternative text, meta-tags, and page navigation dividers truly emphasize the importance of these technical conventions to screen reader users.

Mental workload is therefore substantially higher for screen reader users due to the reality of navigating pages filled with obstacles including advertisements, poor alt text for images and links, and links for extraneous or unrelated information, listening to large swathes of text being read and limited scanning capability as a result of ineffective page divisions, and the need to utilize a large array of different keyboard shortcuts. These factors all generate additional complexity for low vision users searching for health information. The inherent serial navigation approach makes rapid scanning and filtering within pages increasingly more difficult and time consuming, leading to more frustration and errors in accessing and understanding the appropriate health data. No search tasks were completed by either screen reader user in under 10 minutes compared with 5.40 minutes on average for non-screen reader users. This finding reinforces that there remains a large amount of work to be done to improve the web browsing experience for individuals with visual disabilities that utilize screen readers to access online health information.

DISCUSSION for both Study 1 and 2

Both studies described above were conducted to evaluate the online search behaviors of individuals with and without visual disabilities within the health information domain. Given the critical importance of health information accessed via the web, there remains real issues with the accessibility and usability of this digital content for all users (Berland et al., 2001; Gilmour, 2007; Morahan-Martin, 2004). The current research employed a mixed empirical (Study 1) and qualitative design (Study 2) to investigate how different user groups search for and recommend health information sources via the

Internet. Also, to specifically assess the influence of keyword provision and stressor appraisals of challenge or threat upon online health information search behaviors.

The SAS has been significantly correlated with performance across a wide array of performance situations, but had not been implemented in an Internet search task in previous research. The demonstrated moderate to strong significance of the influence of stressor appraisals for certain search tasks indicates that it could be fruitful to further explore the role cognitive appraisals play in other online and personal computing behaviors such as completing job and school applications, shopping and commerce, scheduling academic courses, booking flights and hotels, etc. Training could also be developed to assist users in developing more effective search strategies, selecting reference information from websites that are of a higher quality and pedigree, and making decisions and seeking recommendations that are more scientifically and medically sound. This research also presents several implications for designing and implementing more user friendly websites for both fully-sighted and individuals with visual disabilities through a better understanding of the ways in which users encounter both screen-reader and software-based obstacles.

Generalization of the study's results to other domains should be cautiously applied given the limitations of the current research. A small sample, composed mostly of college freshmen participating for course credit could skew Internet search behaviors results in a manner that more diverse groups of individuals may not demonstrate. This is a strong consideration for the applicability of the results gleaned from the qualitative examination of screen-reader users as well. There are a wide array of interaction elements and techniques available for web browsing, in general, and health information search behaviors, in particular. Different experiences with assistive technology and levels of familiarity with the online experience and health-related websites could have a strong influence on the results reported for the current research. Therefore, a larger and more diverse participant sample of screen reader users would provide greater statistical power and confidence in the theoretical and applied interpretations of results for future research.

There were also ceiling effects noted in participant performance metrics; especially for the average accuracy of responses across the items. This finding indicates that search tasks were perhaps too easy for participants and may therefore artificially restrict the utility of the results. However, search tasks were designed and implemented utilizing previously published research protocols to accurately reflect vignettes that actual users encounters on a daily basis (Hansen, et al., 2003). Ceiling effects, for participants without visual disabilities, could be a result of the online health-information landscape that includes thousands of websites dedicated to a single health issue or condition. Future research could explore how to develop search tasks that are more intricate or complex based on the relative obscurity of the topic to account for factors such as ubiquitous nature of the condition, number of websites associated with that issue/condition, lengthy or intricate procedural components to treatment and health maintenance, and the degree to which experts agree on optimal treatment strategies.

An additional consideration that was not addressed in the current research includes the rapid expansion of health information content into mobile applications and tele-health initiatives. Accessing and understanding the Internet via alternative platforms and various web portals adds additional layers of dynamism to the health-information search experience. The influence of handheld computing, haptic feedback, eye and head-tracking interaction, and speech-to-text interfaces will undoubtedly impact how individuals search for and ultimately digest digital content. Future research into how these emerging technologies moderate search behaviors in the health information arena is critical to informing standards and best practices to support efficient and effective knowledge acquisition for all users regardless of their preferred platform or disability.

Conclusions

The current research results indicate that keywords and stressor appraisals of challenge or threat do influence participant performance of health-related, online search tasks. The overall trend identified here suggests that for particular health conditions, especially for diabetes and high blood pressure, threatened individuals that do not receive keywords and challenged individuals that do receive keywords demonstrate what is typically considered to be more effective performance. This inverse relationship is interesting and denotes that the interaction of keyword provision coupled with individual differences play a role in how people access and understand online health information content.

The differential application of keywords by threatened and challenged participants has implications for the user experience and the types of search strategies employed to obtain health-information. Particularly, it may be advantageous for keyword presentation to be user-selectable and filterable given the nature of personal relevance of the task and availability of condition-specific health information. Self-assessment of whether users wish to receive keywords via a filtered search approach where keywords have been applied for similar searches by the web community could also be included, refined, or excluded based on personal and contextual factors. The customizable approach to web searches via keyword preferences may afford users with differing perceptions (challenge or threat) of the task with a mechanism for exerting additional control and building fluency in their pursuit of high quality and accurate health information online.

Table 1. Mean Accuracy of Responses (SD)

	Keyword Absent		Keyword Provided	
Search Task	Threat	Challenge	Threat	Challenge
Diabetes	3.40 (1.26)	3.56 (1.03)	3.56 (1.03)	3.44 (1.29)
High Blood Pressure	3.91_{a} (0.30)	3.13_{b} (1.09)	3.35_{b} (0.99)	3.44_{ab} (0.96)
Paxil	3.78 (0.94)	3.63 (1.09)	3.80 (0.63)	3.88 (0.34)
Smoking Cessation	3.40_{a} (0.88)	2.57_{b} (1.22)	2.76_{ab} (1.56)	2.33_{ab} (1.73)

Note. Simple effect differences were calculated. Different subscripts indicate significant differences between groups.

Table 2. Mean Quality of Recommended Sources (SD)

	Keyword Absent		Keyword Provided	
Search Task	Threat	Challenge	Threat	Challenge
Diabetes	1.60_{ab} (1.26)	1.31_{a} (1.25)	2.30_{b} (1.22)	1.83_{ab} (1.34)
High Blood Pressure	1.10_{a} (1.30)	2.31_{b} (1.57)	2.30_{b} (1.31)	1.90_{ab} (1.54)
Paxil	2.61 (0.92)	2.50 (1.15)	2.70 (0.50)	2.63 (0.81)
Smoking Cessation	1.63 (1.16)	1.67 (1.07)	1.65 (1.45)	2.00 (0.87)

Note. Simple effect differences were calculated. Different subscripts indicate significant differences between groups.

Table 3. Mean Number of Websites Visited (SD)

	Keyword Absent		Keyword Provided	
Search Task	Threat	Challenge	Threat	Challenge
Diabetes	3.10_{a} (1.45)	1.69_{b} (1.01)	2.13_{ab} (1.02)	2.83_{ab} (1.80)
High Blood Pressure	2.45 (1.63)	1.90 (1.71)	2.94 (1.75)	3.00 (2.03)
Paxil	1.72_{ab} (1.01)	2.81_{a} (2.20)	1.70_{ab} (1.10)	1.62_{b} (0.72)
Smoking Cessation	3.80 (2.21)	3.21 (2.33)	3.12 (1.83)	2.44 (1.81)

Note. Simple effect differences were calculated. Different subscripts indicate significant differences between groups.

Table 4. Mean Time Spent on Task (SD) presented in seconds

	Keyword Absent		Keyword Present	
Search Task	Threatened	Challenged	Threatened	Challenged
Diabetes	362.70_{ab} (102.83)	279.75_{b} (135.36)	347.31_{b} (108.24)	434.70_{a} (84.81)
High Blood Pressure	334.20_{ab} (104.80)	286.75_{b} (103.00)	320.18_{ab} (108.51)	367.70_{a} (115.90)
Paxil	284.72 (139.10)	254.81 (121.80)	248.60 (146.54)	270.31 (128.10)
Smoking Cessation	371.20 (83.34)	327.64 (117.84)	347.50 (131.10)	313.22 (144.13)

Note. Simple effect differences were calculated. Different subscripts indicate significant differences between groups.

Table 5. Mean Number of Web Searches Performed (SD)

	Keyword Absent		Keyword Provided	
Search Task	Threatened	Challenged	Threatened	Challenged
Diabetes	1.20 (0.42)	1.13 (0.50)	1.38 (0.62)	1.44 (0.70)
High Blood Pressure	1.64 (1.02)	1.50 (1.03)	1.53 (0.62)	1.81 (0.75)
Paxil	1.11_{ab} (0.32)	1.50_{a} (0.82)	1.00_{b} (0.00)	1.31_{a} (0.60)
Smoking Cessation	2.55_{a} (1.23)	2.30_{ab} (1.33)	2.30_{ab} (1.31)	1.70_{b} (0.71)

Note. Simple effect differences were calculated. Different subscripts indicate significant differences between groups.

APPENDIX A – STRESSOR APPRAISAL SCALE (SAS)

Variant A Directions: Using the responses provided below, please place an "x" next to the selection that best describes how threatening you feel the upcoming online health information search task will be and/or your ability to cope with the task. Please keep in mind that you **will be** receiving relevant search keywords to assist you in the upcoming search task as you answer the following questions.

Variant B Directions: Using the responses provided below, please place an "x" next to the selection that best describes how threatening you feel the upcoming online health information search task will be and/or your ability to cope with the task. Please keep in mind that you **will not be** receiving relevant search keywords to assist you in the upcoming search task as you answer the following questions.

1) How stressful do you expect the upcoming task to be?
Not at all stressful
Not very stressful
Somewhat stressful
Moderately stressful
Extremely stressful

2) How threatening do you expect the upcoming task to be?
Not at all
Not very
Somewhat
Moderately
Extremely

3) How demanding do you think the upcoming task will be?
Not at all demanding
Not very demanding
Somewhat demanding
Moderately demanding
Extremely demanding

4) How well do you think you can manage the demands imposed on you by this task?
Not at all well

Not very well
Somewhat well
Moderately well
Extremely well

5) How able are you to cope with this task?
Not at all able
Not very able
Somewhat able
Moderately able
Extremely able

6) How well do you think you will perform this task?
Not at all well
Not very well
Somewhat well
Moderately well
Extremely well

7) How important is it for you to do well on this task?
Not at all important
Not very important
Somewhat important
Moderately important
Extremely important

8) To what extent do you think you will need to exert yourself to deal with this task?
Not at all
Not very
Somewhat
Moderately
Extremely

9) How uncertain are you about what will happen during this task?
Not at all uncertain
Not very uncertain

Somewhat uncertain
Moderately uncertain
Extremely uncertain

10) How much effort (mental or physical) do you think the situation will require you to expend?
No effort
Minimal effort
Some effort
A fair amount of effort
An extreme amount of effort

Appendix B – Hansen, Derry, Resnick, & Richardson (2003) Search Task

1. Your aunt was just told she has diabetes. She isn't sure what kinds of food she can or can't eat. Using the Internet, find some information for your aunt about what foods she should or should not eat.
2. A friend recently started taking a drug called Paxil for depression. He seems to be tired all the time, and even falls asleep in class. Use the Internet to find out if the drug might be making him sleepy.
3. Your older brother has a problem with drinking too much alcohol. He wants to go to a local Alcoholics Anonymous meeting. Use the Internet to find a place to help him find a local meeting.
4. You want to get an HIV test, but you don't want anyone to know. You also don't have any money to pay for it. Use the Internet to find a place to get a free and confidential HIV test.
5. For class, you need to learn about medicine that can help people stop smoking. Using the Internet, find the names of these medicines.
6. You are about to get a tattoo, but a friend warned you that some places spread infections like HIV and hepatitis. Use the Internet to find out if this is true.

Appendix C – Modified Hansen, Et Al. (2003) Search Task

Health-Related Questions

The following questions will require you to use the Internet to find information for specific health-related conditions or concerns. Many people use the Internet to search for health information in order to improve the health and overall quality of life for themselves and their friends and family. In this study, you will be asked to provide an answer and a link to a web page that you feel would be a good place for your family member or friend to begin their health-related Internet search.

You will have up to 10 minutes to complete each of the four individual search tasks. Feel free to use any Internet search techniques that you typically use when you find information online. Please provide a written answer and the source(s) for where you found that answer in the answer and source section provided underneath each search question. You may recommend more than one source, but please limit recommendations to three or fewer websites. Please feel free to use the "copy and paste" function as much as you would like. If you have any questions at any point in your search process, please notify the experimenter immediately. Once you have finished each individual search task, please wait quietly and do not use the computer for any other purpose or your cell phone until the next question is administered.

Question 1

Your aunt was just told she has diabetes. She isn't sure what kinds of food she can or can't eat. Using the Internet, find some information for your aunt about what foods she should eat.
Keywords: Diabetes Diet, Carbohydrates, Fats, Proteins, Fiber, Glycemic Index, and Dietary Guidelines

Answer: **0 (no response/no correct information) – 1 (1 correct answer) – 2 (2 correct answers)-3(3 correct answers) – 4 (3+ correct answers)**

Carbohydrates (45-65% of daily calories): vegetables, fruits, beans, and whole grains; Fats (25-35% of daily calories): olive, peanut, canola oils, fish, flaxseed, nuts, avocados; Protein (12-20% of daily calories): Fish, soy, and poultry.

Source(s):
http://www.umm.edu/patiented/articles/what_general_guidelines_a_diabetes_diet_000042_2.htm

Question 2

A friend recently started taking a drug called Paxil for depression. Use the Internet to find the most common side effects that your friend should know about before taking Paxil.
Keywords: Paxil, Paroxetine, Aropax, Seroxat, Most Common Side Effects, Adverse Effects

Answer: **0 (no response/no correct information) – 1 (1 correct answer) – 2 (2 correct answers)-3(3 correct answers) – 4 (3+ correct answers)**

Nausea; Excessive Gas; Decreased Appetite; Sexual Dysfunction; Dizziness; Nervousness; Problems in urinating; Congestion; Sleepiness or Trouble Sleeping; Sweating

Source(s): http://www.mayoclinic.com/health/drug-information/DR601687/DSECTION=side-effects
http://en.wikipedia.org/wiki/Paroxetine#Side_effects

Question 3

For class, you need to learn about prescription medicine and commercially available, over-the-counter products that can help people stop smoking. Using the Internet, find the names of these medicines and products.
Keywords: Quit Smoking, Pharmaceuticals, Nicotine, Over the Counter, Patch, Lozenge, Chewing Gum
Answer: **0 (no response/no correct information) – 1 (1 correct answer) – 2 (2 correct answers)-3(3 correct answers) – 4 (3+ correct answers)**

Prescription Medicine: **Varenicline (Chantix®) , Bupropion (Zyban®), Nicotrol Inhaler and Nasal Spray**; OTC Products: **skin patches** (brand names Habitrol and Nicoderm); **chewing gum** (Nicorette); **lozenges** (Commit)

Source(s): http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm198176.htm

Question 4

Your grandmother was recently diagnosed with high blood pressure. Using the Internet, find some information for your grandmother about what foods and drinks she should **not** consume.
Keywords: Foods to Avoid, High Blood Pressure, Saturated Fats, Sodium, Alcohol, Cholesterol

Answer: **0 (no response/no correct information) – 1 (1 correct answer) – 2 (2 correct answers)-3(3 correct answers) – 4 (3+ correct answers)**

Avoid foods that are: high in saturated fat and cholesterol (red meat, fried foods, baked goods, crackers, and cookies); high in sodium (pretzels, potato chips, frozen dinners, canned soups and vegetables); contain alcohol (beer, mixed drinks, liquor).

Source(s): http://www.mayoclinic.com/health/high-blood-pressure/HI00027/NSECTIONGROUP=2
http://www.livestrong.com/article/23182-foods-avoid-people-high-blood/

Appendix D – Post-Task Questionnaire

1. Did you take into account whether an author was listed for the websites you recommended?

    If "Yes": Please place an **X** next to each item in which authorship played a role in your recommendation.

    i. Paxil ____
    ii. Smoking Cessation ____
    iii. Diabetes ____
    iv. High Blood Pressure ____

2. Did you take into account whether references and citations were listed on the websites you recommended?

    If "Yes": Please place an **X** next to each item in which references/citations played a role in your recommendation.

    i. Paxil ____
    ii. Smoking Cessation ____
    iii. Diabetes ____
    iv. High Blood Pressure ____

3. Did you take into account whether a website was updated less than 12 months ago for the websites you recommended?

    If "Yes": Please place an **X** next to each item in which recency of information played a role in your recommendation.

    i. Paxil ____
    ii. Smoking Cessation ____
    iii. Diabetes ____
    iv. High Blood Pressure ____

4. Did you take into account whether a webpage was sponsored by a company or third-party organization for the websites you recommended?

    If "Yes": Please place an **X** next to each item in which sponsorship played a role in your recommendation.

    i. Paxil ____
    ii. Smoking Cessation ____
    iii. Diabetes ____
    iv. High Blood Pressure ____

5. Please provide the name of the webpage(s) you used to answer the question regarding Paxil. Answer:
6. Please provide the name of the webpage(s) you used to answer the question regarding Smoking Cessation.
   Answer:
7. Please provide the name of the webpage(s) you used to answer the question regarding Diabetes. Answer:
8. Please provide the name of the webpage(s) you used to answer the question regarding High Blood Pressure.
   Answer:

Appendix E – Demographic Data Form

Please complete this demographic form. All responses made to testing materials will be assigned a random identification number, and will be stored separately from any personally identifying information in order to ensure your anonymity is maintained. No personally identifying information will be included in any analyses of data obtained from this study, or in the written report detailing the results of this study.

Please write in your answer to each of the following questions in the space provided.

Which of the following best describes your Race/Ethnicity:
Caucasian; African American; Hispanic/Latino; Asian, Native American; or Other
Answer:

What is your Age in years?
Answer:

Is your Gender male of female?
Answer:

Which of the following best describes your highest Education Level:
High School; Freshman in College; Sophomore in College; Junior in College; Senior in College; Graduate Student in College; or Post-College
Answer:

How much time per week (in hours) do you spend using a computer?
Answer:

How much time per week (in hours) do you spend using the Internet?
Answer:

Do you have computer access at home?
Answer:

Do you have Internet access at home?
Answer:

What Internet search engines do you use when looking for information online?
Answer:

On average, how many health-related Internet searches do you perform per month?
Answer:

Appendix F – Counter-Balancing Structure For Study 1

Counter-Balanced Task Ordering for Study 1

Subject	A	A	B	B
1-7	Diet 1	Diet 2	Med 1	Med 2
8-14	Diet 2	Diet 1	Med2	Med 1
14-20	Med 1	Med 2	Diet 1	Diet 2
21-28	Med 2	Med 1	Diet 2	Diet 1
Subject	B	B	A	A
1-7	Diet 1	Diet 2	Med 1	Med 2
8-14	Diet 2	Diet 1	Med2	Med 1
14-20	Med 1	Med 2	Diet 1	Diet 2
21-28	Med 2	Med 1	Diet 2	Diet 1

Note. "A" refers to the provision of search keywords and "B" refers to the absence of search keywords. Twenty-eight university students without visual disabilities (four blocks of seven counter-balanced participants) will receive search keywords in their first two trials, and twenty-eight university students without visual disabilities (four blocks of seven counter-balanced participants) will receive search keywords in their final two trials.

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