

Inclusive Interface Design for Seniors: Image-Browsing for a Health Information Context

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This study explores an image-based retrieval interface for drug information, focusing on usability for a specific population—seniors. Qualitative, task-based interviews examined participants' health information behaviors and documented search strategies using an existing database (www.drugs.com) and a new prototype that uses similarity-based clustering of pill images for retrieval. Twelve participants (aged 65 and older), reflecting a diversity of backgrounds and experience with Web-based resources, located pill information using the interfaces and discussed navigational and other search preferences. Findings point to design features (e.g., image enlargement) that meet seniors' needs in the context of other health-related information-seeking strategies (e.g., contacting pharmacists).

Introduction

The proper identification and use of medication is an ongoing concern in the health care community, particularly for individuals who take many different drugs for a host of ailments. As the general population ages (and as life expectancy rates increase), seniors are increasingly faced with complicated medical regimes. Sorting pills and ensuring that certain medications are taken at particular times of the day or

with meals can be a daunting task for many patients. Visual and motor impairments, which occur as individuals age, make sorting, holding, and identifying pills a challenge. At the same time, health-related Web-resources (including drug information Web sites) are increasing in number, and regularly targeted to consumers, such as patients and their caregivers. This project was designed to explore the viability of a prototype, visually based interface that would meet seniors' specific searching and retrieval needs within the context of their general health-related information behaviors. As pharmaceutical companies and third-party providers continue to develop Web-based resources aimed at consumers, taking seniors' particular needs into account becomes increasingly important. The prototype interface presented in this article was designed to bridge the physical (e.g., vision-related) and cognitive-emotional (e.g., issues of trust related to health information) needs of seniors in the design of an image-based retrieval system. Prior to exploring the results of the study, it is important to first explore the broader context of health-related information behaviors and inclusive design principles that inform this project.

Background and Rationale

The Drug Information Context

Elderly patients may have every intention of following medical advice, but physical and cognitive decline, as a result of aging or illness, can adversely affect medication regimens.

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Logue (2002) notes, for example, that memory deficit is one of the most common causes of medication misuse, and can result in double-dosing, forgetting to take pills, or changing the medication schedule. Loss of vision or manual dexterity may also adversely affect medication use, particularly where patients are unable to read instructions, to open and close bottles, or simply to hold onto pills without dropping them. Existing research points out that seniors are particularly prone to negative drug interactions, hospitalizations, addictions, etc., as a result of improperly identifying their medications (e.g., Alemagno, Niles, & Treiber, 2004; Gleckman, 2003; Logue, 2002). Ahrens (2003) found that nearly one in three elderly home-care patients had experienced a medication error. Jorgensen, Johansson, Kennerfalk, Wallander, and Svardsudd (2001) found that seniors living at home used multiple drugs extensively and had a difficult time organizing their pills. Although some seniors use pill diaries, stopwatches, week-by-week or month-by-month pill cases, and other strategies to successfully manage their medications, others continually struggle to manage their care (see Metley et al., 2005; Neafsey & Shellman, 2002; Simonson & Feinberg, 2005).

Some innovative projects have been developed to increase awareness of drug-management and drug-information problems (e.g., Neafsey, Strickler, Shellman, & Chartier, 2002; Voyer, 1999). Young (2002) points to the value of practitioner intervention (e.g., through drug-use reviews and computerized drug-tracking systems) to manage drug-related problems. However, little research explores the benefits (or adverse effects) of Web-based, consumer-driven drug databases in guiding seniors' management of medications or drug information. Alemagno et al. (2004) report on one project that provided seniors with laptop computers and reminder checklists to manage their pills (with very positive results); however, little is known about how seniors locate drug information with existing Web-based databases and what search features might best facilitate their retrieval of this type of information. Curtis et al. (2004) point to the value of pharmaceutical databases as important tools to ensure that use of medications is appropriate and well-monitored, but this area of research and development is in its infancy.

Seniors' Information Behaviors: The Health Context

Personal context is a central point of inquiry for current research on individuals' information behaviors. As individuals determine what is relevant or useful based on their personal situations, as well as a host of other factors (e.g., previous experience, affect, time constraints, the format of available information), scholars have examined a range of populations and use-contexts in exploring how individuals locate, use, and make sense of the information around them. As Case (2002) notes, the seeker of information "exists in an environment that partially determines, constrains, and supports the types of needs and inquires that arise [and] also has his or her own memories, predispositions, and motivations—an

internal environment of influence" (p. 226). All of these factors, taken together, affect how individuals search for and use information to support their particular needs.

Seniors' information behaviors have received considerable attention over the last few decades, and the health information context remains a core point of focus for studies concerning this population. Todd's (1984) study found that health and finance headed the list of retirees' personal concerns—a finding that continues to hold true given more recent research in this area (e.g., Williamson, 1995). At the same time, other researchers note that interpersonal contacts (including friends and family) are important sources of information for many seniors (e.g., Chen & Hernon, 1982; Wicks, 2004; Williamson, 1997), ahead of libraries, television, newspapers, and other institutionalized information channels. As people age, and particularly as they encounter health problems, access to relevant information becomes increasingly important so that individuals can play active roles in their own health care. At the same time, health-related Internet resources are increasingly used by seniors looking for preventative or treatment-based care (Leaffer & Gonda, 2000). A number of general models of information seeking have been developed and tested over the past few decades (see Niedzwiedzka, 2003 for an overview); however, additional data are needed to develop an overall model of seniors' online health information needs and searching strategies.

Access issues remain one of the most central concerns related to seniors' information behaviors, particularly for those with physical limitations. Edwards and Lewis (1998) state, for example, that "access to the printed word has long been recognized as a significant barrier to the integration of visually impaired individuals" (p. 302), including seniors. Luxton (1990) notes that people with vision impairments are slowed down by standard print resources, which may make them dependent on other people (p. 524). Studies involving only senior participants show that these individuals generally have trouble reading educational materials provided as part of a health care regime, including instructions on pill bottles (e.g., Drummond, Drummond, & Dutton, 2004; Weiss, Reed & Kligman, 1995). As the Internet continues to grow as a popular source of health information for seniors, design issues must accommodate these individuals' particular needs.

There is a wealth of health information which can be found in numerous sources, including the Internet. Today, seniors can feel empowered by the ability to search for health information through traditional means such as print resources or medical professionals, and also through other means such as Internet searching, to help in making informed health-related decisions. With aging, seniors may encounter multiple health problems, and they will need to access a wide range of reliable healthcare information in a quick and efficient manner. Seniors need to procure information if they wish to assume an active role in their own health care (Leaffer & Gonda, 2000). The increasing cost of health care and the limited visits that seniors are able to make with their doctors, are additional incentives for seniors to seek information

independently. According to Case (2002), the Internet represents a “universal venue for health-related information seeking (p. 265). A recent study of seniors’ use of online health resources in the United States found that 21% of individuals over age 65 (and 53% of 50–64 year olds) have used the Internet to locate health information—with prescription drug information being the leading health topic for these seniors (Voelker, 2005).

At the same time, Voelker (2005) notes that the American National Institute on Aging has compiled data showing the need for age-related changes to Web site designs that account for seniors’ specific needs, and (along with the National Library of Medicine) have compiled senior-friendly Web design guidelines. Age-related changes in hearing, vision, cognitive function, and motor skills affect the delivery and comprehension of Web-based health information, and may hinder older adults from using some Web sites (see Aula & Kaki, 2005). Web usability studies with older users have identified a number of useful design tips, including: fast moving objects in screen design should be avoided; 12–14-point font sizes are best for this age group; older users rely heavily on toolbar buttons and links, which must be easy to see on screen; users prefer dark type on light backgrounds; and, content should fit on one screen, to avoid unnecessary scrolling (Ellis & Kurniawan, 2000; Nielsen, 2002).

Usability Theory and Inclusive Design

Studies like these, that examine how individuals use Web-based interfaces, are also common in the area of information behavior research. Web-usability studies illuminate users’ behaviors in seeking digital resources. They examine participants’ assessments of site navigation, layout, and other design elements, as well as the ways that those individuals locate, retrieve, read, and understand the information contained in that Web site (e.g., Allen, 2002; Gullikson, Blades, & Bragdon, 2002; Palmquist, 2001; Saumure & Given, 2004). Usability testing examines whether a site can be used by specified users (e.g., new employees) to achieve specified goals (e.g., locating the organization’s mission statement), using strategies that are effective, efficient, and that satisfy the user at the end of the search (Campbell, 2001, p. 1). Usability testing explores whether users can accomplish information retrieval and information sharing tasks completely, accurately, in a timely fashion, and in ways that leave them wanting to interact with the site in the future. In general, then, usability testing has two main goals: to evaluate a site to see if the site works well and if the design suits users’ needs, and to uncover problems or stumbling blocks that may interfere with Web navigation (e.g., ambiguous labels).

Usability theory (as pioneered by Nielsen, 2000; Rosenfeld & Morville, 2002; and others) outlines core principles that place users’ information needs at the forefront of Web design. In this context, a Web site’s information architecture is designed to fulfill three main goals: (a) to organize information in a logical, usable fashion for the Web; (b) to build

simple, effective sites that are grounded in users’ needs (i.e., how they search for information and what they need from the site); and (c) to create a flexible design that will grow and change over time, as users’ needs evolve. To achieve these goals, Web design must focus on content and functionality—from the user’s perspective—including quality writing, consistency, utility, simple design, and other elements that privilege function over form (see Rosenfeld & Morville, 2002, pp. 3–15). Aesthetics are also an important consideration in design, but not to the point that the look (e.g., flash-enabled “splash” pages) subsumes the informational focus of the site. Users are easily frustrated when they cannot find the information they need, and quickly abandon even useful resources when a site is difficult to navigate, relies too heavily on gratuitous graphics, or uses inappropriate language (e.g., jargon).

Usability theory changes the focus for Web design in a project, from accounting for the designer’s needs and interests (such as testing new code), to meeting the needs of the site’s intended users. Usability-based design decisions, then, focus on the creation of clean, simple organizational structures that use clear, intuitive headings and labels. It is important that these features are tested with real users in advance of a site’s formal launch. Quick and accurate navigation and search features, as well as audience-specific criteria (e.g., multilingual access) must also be taken into account. By following usability principles, designers are also able to create sites that work well for users with visual impairments or other disabilities, as the resulting design is clean, simple, and well-labeled (and therefore, perfect for screen readers, text magnifiers, and other Web navigation tools).

Previous work on the design of browsing interfaces, in particular, suggests that there are a variety of new perceptual advantages and new opportunities for action that can be made available to seniors accessing health information (e.g., Ruecker, 2003; Ruecker & Chow, 2003). Rich-prospect browsing interfaces combine these key features: a meaningful representation of every item in the collection, with each linking to additional information; a set of tools to manipulate the display; wherever appropriate, alternative representations of data; and where possible, the tool features emerge from the characteristics of the information. In the design of the prototype examined in this study, other factors (e.g., high contrast; clear visual cues; large font size for buttons) were also taken into account in the design, based in part on previous empirical studies carried out by Strickler and Neafsey, 2002). The rich-prospect tools provided additional features of benefit for seniors, including a magnification to 2000×.

Research Questions

This study was intended to test a visually based image retrieval interface in the context of seniors’ health-related information behaviors. The research questions were as follows: (a) What are seniors’ health-related information behaviors, especially in the context of online resources?; (b) To what

extent does interface design affect the usability of online drug databases?; and (c) To what extent can visually based interface design principles facilitate the usability of online drug databases?

Data Collection Procedures

Twelve participants, all aged 65 or over and comfortable with basic computer use, were recruited for this exploratory project; six men and six women were included, ranging in age from 65 to 80. Ads were placed in seniors-only apartment buildings, public libraries, and community centers to attract individuals from a range of backgrounds. Qualitative, task-based interviews were conducted which included a 20-minute discussion of participants' general health information behaviors and a 40-minute task-based session involving searching for pill information. These tasks involved two databases: a publicly accessible, text-based retrieval system (i.e., www.drugs.com Web site; see Figure 1); and, a newly designed, visually based retrieval prototype that grouped 1000 pill images using similarity clustering (see Figures 2 and 3). The owners of the www.drugs.com Web site gave the researchers their complete database of pill images, allowing the images in the prototype to be exactly the same quality and resolution as those found in the existing

Web site. The owners also gave permission to include screen captures of their Web site in all research publications.

Participants were asked to locate information about three different pills in each of the two databases, using color images of pills (both front and back) printed on 3 × 5 recipe-style cards; 11 pills were examined, randomly assigned across the interviewees. Digital audio recordings were used to gather the interview data and to record individuals' perceptions during the task-based sessions, and were fully transcribed. Digital video was used to capture screen images during the task-based activities. A verbal analysis protocol was used to allow participants to comment on their preferences for navigation, layout, aesthetics, etc., in each interface. Task completion checklists were also used to track which search features (e.g., zoom button) the interviewees used on their own, and which ones they used only when prompted to do so by the researchers. It should be noted that participants were first asked to search for each pill using any search process or feature that they felt were appropriate; once they had done so, the researchers pointed to any additional (unused) features, so that each participant commented on all available search features. This was an important step in the design of the project as some participants simply did not see (or did not understand) particular design features; these findings are discussed in detail later in this article.



FIG. 1. The www.drugs.com interface, a text-based system for pill identification. The interface guides users through a step-wise process (based on the color or type of pill). Results appear on separate Web pages for each step, with a pill image only at the last step. Used with permission of www.drugs.com.

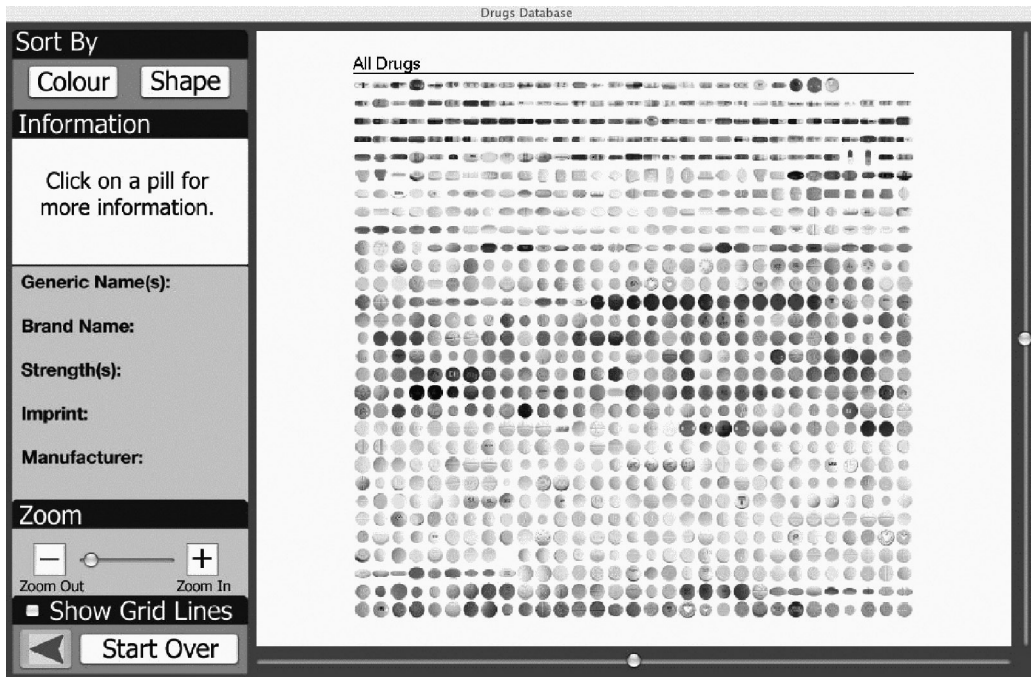


FIG. 2. The prototype—a rich-prospect browsing design that displays all pills in the collection on one screen; users search by sorting images, subsorting, and zooming in and out. Users cluster pill images by choosing similarity criteria across dimensions similar to the text-based options in www.drugs.com.

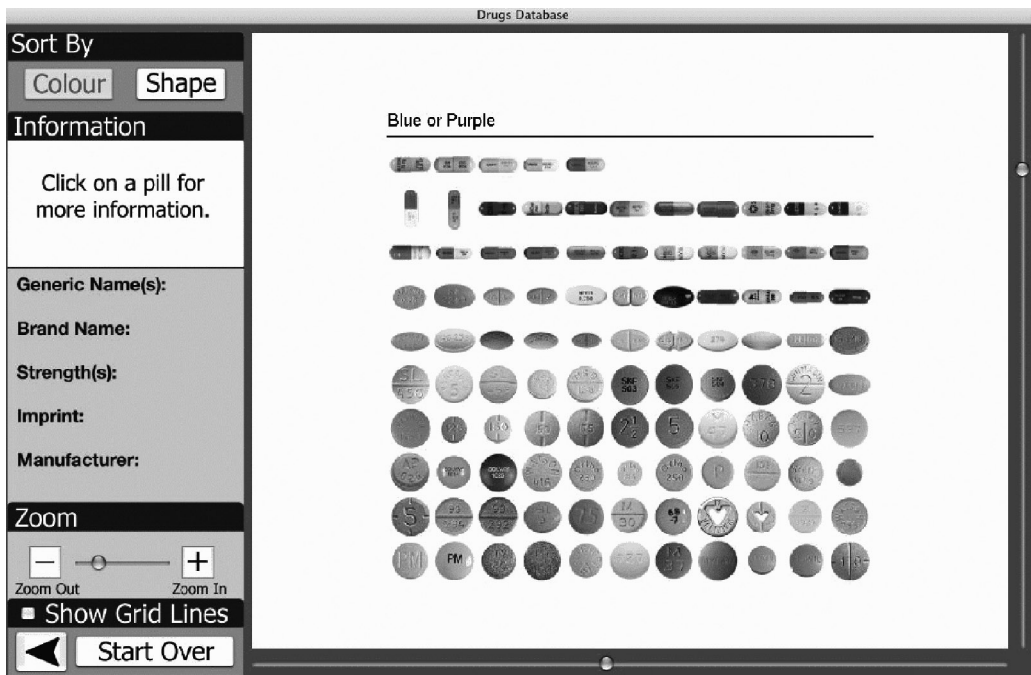


FIG. 3. The interface that appears when users sort the images by color (e.g., blue); pills can be further subsorted by shape. Users click individual images to locate drug information (e.g., generic drug name).

Findings and Discussion

Information Behaviors: Health Resources

Each participant had at least one computer in the home, and reported typical daily use between 1–4 hours; these individuals

spent a minimum of 10 minutes per day to a maximum of 3 hours a day on the Internet. It should be noted that the findings reported here might vary for individuals without computers in their own homes. Most participants reported using online resources to satisfy health-related information needs, although

they typically used these in combination with print materials. The majority described online materials as supplementary to the print materials that they consulted. The public library's Web site was cited as a useful mechanism for locating journal articles or for placing print materials on reserve for later pickup. All of the participants discussed the authority of online sources, particularly materials related to drug information. As 71-year-old Rhonda (a retired chaplain) noted, "The question is ... who wrote the information that is related to the drug company? You know... one has to become much more critical about the information that one gets [online] because there's usually some business behind that [information]." Many of the participants realized the importance of being critical of the information that they found online, but they did use the Internet as a way to locate additional information beyond that found in the print resources they could access.

In particular, the study participants reported that the pamphlets that came with their medications were very valuable sources of information. The details provided through brochures and computer printouts obtained from their physicians and pharmacists were seen as vital for a full understanding of medications and health issues. Some interviewees tracked their specific drug information with diaries (e.g., their specific reactions to new drugs), and others mentioned using pill boxes to track their medications. In addition, most of the participants reported using the Internet to locate health-related information, including drug information. Some participants discussed favorite Web sites, which were often recommended by health care workers or personal friends. Others saw the Internet as a way to search for alternative or holistic remedies for health problems. Television and radio advertising for medications were seen as generally unreliable sources of drug information.

Health Resources: People

Physicians were a major source of information about health issues, including medications; however, participants reported only rarely calling their doctors for drug-related information or making special appointments outside of their regular doctor's visits. In discussing the steps he takes to obtain drug information, 73-year-old Matthew (a retired engineer) had this to say: "Oh firstly [I talk] with my GP [general practitioner] ... secondly, with any specialist that the GP may refer me to. And thirdly, [my wife and I] have a good relationship with our pharmacist, always have done, because they're a part of the health team as it were." Although a personal physician was the logical first step for all of the participants, the interviewees also stressed that their doctors were very busy, and often did not have the time to go into details about the drugs that they prescribed. Pharmacists were generally seen to be a second important resource for these seniors, especially for drug-related questions. The participants had sought information from pharmacists on issues such as side effects and possible reactions to other medications. John, a 75-year-old retired teacher, regularly consulted pharmacists, noting "you get better information, more useful, than from

the doctors, because the doctors are usually too busy. I mean... doctors usually schedule one appointment every 10 or 15 minutes. Pharmacists are willing to take a little more time and generally speaking, I would say that they know, that they have better information, about drugs than the doctors do.

The third, commonly cited source of information for the participants was personal contacts (including friends and family), especially those working in the health care field. The seniors viewed these individuals as useful for both immediacy of access to information and for providing different opinions from those offered by physicians and pharmacists. Many interviewees described, for example, using friends and family as a way to get the "inside scoop" or "real truth" about certain drugs, side effects, and other medication-related details. However, the Internet was regularly cited as a useful supplement to all of these interpersonal contacts.

Health Resources: The Internet

Most of the participants liked searching the Internet, as they were able to find information that was very current and from a wide variety of sources. However, many also felt a great deal of frustration with using the computer, feeling that it was "confusing" and "tiring," and they often mentioned problems with "information overload." The participants found it difficult to "sift through" Internet sites, as they were often unsure of the usefulness or validity of the sites. Many of the seniors also reported being frustrated by "misinformation" on the Internet that needed to be filtered out. Other major concerns included a lack of available drug information about side effects and difficulties sorting out drug "ads" from truly informational Web sites. And, many pointed to problems with small font sizes in Web sites, as well as with more traditional print resources. Matthew noted, for example, that "on ointments and [drugs] in bottles, the print is so confoundedly fine that anybody who's getting on [in age] can't even [read these] with a magnifying glass ... so that's a serious crisis."

Search Tasks: www.drugs.com

When searching the www.drugs.com database for information on three different pills, none of the seniors could complete the task and locate information on those pills. Generally, the participants found the interface to be too crowded and confusing, and many had a hard time distinguishing between "drug search" and "Internet search." Other problems included being confused by the descriptions of the pill shapes, as there were no visuals to show the differences between the options (e.g., "tablet" shape vs. "capsule" shape), and being unable to distinguish between color categories in the search options (e.g., "black/grey" color combination from the drop down menu was often presumed to mean a pill that was half black and half grey, as opposed to this being a category including pills of both colors). In addition, many of the participants found the drug advertisements very distracting to their search tasks. As Aaron, a 70-year-old retired chemist noted at the end of one of his tasks, "Um ... well what do we have to

do? Restart this thing? Well it's already turned up no results. At that point I would give up." Many participants noted that a simpler interface with clearer options and more visuals would have been more efficient and easier to use.

Search Tasks: Prototype

Compared with the www.drugs.com site, most of the participants found the prototype much easier and quicker to use, and were able to complete all search tasks. As Vicki, a 66-year-old semiretired secretary noted, "... this one is easier to use ... because the colors are easier to identify for me. [It's] faster and simpler." Many of the seniors liked the "simpler" interface of the prototype, noting that there was less "guess work" involved in the pill identification. The pill images were described as very helpful and they found the sorting options and tools much easier to use.

However, the prototype design also raised concerns, particularly for those participants who felt "overwhelmed" with the number of pills on screen at one time. Many of the participants found the pills very hard to see and wanted larger images; although the prototype did include a "zoom" feature, most of the seniors did not see this on screen. Others did not see the "sort" feature, which would have allowed them to reduce the number of pills by color or shape. Reducing the cognitive load and highlighting available search features remains an issue, even in this simpler interface design. In addition, distinguishing between colors was a problem in both the www.drugs.com site and in the prototype. Some of the participants misjudged a pill's color, leading to a misidentification of drug information. As Martha, a 68-year-old retired social worker noted, "Well you see, they don't look very orange and brown to me. It looks like a very pale red and an off-white." Distinguishing between similar shapes (e.g., round vs. oval) was also a concern. In any visually based interface, resolution and clarity of images will affect quality of retrieval results. Although sorting by color was frustrating for the one participant in the study who was color-blind, sorting by size was much more efficient for him than in the www.drugs.com interface.

Conclusions and Future Directions

Design Considerations

Overall, although the prototype design resolved some of the search challenges encountered in the www.drugs.com Web site (such as screen crowding and complexity of search activities), additional revisions are necessary for this design to work well for this particular group of users. A few of the problems that were encountered here centered on the size and the look of the images on the screen. Some of these problems can be resolved with higher resolution; others (e.g., the large number of "round white pills" in the data set) may require additional sort features (e.g., to sort by pills with text stamped on the drug itself). The rich-prospect browsing interface used for this prototype can be improved in a number of ways. First, the transitions between the

unsorted and sorted versions are currently accomplished by swapping one display for another. Although this is a common method for moving between screens, it can be disorienting and can introduce doubt as to whether all of the pills on the first screen are actually present in the subsequent (sorted) screens. To provide some cognitive reassurance, a better strategy would be to animate the sorting of the pills.

For reasons of technical simplicity, the current prototype also used a white background for the pill images. This avoids the need for using gif image formats instead of jpegs because the transparency on gifs slows loading times for the images. However, because contrast was identified as an issue by Strickler and Neafsey (2002), it would be worthwhile to consider developing a variation of the prototype that would allow users to select a colored background. Indeed, the principles of rich-prospect interface design suggest that it may also be useful to explore alternative ways to represent the items in the collection. In this case, for example, including images of the reverse sides of the pills would be a useful search feature addition because in some cases this image contains information that could make the selection process easier. Animation to present a three-dimensional image, or that would allow the user to rotate the pill image, would be useful here.

Implications for Health-Related Information Behaviors

Many of the participants noted that they wanted more relevant information about the pills than the existing databases could provide, including drug interactions and side effects. Participants felt that they would more likely approach a pharmacist rather than trust a Web database, especially because of the possible adverse effects to their health if medications were to become confused. Despite the prevalence (and growth) of these drug resources on the Internet, Rhonda was adamant in her belief that these resources would never displace interpersonal and other trusted sources of health information—particularly for seniors; she noted "It will never work, the whole public will never get to [search like this on the Web]. That's extremely dangerous. There has to be a name attached to a pill. I don't know what the goal of this [interface design] eventually is going to be ... that people find their own ... self-medicating? It doesn't make sense They will never find the information on a computer, not old people." However, many of the participants felt that health professionals (such as pharmacists or physicians) would find this type of tool very useful, and also felt that such a database would be attractive to the "younger generation" of Internet users. In looking ahead to new designs or uses for these types of resources, pharmacies, emergency-room triage centers, or poison control centers, are possible end-users for these types of visually based search features. In addition, there are great opportunities for sharing medication information across data sources, and expanding the type of information in the database (e.g., side effects) beyond the basic information that is typically included in existing online sources. This project also points to the necessity for global approaches to indexing drug databases, as the current resources include only those pills available in the

United States, which were not accessible to the seniors in this study, who lived in Canada. By expanding the content and search features of existing drug databases, and by developing interfaces that employ inclusive design theory, the opportunities for contextually relevant use will also grow.

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