# Investigating Web Searching Behavior in Home Environments

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**The study investigated situational elements of the home as a Web use environment, examining how domestic settings influenced people's Web search activities and behaviors. Traditionally, information searches have been conducted in public places in quest of work- or school-related information. However, as greater number of people gain access to the Internet at home, a shift has occurred in both location and purposes of Web searches from public to private venues and from work to personal interests. For this study, twelve participants in ten different households were recruited in northern California. The data were collected through semi-structured interviews of an individual at home, and were based on a self-reported "Search Activities Diary" kept over a 3-5 day period. Interviews were videotaped and then transcribed for content analysis. Findings indicated that the home, indeed, provides a unique search situation in which people conduct searches in different ways from those in the workplace. The subjects in this study searched on the Web more frequently, more briefly, and less intensely for broader and more diverse information. The study results have direct implications for design of Web search systems to support Web searching behaviors in home environments.**

## Introduction

The Internet has influenced human lives in numerous ways over the past a few years, having become a mainstream information resource that people turn to for information and communication. The Pew Internet American Life Project has found that 60% of Americans have access to the Internet and that 40% of them have been online for more than three years (Horrigan & Rainie, 2002). The UCLA report (2003) also revealed that use of the Internet at home is growing steadily. In 1995, a report by the National Science Foundation showed that only about one-fifth of respondents had access to the Internet at home; since then, home access increased to 58.4% in 2001 and 59.3% in 2002. Cummings and Kraut (2002) called these changes "the domestication of the internet," claiming that a shift has occurred in both the location and purposes of Internet use. According to Cummings and Kraut, the use of computers and the Internet is shifting from places of employment to homes, from economic purposes to more pleasurable pursuits, and from work interests to more personal ones.

Before the Internet era, searching for information in information retrieval systems was traditionally conducted in public spaces such as offices, schools, and libraries, usually via commercial databases or library catalog systems. Consequently, research on information seeking behavior has focused on work-related or school-related information problems. Now that the Web, as the most popular information retrieval system, is used not only in public but also in private places, investigating Web searching behavior in home environments has become a significant research problem. Home environments provide not just different physical settings. Rather, conducting searches in the home is related to situational settings in which diverse information activities including search, use, and evaluation are taking place.

To better understand information seeking behavior and information retrieval interaction, researchers have emphasized the importance of conceptualizing situations or contexts (Cool, 2001; Cool & Spink, 2002; Johnson [in press]; Talja, Keso, & Pietilainen, 1999). However, as Cool (2001) pointed out, there is no standard definition of situation or context, and worse, context and situation are being used interchangeably in information science literature. In this study, the meaning of the term *situation* captures the environmental or ecological perspective. Some years ago, Wilson (1981) pointed out that those factors determining information seeking behavior and uses necessarily included environmental aspects such as the work environment, socio-cultural environment, and physical environment. Later, Taylor's (1991) discussion of the information use environment placed the user at the center of the social contexts; according to him, people's choices about what information is useful are based not only on subject matter but also on the other elements of the context within which users live and work. It was noted that most of studies on the context or situation of information use have focused on factors such as "where a user works" or "how the organization works," (e.g., Lamb, King, & Kling, 2003; Taylor, 1991) while paying little attention to "where a user lives" or "how user lives with information."

This study is designed to explore people's Web behavior in a conventional setting – Web users' homes – to understand real search behavior in everyday life. The focus of this study is to investigate the *home* as one kind of information use environment and identify how it influences Web search activities and behaviors in which people engage. This study attempts to analyze a variety of information search activities not necessarily limited to problem-specific information seeking in that entertainment and recreational purposes are considered as well. In this study, on the other hand, Web activity focus is on the use of the Web for finding information to the exclusion of other Internet uses such as email, instant messaging, and chatting. Basically, this study address three research questions: (1) What are the situational factors of the home as a Web searching environment?; (2) What are the characteristics of Web search activities at home?; and (3) How does the home setting affect people's Web searching behavior?

## Related Work

Although researchers in the library and information science field have paid little attention to the home as an information use environment, there have been a few studies in other areas such human computer interaction (HCI) and computer-supported cooperative work (CSCW) that have investigated various research problems on the Internet with respect to technology, home use, and system development.

Probably one of the best-known studies in this area is Kraut's HomeNet project at Carnegie Mellon University (Kraut et al., 1996). Beginning in 1995, Kraut's research group provided 93 families with Internet service and documented how family members used online services such as electronic mail, computerized bulletin boards, online chat groups, and the Web. Through various sources of data including logs, questionnaires, help requests, and interviews with families, the research group measured how people were integrating electronic communication and information services into their lives and how these services thus affect them. Researchers found that people used the Internet for pleasure: to communicate with family, friends, and strangers; to track sports and popular culture; to listen to music; to play games; and to pursue specialized interests. These pleasurable uses, while generally supplementary, were, for many people, more important than the practical uses of the Internet for jobs, school, and shopping. On the other hand, their research showed that extensive use of the Internet might have negative social consequences. For instance, greater use of the Internet was associated with declines in the size of participants' social networks, increasing loneliness and symptoms of depression (Kraut et al., 1998). There have been some criticisms about their work as they did not take into account many related factors such as demographic characteristics of heavy Internet users.

Another large-scale research project on Internet use in home environments is the HomeNetToo project of Michigan State University (Jackson et al., 2002; Jackson et al., 2001) which focused on the Internet use of low-income adults (those earning $15,000 annually) via server-logs and self-report methods. Surveys were administered during home visits at pre-trial, 1 month, and 3 months. In addition, 30 adults from 90 families participated in 2-hour home interviews and observations. The results revealed that half of the participants did not use email at all, but that the main Internet activity was information searching on the Web. Participants in the HomeNetToo project incorporated the Internet into their ongoing lives as a communication device and an information resource. They said that it supported parenting, provided convenient access to information, and even afforded escapism. For many participants, however, the Internet had a dark side. There was concern about the potential danger of the Internet to children from pornography, and users developed a variety of strategies to monitor their children's Internet use. Participants also cited frustration. For example, they perceived that the commercialism of the Internet violated their expectations about its value as an information resource. They also noted that the Internet retained novelty and Internet-use skills were slow to develop.

Mateas et al.'s (1996) ethnographic study attempted to gain a detailed understanding of "a typical day in people's home" by visiting homes and talking with family members. One interesting finding of their study was that while families spent most of their time in the family room and kitchen, the computer was located in the domestic "work space." Mateas et al. also found that much of computer activity could be characterized as communication to support emotional bonding, unlike in office spaces where computers carried out instrumental tasks.

Savolainen (1999), who has been active in the area of everyday life information seeking, conducted 23 interviews in Tampere, Finland, exploring various issues pertaining to network use, especially with respect to people's job-related and non-work information seeking. His interview results showed that the seeking of "orienting information" for purposes of staying up-to-date or monitoring daily events occurred more frequently than searches for practical or problem-specific information. In the cases of purposeful attempts to seek information, searches were limited to discrete facts or to relatively well-defined problem areas. Savolainen's study indicated that the Web searches could provide the most economic way of finding up-to-date answers to specific problems.

Recently, Hektor (2001) conducted a comprehensive study in Sweden on information seeking in the context of everyday life by investigating ten "real people" in their "real environments." His study looked at various kinds of information activities in the Internet, and was not limited to Web searches. He proposed a model of human information

behavior based on his own data analysis and relevant literature in which he characterized information use in the four parts: environment, information and communication technology (ICT)-setting, information-activities, and outcome and change. In Hektor's model, environment is taken to encompass elements of the context in terms of the people in question and the social and physical location of activities. The ICT is the part of the information use environment which includes information and communication technologies (e.g., computer, telephone, television) that are understood to be resources drawn upon in engaging in information activities. Finally, outcome and change can be seen as the individual's feelings, thoughts, and actions.

Considering the findings and limitations of these related studies, it seems clear that although there have been some attempts to explore the use of the Internet and information seeking in everyday domestic life, researchers have paid little attention to *Web searching behavior* in a detailed level in which the analyses are related to people's search goals, tasks, and search strategies. By investigating Web search behavior using multiple methodologies – interviews, diaries, and observation - this study will present findings on a greater micro-level of Web searching, an approach missing in previous studies.

## Methodology

The goal of this study was to observe, identify, and describe a range of information search behaviors in people's home environments. To achieve this, the methodology had to be qualitative and inductive. The primary data collection method was semi-structured interviews with individuals in household settings. The interviews were based on a "Search Activities Diary" in which subjects took notes each time they looked for information on the Web over 3-5 day periods.

*Sample*

There were at least two major constraints on selecting the sampled populations: the subjects had to live in northern California and had to have broadband service. The first constraint was for the convenience of researcher, who resided in California while conducting this study. The second constraint came from Excite@Home, which sponsored the larger study on which this paper is based. Excite@Home provided specialized Web portal content to the subscribers of high-speed Internet service through its cable infrastructure and was interested in studying search behaviors of broadband users exclusively. Broadband users were defined as those people who have in-home high-speed Internet connections including DSL, cable modem, and satellite links. According to the UCLA Internet report (2003), 23% of U.S. households with Internet access have high-speed Internet connections.

We contracted with a local recruiting agency to identify subjects for this sample. The staff member in a recruiting company called homes randomly from the phone book in the area of San Francisco and San Jose and when their calls were accepted seven screening questions were asked. The questions were designed to select subjects according to pre-determined criteria. We recruited people only when they affirmed that: they had a computer at home and used the Internet; they had broadband connection at home; they had not participated in any market research focus groups or interviews in the previous year; they were older than 18; and they spent time on the internet, browsing or looking for information (not including emails) more than one hour per week. We excluded those people whose job was related to: engineering, technical support, database administration, network operations, and graphic/web design. Twelve Web users in ten different households were recruited. All subjects except S02 had high-speed residential broadband connection. Characteristics of the participants are summarized in Table 1.

TABLE 1. Participant Profiles (Note: S07 & S08 are a couple in the same household; S09 and S10 are a couple in the same household).

| Subject # | Occupation | Age | Gender | Hours of Web Searching at Home | Internet Connection |
|---|---|---|---|---|---|
| S01 | Executive Director | 26-35 | F | 1 hour a day | Megapath DSL |
| S02 | Waitress | 26-35 | F | 7-10 hours a week | AOL |
| S03 | Architect | 26-35 | M | 3 hours a day | PacBell DSL |
| S04 | Homemaker | 36-45 | F | 1 hour a day | PacBell DSL |
| S05 | Executive Director | 46-55 | M | 10 hours a week | Concentric DSL |
| S06 | Meeting Planner | 26-35 | F | 4 hours a week | @Home |
| S07 | Homemaker | 26-35 | F | 1-2 hours a week | @Home |
| S08 | Attorney | 36-45 | M | 1-2 hours a week | @Home |
| S09 | Program Coordinator | 26-35 | F | 1-2 hours a day | PacBell DSL |
| S10 | Artist/Consultant | 26-35 | F | 25-40 hours a week | PacBell DSL |
| S11 | Instructional Designer | 36-45 | M | 1 hour a day | @Home |
| S12 | Supervisor | 26-35 | M | 15-30 minutes a day | PacBell DSL |

*Data Collection*

The researcher contacted each subject individually about 5-7 days prior to the interview visit and asked the subject to keep track of all search activities in the Web using the "Search Activities Diary" form which was sent by either email or postal mail. In the Diary form, participants were asked to indicate the following for each activity: what kind of information was being sought; how long each activity took; how the search was started (e.g., by using a search engine or going to a known site directly); and whether the search was successful or not.

The research team, composed of the researcher and a transcriber, visited the subjects' homes from March 7 to March 16, 2001, in various cities of northern California including San Francisco, Cupertino, Campbell, Montara, Sunnyvale, and San Jose. Data collection for each subject proceeded as follows:

- Upon arrival at a subject's home, we asked the subject to take us to a room where s/he accessed the Internet. In the room, after giving an explanation of study purpose, study confidentiality, and data collection process, we confirmed the agreement on using a camcorder. While the subject was signing the consent form, the researcher scanned the Diary form completed by the subject. At the same time, the transcriber set up a camcorder to record the computer screen and also prepared to type the interviews in her laptop computer.

- On completion of the consent form, the researcher initiated an interview by asking background questions including the hours of Internet use, the hours of Web searching, other family members who used the Internet, typical search tasks in the Web, the difference in search tasks between work and home environments, and the most frequently visited Web sites.

- The researcher then asked questions about each activity entered on the Diary form. The questions included: for what reasons were you trying to a use the search results?; what were you trying to find?; where did you start?; why did you choose a particular site (search engine)?; what were you going to do next? Although some of the questions would already have been indicated in the Diary form, the subject explained the search process in far more in detail when reporting on search experiences. The subject might have been asked to demonstrate search behaviors on a Web browser.

- At the end of the interview, the subject was asked to describe general difficulties in Web searching along with suggestions for improving the Web search experience.

On average, each interview took about 1.5 hours. The real-time interview transcriptions were later edited by viewing the videotapes. The revised transcripts were then subjected to content analysis.

*Data Analysis*

As this study was motivated by the desire to better understand real world Web searching, attempts were made to reflect the reality of data rather than merely break down the data into a certain "coding categories." To investigate home situations with respect to Web searching behavior, content analysis was primarily used to find evidence of the empirical connection between data (interview transcripts) and inferences from the data (Krippendorff, 1980). Two specific interview questions had ability to identify the situational factors of home Web use environment: (1) Are the searches you do at home different from the ones that you search at other locations, such as work or school?; (2) Since you have broadband service at home, are you using the Web in different ways than you used to? While the responses from the questions were included in the analysis, the evidence was also found in the transcripts throughout the interview when the subjects indicated home situations with respect to their Web search experiences. The data were classified whenever similar meanings were found in sentences or phrases in the transcripts. Appropriate thematic titles were then given to the classified texts.

## Results

This study presumed that the home provided a different environment for Web searches than did the workplace. In general, home is not a place where people are expected to concentrate or engage in intensive activities. For most people, home by nature offers a relaxing environment, though there may be more interruptions at home than at work. Taken into consideration, however, was the fact that many people telecommute from home, on a regular or irregular basis, so it might be difficult to argue that Web searching at home is only for non-work purposes. It should be noted that the focus of this study is not to compare work and home behavior. Rather, the emphasis is on investigating Web searching behavior in people's relatively private places with respect to their search goals, activities, behaviors, and other situational factors.

*Home Situations*

Most subjects responded that searching on the Web was a more often-used Internet activity at home than at work. They said that while they visited only a few known Web sites relevant to their job at work places, they used a much more diverse array of Web sites at home due to the fact that they had more diverse search interests. S01 said that she

did not use the Web much at work, and if she did, she used it technically: "I tend not do searches on search engines when I am at work. At home, I do. I search for all kinds of things, almost any time I think of a question." S09, who was a boathouse employee, would rarely have time to sit down and spend time on the Internet at work. S06, who had a home-based job as a meeting planner, said that she searched a broad range of subjects at home as she was "having success finding information" and "you just need to find it and pull out what you need."

It was noted that the study subjects conducted more searches at home than at their work places because there were many instances in which they looked for topics with which they were unfamiliar. In fact, Search Activities Diaries showed that search interests were quite diverse - from news, products, and health information to leisure, arts, and travel. Although there were a few topics that they searched on a regular basis, such as movies, restaurants, stocks, news, and weather and traffic reports, in most of cases, they sought a kind of information which they had never sought before. For example, S07 was looking for information about a Hindi class in the local area. S08 was planning to buy a new house, and trying to get more information on that. S09 and S10 were thinking about relocating to Oregon, and wanted to learn more about the state. S01 was taking a medicine for her cold and wanted to know about the ingredients in that medicine. These might be kinds of search topics that would occur infrequently in their lives. So when the study subjects encountered a search task in unfamiliar areas, they turned to a site devoted to the search.

It was also found that the study subjects not only searched frequently on the Web but also searched in shorter intervals and less intensely at home than at work. Diaries showed that these people spent about 10-15 minutes per search activity as they broke up their "leisure time" for Web searches. Therefore, the Web users in home environments tended to search multiple times on a certain topic, especially when the task was one important to them or one on which they had to spend a lot of money (e.g., buying a house (S08), finding a good place for vacation (S07), moving to another area (S10), and buying a digital camera (S09)). In general, they did not expect to complete their search by trying just once for this kind of task.

Searching over time on the same or evolving information problem, called "successive searching" (Lin, 2002; Spink et al., 2002), is not new. What is new in this study is that the findings showed successive searching to be related to communication and information behavior among family members. Some cases were noted in which two family members separately conducted searches on the same topic and needed to go back to the specific Web sites to discuss their search results and perhaps make decisions. This behavior mostly came out of a potential big investment (buying a house, buying a car) to smaller decisions (vacations, movies, product information).

Search alone is another important factor influencing Web search behavior at home. When people encountered search problems, there was no co-worker or "information service person" (S06) to whom they could direct questions. This is a different situation from a workplace in which one can always seek information from other people, especially, those who have knowledge either in a domain area or Web systems in general. Noteworthy was the finding that the two subjects who were working full-time at home (S06, S10) said that they wanted search engine-associated "help desks" that they could call. If that was not feasible, S06 said that she wanted a manual because "I did not grow up in technology and now I work at home." Both S09 and S10 pointed out that they would want to consult either a thesaurus or a dictionary in search engines, saying that "none of the Web sites tell you alternatives." This comment was made after S09 searched for a recipe for "roasting walnuts" in four different sites (cooking.com; marthastewart.com; iwon.com; askjeeves.com). Interestingly, S09 never changed her search term across all the sites as she could not think of any alternative terms.

*Characteristics of Search Activities at Home*
Characteristics of search activities at home can be summarized in terms of three distinct kinds of search tasks that the subjects were seeking most often in this study: entertainment information, local information, and product information. Within each category, the subjects showed interesting and consistent patterns of search.

(1) Interests in Entertainment Information
Not surprisingly, both the Search Activities Diaries and search stories coming out during the interviews showed that people often conducted home searches out of idle curiosity. S12 explicitly mentioned that he used the Web mainly for entertainment at home. S01 said that she often wanted information for recreation. Movie listings and restaurant reviews proved quite popular. Some subjects, such as S05, looked for sports information, for scores or player profiles. S01 and S10 wanted to locate song lyrics. More interestingly, as the purpose of searching was often not so much for problem-solving but rather for entertainment, subjects seemed to give up on their searches fairly easily. When not giving up, they often just "put it off." Thus, it appeared that whenever a question arose, users often spent minimal amount of time for searching, without completing their search task.

(2) Difficulties in Finding Local Information
Because of the nature of the home setting, numerous subjects sought information within their geographical area. These were the kind of searches with which many frustrations were experienced. S03, for instance, wanted

contractor information for a business development project; as he resided in San Francisco, he wanted a contractor from the immediate region. S06 and S09 had searched for more specific local information; S06 wanted to find the Kinko's in her area, and S09 was looking for the nearby HomeDepot. While S09 finally thought of Yahoo's Yellow Pages and found what she wanted, the other subjects had difficulties finding their local information because when the search query included a city name such as San Francisco, the search engines brought up numerous travel sites. S10 said that she found it annoying that she had to enter "San Francisco, California" constantly when looking specifically for entertainment information. Her wish was that the Web would remember her location.

(3) Dynamics of Online and Offline in Product Information

Searching for product information and shopping was one of the most popular home search activities. The study subjects looked for a variety of product information in terms of both topics (e.g., toys, books, houses, automobiles, groceries) and forms (e.g., prices, reviews, sales, pictures, comparison tables). One interesting finding was that the dynamics of information search and use online and offline. The subjects in this study used the Web mostly for browsing products and getting detailed product information in order to make informed decisions when buying in retail stores. Apparently, most of the subjects would look online for products and then buy in stores while they rarely browsed in retail stores and then bought on the Web. However, a subject like S09 showed dynamic behavior online and offline as follows: She searched for information on a digital camera that was a gift for her Mom who lived in Washington, D.C., narrowed down her choices on the Web, and then went to a local store such as Circuit City or Best Buy "to see it, touch it, feel it, play with it, and make sure that it's right." If satisfied with the camera, she then came back to the Web to purchase it online, then sending it directly to her mother.

*Search Behavior at Home*

In this paper, Web search behavior will be discussed with respect to the interactions among three primary factors: search goals, search systems, and search queries.

(1) Search Goals

The results of data analysis revealed at least three interesting findings about search goals associated with home settings. First, it was noted that a Web search goal was often to locate a homepage of Web site which might contain the desired information, rather than to find a certain Web page directly. Subjects were well aware that it was difficult to accomplish their search goal within one search session; thus their sub-goal was usually to identify relevant site(s) rather than relevant content. As long as they determined where to return to continue their search in the future, they considered their search successful. For

instance, the eventual goal of S03's search was to find a club at which he could entertain his friend visiting from another city. In this particular search, however, he wanted to find an entertainment site, so entered "Entertainment Search and San Francisco." Eventually he found a site called "downtown.com" and emailed it to his friend. He said that he would check out this site later and look for club information there.

It was also noted that "feeling successful" was one of the terms frequently occurring with respect to subjects' search goals. Interestingly enough, "feeling successful" did not always mean that the subjects actually found the information they were seeking. In fact, they felt successful when they found "some" information or sites to start with and then return to later. They sometimes indicated in the Diary form that the search was successful even though they did not actually solve their problems because they knew they might not finish the search within the limited time they had. S05 said that he always felt inadequate while searching the Web, also stating that "a site that makes me feel successful is the site that makes me come back. I haven't developed a loyalty because I haven't felt successful."

Arguably one of the reasons that people turn to the Web to find information is either the quest for knowledge or the opportunity to act on that information. Interestingly, the subjects did not take immediate actions based on the information when the information was associated with significant decision-making (e.g., buying a house, buying a car, taking vacations). In these scenarios subjects always said that they needed to look for more information on the Web and/or they needed to discuss this issue with their partner. In these cases the information was apparently used as reference or starting points in a protracted search process which could take months. If their search was simply out of curiosity, the Web information obtained would be used for their intellectual satisfaction but rarely for anything else. They said they shared the information with a family member (S06), or kept gathering information until the other member confirmed the information by finding another Web sites (S07). Interestingly, the instances in which subjects actually used the information for decision-making and action-taking were information searches for entertainment such as movies, restaurants, and cooking.

(2) Search Systems

The results of this study showed that general Web search engines were not the first place that the subjects turned to when they needed to look for information. If they knew a topic-specialized site dedicated to their area of interest, they would prefer to go to that site rather than general search engines such as Google or Altavista. For instance, they went to SFStation.com for movie information (S01), citysearch.com for travel and restaurant information (S03), space.com for space information (S12), nfl.com for football information (S05), and marketwatch.com for stock quotes

(S11). One reason that users preferred specialized Web sites over general search engines was that they knew that these specialized sites already had "contexts" which would help them obtain the appropriate search results. For instance, S05 explained why he would use topic-specialized sites rather than general search engines as follows: "[I] would not use Lycos or Excite to find out about a player because all these other things about the player will be retrieved... like who is his lawyer or why he isn't married yet." What S05 would be interested in was actual statistics about how a given player performed in a game, and he could find the information at NFL.com site. S03 commented similarly by demonstrating a search for a computer virus called Naked Wife. He said that if he typed in "Naked Wife and Virus" in HotBot or Excite, the system would think that he was looking for "dirty links." However, if he typed in the same query in CNN site Technology Section, that this technology-oriented site would better understand his intentions.

However, cases still abounded in which the subjects used general search engines, usually when they looked for information in unfamiliar areas. As S01 put it: "I only start at Google if I don't know anything about what I am doing." Among numerous general search engines, users had to decide which system they would select. Most the subjects, with an exception of S05, seemed to remain loyal to particular search engines; thus they usually started their searches with their "favorite engine." If they did not find what they were looking for with their favorite engine, they tended to try two or three additional search engines. Interestingly, users expressed weaker loyalty toward their second and third search engine choices than they did to their first one. That is, once their first choice failed to work for them, they tried whatever came to their minds first among several search engines. Another interesting finding was that some subjects differentiated search engines from portals, keeping their favorites separate. As a result, Google and Alltheweb.com were often selected because of "no feature" while Yahoo and Altavista were selected because of certain features such as yellow pages (S04, S09, S10, S12), maps (S04, S09), categories (S01), greeting cards (S12), image searches (S12). S12's comments are worth noting: "The reason why I use Google and I like Google so much is that they don't have a lot of other functions on there. It's like I want to have a multi-functional search engine site, and then I also want to have a simple one. And Google is my simple one that works for almost everything and then Yahoo is my second choice site to get more details like what I said before to get yellow pages or maps...things like that."

(3) Search Queries

It was found that subjects often had questions to be answered rather than search topics to be investigated. For instance, S09 said: "In my mind, it was a question. What is

a Nautical Mile?" S06's son had a tick in his hand, and she had to look for information. She expressed that the information she needed was "how to remove a tick." Another question-type search came from S12, who had recently encountered people with ash crosses on their foreheads for the first time. He knew the crosses had something to do with Ash Wednesday but did not know the exact reason. So when he got home that day, he typed in: "Why do people put ashes on their foreheads." It was interesting to note that although some activities appeared to be specific question-answering quests, others (S08, S09) insisted that they were "not looking for a specific thing." This could be interpreted that the searches were less task-oriented and in some cases loosely defined.

There were some subjects who entered search queries in terms of "type" of information source instead of "topic" of information. S05 was such a subject. His wife told him that there had been another school shooting that day (March 8, 2001). The only thing that he knew was that there was a young girl who had allegedly shot someone. Instead of typing in "school shooting," he typed in "headlines" because what he wanted to see was "today's news" or "breaking news stories." As a result, he failed to get the results that he was expecting. The reason for not using "school shooting" was that he explicitly wanted to read "a news story that's happened in the last 12 hours." He made his concern clear about the type of information source: "I don't want books about school shootings, and I don't want the psychological studies about the kids in the Colorado school shooting," nor other "stuff" such as "books or things like that." In the end, he expressed his frustration by saying "I cannot believe a search engine would not have something as obvious as news. So I know that I'm probably doing something fundamentally wrong."

Most subjects started their searches with general terms, then shifted to more specific ones. For instance, S05 started with "Kaplan" and changed the query to "Kaplan AND the concept of god" saying "I might try to narrow the search." However, there were other users such as S11 who said that his strategy was to "first try to make it very specific and the if that doesn't work, make it less specific." S11 made interesting comments: "Because you know you get millions of links that come up for very general things, so it can't hurt to be very specific... It can only help to be specific if it zeros it in, you know, to exactly what you're thinking about right away."

## Implications for Design of Web Search Systems

There are a number of significant findings in this study with direct implications for Web-based information systems. First, the study results revealed that users often looked for "sites" that contained a topic of interest when using general search engines, queries such as "travel agency" (S03) or "recipe" (S04) being examples of those.

What people expected from the search results were sites devoted to travel or recipes. Once people found their topic-devoted sites, they navigated or searched again in that topic site with more specific search terms. Spink and her colleagues (2002) analyzed approximately a million query logs over several years and found that search queries on the Web tended to be shorter than in traditional information retrieval systems; they did not, however, clearly speculated on the reasons for that finding. This study results indicate that queries that are shorter on the Web than in other IR systems may be related to different search goals on the Web, that is, to locate Web sites.

As people seek topic-specialized sites, they become increasingly knowledgeable about the kinds of Web sites. Therefore, it would be useful if search engines offered a feature allowing users to enter in which users can type in their query and preferred site at the same time. Google's "Search a Site" feature is one such step towards enabling users to restrict their search to a specific site. For example, users can enter the "movies site: www.sfstation.com" syntax in the search box to find movie information on the SFstation Web site. In offering a way to conduct searches associated with a particular Web site, this feature is certainly on the right track. But, the "Search a Site" has the limitation of being based on the assumption that users know the exact URL, which often may not be the case.

The study results have confirmed the findings of previous studies on successive searches (e.g., Lin, 2002; Spink et al., 2002): people conduct searches multiple times on the same topic, and want to continue their searching from the point which they left off. Especially in the home environment, people share computers and Internet connections with other family members. Therefore, once they leave the computer only to come back later, the computer may not have retained the screen that they left. In addition, it was found that users needed to return to a previous search process to share the information that they found with other members. For instance, a couple such as S07 and S08, who had two children, often needed to go back to the search that they had been after they put the kids to bed. Although they could bookmark a Web page, they were not able to save the process that got them there. So, they were forced to "look for the exact same information again and again."

Web users might therefore take advantage of a feature that would save their search query history. A step further, users might want to keep track of their search logs during search sessions, to avoid the getting-lost feeling as well as to find out how they reached at a certain page. Because it is easy to follow the links on the Web, users often had no idea how they got there but wanted to go back to a certain page that they had previously looked at. Keeping track logs until users exit the browser, not necessarily over extensive time periods, could be a useful support for those users' behaviors.

Not surprisingly, the study results indicate that one of the most common problems users encounter in searching the Web is coming up with appropriate search terms for their needs. In the case of S09's search activities, the same query, "roasted walnuts," had been put to four different sites. Until the interviewer pointed out, S09 even did not realize that she was repeating the exact same query without trying any different search terms. S07 was another example: she entered the search query "Hindi classes." During the interview, it was discovered that what she was actually looking for was "Hindi educational resources in the Bay area." It had not occurred to her to attempt other terms. Web search engines might also provide a feature that suggests alternative terms in a structure of specified terms, generalized terms, and synonyms. In this way, the system might better assist users in their thinking process, guiding them modify queries so as to more accurately represent their information needs. Although some search engines already offer some similar features (e.g., AltaVista's Prisma, MSN's Popular Topics), these features still have some limitations because most of the terms listed tend to be more specific, thus supporting only one aspect of diverse query reformulation patterns (Rieh & Xie, 2001). Additionally, their lists are incomplete, many providing only 5-10 terms from which to choose.

## Conclusion

As the Web has evolved into the most popular information retrieval system in everyday life, it is important to study Web search behavior in real settings, and home is obviously one such place. Probably one of the most significant findings of this study was that the home provided a unique situation in which people conducted Web searches in ways differing from those in the workplace. While the subjects visited only a few Web sites that were directly relevant to their work, they looked for many diverse kinds of information and therefore engaged in at-home search activities more frequently. One of the common patterns to emerge was that Web users conducted Web searches incrementally, involving intervals of hours or days. For these users there was rarely any urgency in the search, so there was little time pressure in terms of arriving at results even though the time spent for each search session seemed to be limited. In addition, it appears that most of the study subjects felt relaxed when engaging in search activities and even experienced enjoyment in the search process.

The second important finding was that the success of searches did not entirely depend on whether the subjects found the actual content for which they were looking; rather, success depended on whether they made a progress in the search by at least locating a site to which they could return in the future. This pattern relates to their preferences toward topic-specialized Web sites over general Web search engines. Although the subjects in this study

reported that they conducted more searches at home than at work, that fact did not mean that they always relied on general search engines for various kinds of searches. When subjects knew any topic-specific sites appropriate to their search areas, they preferred going to these sites first. And, if they did not have any sites saved or could not think of any other sites, they then turned to general search engines as the "last" search destination. When using general search engines, users' search goals were often associated with identifying a new Web site that they could bookmark for future use.

Further analyses are underway. One research question this author is examining is people's judgments about what constitutes "successful searches," and the major factors that influence such judgments. In the Search Activities Diary, the subjects took notes whether or not the search was successful, and it was noted that there were variations in how people judged a search session as "successful." By classifying search sessions as successful or not, the author will compare the goals, tasks, and search strategies taken in self-judged "successful" and "failed" searches. Another analysis underway is an exploration of search "outcomes" \with respect to post-search activities in which people engage after completing their searches. The author is particularly interested in looking at evaluation, interpretation, dissemination, sharing, and saving behaviors that may occur. Another interesting research question for exploring would be the kinds of "alternative" information seeking that might be pursued subsequent to failed searches.

A limitation of this study lies in its presumption that different search behaviors occurred at home and at work, though evidence is still lacking as to whether or how they differed given subjects' self-reported comments. In the future, it would be interesting to more directly compare Web search behaviors at home and at work with a focus on situational factors affecting Web use environments.

## ACKNOWLEDGMENTS

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