A Survey of Collaborative Web Search Practices

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ABSTRACT
Today's Web browsers provide limited support for rich information-seeking and information-sharing scenarios. A survey we conducted of 204 knowledge workers at a large technology company has revealed that a large proportion of users engage in searches that include collaborative activities. We present the results of the survey, and then review the implications of these findings for designing new Web search interfaces that provide tools for sharing.

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Web search, computer-supported cooperative work.

ACM Classification Keywords
H5.3. Information interfaces and presentation (e.g., HCI): Group and Organization Interfaces - *CSCW*.

INTRODUCTION

Web search is generally considered to be a solitary activity. All major search engines and Web browsers are designed for solo use. However, many tasks in both professional and casual settings can benefit from the ability to jointly search the Web with others. Our intuition was that such situations might be commonplace. Thus, as part of a larger survey on users' Web search habits, we included questions to determine whether people need and/or want to collaborate when searching the Web, and, if they do, what strategies they employ to collaborate given that this activity is not explicitly supported by current search interfaces.

SURVEY

Our twenty-five question survey elicited both multiple-choice and free-form responses regarding respondents' Web search habits. This survey was distributed online in November 2006 to 740 workers at a large U.S. technology company. 204 respondents completed the survey (27.6%).

Demographics

80.4% of respondents were male. Respondents' ages ranged from 21 to 61 years (median = 36). Respondents had various roles within the company: 38% were researchers, 22% were software developers, 17% were program managers, and the remaining 23% included managers, administrative assistants, attorneys, and student interns.

Respondents all self-identified as relatively sophisticated Web searchers. When asked to rate their ability to successfully find information using a Web search engine as either "novice," "average," or "expert," 73.5% chose "expert," and the remaining 26.5% chose "average." As an additional indication of search expertise, we asked how often they used a Web search engine. 91.7% responded "several times per day," 7.8% responded "once a day," and only 1 respondent indicated that he/she searched the Web less frequently than once per day.

We targeted our survey to this demographic of skilled searchers, as we suspected they might push the boundaries of envisioned usage scenarios for search tools. It is possible that the data we report may not generalize beyond this demographic; however, we believe that many of the behaviors and task types described are more generally applicable since many respondents reported collaboratively searching with people from less tech-savvy demographics (*e.g.*, spouses, parents, children, friends).

Prevalence

When asked, *"Have you ever cooperated with other people to search the Web?"*, 53.4% of our respondents answered "Yes." This figure likely underestimates the number of respondents who cooperatively search, as a subsequent question naming specific cooperative search activities received "yes" answers from more people – only 2.9% of respondents did *not* report engaging in any of the sample collaborative search activities listed in Table 1. Additionally, of the 46.6% of people who said they had *not* cooperated with others on Web search, 10.5% indicated that they had *"needed/wanted to cooperate with other people to search the Web and been unable to effectively do so."*

Frequency

We asked the 109 people who self-identified as having cooperatively searched about the frequency with which they engaged in joint Web search tasks. This data is summarized in Table 2. Over a quarter of respondents cooperated on a weekly basis, and over three-quarters on at least a monthly basis, which is surprisingly frequent given that Web search technologies do not explicitly support this type of cooperative activity.

Configurations

We also asked these 109 self-identified cooperators about their group configurations when cooperatively searching the

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Web. 22% indicated they were always co-located when cooperatively searching, 11.9% indicated they always collaborated remotely, and 66.1% reported engaging in both remote and co-located collaborative searches.

We also asked these same respondents *"What is the typical size of the group of people you cooperatively search with (including yourself)?"* 80.7% reported a group size of two people, while 19.3% reported a three or four person group, with no respondents reporting a larger group size.

Methods

To the 109 self-identified cooperators, we also asked a free-form response question: *"Please describe the method(s) by which you cooperate in order to search the Web (i.e., how is work divided among participants, what devices are used, how are results shared, etc.)"*.

Respondents reported sharing both the process (*e.g.*, search terms, search sites) and products (*e.g.*, useful links, facts found within sites) of a search with remote collaborators. They indicated three primary means of accomplishing this sharing: email, IM, and phone calls. 20.2% of people reported using email for this purpose, 19.3% used IM, and 15.6% spoke on the phone. No respondents mentioned using special tools or websites for collaboration.

Table 1. Responses by the 204 respondents about engaging in multi-user search activities associated with varying levels of collaboration on the process or products of Web search.

Collaborative Activity	**Respondents**
Collaboration on Search *Process*	90.2%
Watched over someone's shoulder as he/she searched the Web, and suggested alternate query terms.	87.7%
Instant-messaged other people to coordinate real-time Web information-seeking.	30.4%
Divided up responsibilities for a search task among several people, and then shared the results.	18.1%
Collaboration on Search *Products*	96.1%
E-mailed someone links to share the results of a Web search.	86.3%
Showed a personal display to other people to share the results of a Web search.	85.3%
E-mailed someone a textual summary to share the results of a Web search.	60.3%
Called someone on the phone to tell them about the results of a Web search.	49.0%
Printed Web pages on paper to share the results of a Web search.	41.2%
Created a document (other than a Web page or email) to share the results of a Web search.	34.3%
Used a large form-factor or projected display to share the results of a Web search.	24.5%
Created or posted to a Web page to share the results of a Web search.	15.2%

One aspect of the search process on which respondents cooperated was the generation and refinement of query keywords. Although we did not ask about this specifically, 22.0% of respondents mentioned that they cooperated by brainstorming or suggesting keywords to others. Example descriptions included:

- "[We] brainstorm in a group for the best keyword."
- "[We make] joint proposals on query refinement."

When all participants in a joint search task had their own computer available to use, the group tended to use one of two search strategies: *divide-and-conquer* or *brute force*.

The *divide-and-conquer* strategy involved explicit coordination and planning, such as assigning different search engines or reference sites to different group members, explicitly dividing up the space of keywords among group members, or explicitly dividing the search task into sub-tasks for each group member to undertake (*e.g.*, planning a vacation divided into finding plane tickets, finding hotels, and finding tourist attractions). For example:

- "[We] use different search engines, search terms."
- "If the search has various aspects we might split them and each of us would do a part of it."

The *brute force* strategy, on the other hand, did not involve any explicit coordination of the search process. Instead, all parties searched separately, possibly duplicating the efforts of other group members, and results were merged afterwards. For example:

- "We both search independently using our own individual strategies. Whomever comes up with an interesting result sends it to the other. We usually share results through e-mail or, less commonly, through Instant Messenger."

This class of strategies sometimes takes on aspects of a "race," to see who can find the information fastest. In fact, seven respondents in our survey used vocabulary like "race" or "contest" to describe their multi-user search strategies, giving descriptions such as:

- "I've had Google-races."
- "There is less a division of labor here, than a competition to

Table 2. Frequencies of collaborative actions by respondents who explicitly said they cooperated on Web search (n=109).

Frequency of collaborating on Web search	**Respondents**
Daily	0.9%
Weekly	25.7%
Monthly	48.6%
Yearly	24.8%

see who can come up with the most interesting (or entertaining) results."

Co-located users sharing a single device tended to follow a *backseat driver* approach, where one person controlled the mouse and keyboard and the other(s) looked over the "driver's" shoulder, suggesting either keywords to enter or links to examine in more detail; such behavior could be considered an "over the shoulder learning" interaction [12]. 87.7% of all respondents reported having engaged in this type of behavior. Example descriptions included:

- "If we are in the same room, typically one person 'drives' and the other looks over his/her shoulder and offers suggestions as needed."
- "[We] look at the same screen and one person does the search while the other advises and does 'backseat driving.'"
- "It was more like extreme programming where one person was driving and the other giving suggestions for better results."

Tasks

The 109 self-identified collaborators were also asked to *"describe the task (or tasks) for which you have executed a cooperative Web search."* Although the responses were free-form, there were quite a few common themes in the tasks people indicated cooperating on, spanning both business and personal topics (see Table 3).

Purchasing items online (for personal or business use) was one major task undertaken through cooperative Web search. In addition to general online shopping tasks, two sub-categories of shopping were specifically mentioned often enough to deserve separate note: making travel reservations and looking for real estate. For instance, "Researching travel info for a group trip, to match budgets & personal tastes (flights/airfares, accommodations, rental cars, restaurants, local attractions/activities)."

Searching for medical information relevant to an ill family member was also identified by several respondents as a cooperative activity. For example, one respondent described cooperating with his spouse on an internet search while "Diagnosing why our baby was sick one evening."

Table 3. Percent of people (n=109) whose cooperative search task descriptions included the following:

Task	% of Respondents
Travel planning	27.5%
General shopping tasks	25.7%
Literature search	20.2%
Technical information	16.5%
Fact finding	16.5%
Social planning	12.8%
Medical information	6.4%
Real estate	6.4%

Social planning tasks (choosing a restaurant, finding movie schedules, preparing for a party) were frequently cited as multi-user Web search activities. For instance, one user described cooperatively searching when "Looking for a good movie to view together, either in-theatre or rental; picking a local restaurant."

Job-related tasks were also mentioned frequently. For our survey population, which contained several researchers and software engineers, finding references for a jointly-authored report was a common multi-user search task, as was searching for technical information (APIs or SDKs, or the meaning of mysterious error messages). One respondent noted, "I have searched for balanced cuts in hypergraphs with my coauthors."

Finally, general fact-finding (in support of a discussion or debate, for curiosity, or to assist a child with homework) was also a task that was sometimes carried out through a joint Web search. One respondent mentioned that he jointly searched the Web "to find more information about a topic that we have just had or started a discussion about."

Obstacles

Respondents also described occasions when they had wanted to perform a cooperative Web search, but were unable to. The following responses illustrate the key themes that we saw throughout the survey as to why current search interfaces don't adequately support cooperation:

Theme 1: Desire to parallelize task without unnecessary duplication of effort. "We were trying to do a lit search but we both have different strategies for how we traverse the space. It was difficult to do together (because we wanted to follow different paths) and doing it together was less productive, however, when we did it separately we weren't sure how much redundant information we were gathering."

Theme 2: Difficulty in helping remote collaborators to navigate to the same content for shared context/focus. "We were in separate houses, both searching for hotels online. Difficulty is in comparing hotels. Things like 'go to Google. Type X. Click the third result. See the link on the left that says "more"? Click that. The second hotel is called Y – how does that look to you?' are inefficient, but eventually get the job done."

Theme 3: Not realizing the need to share the results of a search until after it is finished. "Not realizing I wanted to share the key pages of information gain across the session until after it was complete. Browser history mechanisms are too weak to figure out the good stuff in the trail."

Theme 4: Inadequacy of search UIs for teaching search skills to/assisting novice users. "Helping less computer-savvy users search the Web (e.g. my parents). Resolved by doing the search myself and then emailing the links."

DISCUSSION

Our survey results indicate that collaborative Web search is a surprisingly common activity, yet is not adequately

supported by existing tools. Based on these findings, we offer design recommendations for enhancing Web browsers and/or search engine sites to provide a more effective collaborative searching experience.

Providing awareness of the activities of remote collaborators would enhance multi-user search experiences. A common scenario reported in our survey was that people collaborated to brainstorm keywords or to offer query reformulation suggestions to each other. Making users aware of the keyword syntax and combinations entered by their partners can help avoid undesired duplication of effort and assist novice searchers by making them aware of more expert vocabulary and syntax. Duplication of effort can also be reduced by having a collaborative search interface visualize which results have already been viewed by other members of the group. Providing a text or voice communication channel would also be valuable; in our survey, users reported using phones, instant messaging, and email to communicate with others and coordinate the search process. Integrating communication directly into the search application reduces the overhead of this type of coordination, as well as making it possible to capture this aspect of the process for later review. Integrated communication could also be time-correlated with open webpages to automatically create tags or comments.

Storing a search session in a persistent format is important for facilitating asynchronous collaboration. Information relevant to the search session should be captured and saved implicitly, since respondents reported that they didn't always realize when they began a search task that they would need to share the process or products of their search with others. A persistent search session should include not only the final websites (or portions thereof) that contain the results sought, but should also include information such as the keywords and search engine used to find those results, since this information helps collaborators understand what techniques have already been tried and how to interpret the authoritativeness or appropriateness of the results.

RELATED WORK

This research adds to a body of literature that uses surveys, observation studies, interviews, and log data to understand the way that people use the Web and the way that they conduct Web searches, such as [2], [3], [9], and [10].

Our survey highlights the surprisingly high level of cooperative Web search behaviors users engage in, despite the fact that these behaviors are not directly supported by standard search tools. A few prior studies have also found evidence of cooperation during searching activities. For example, Large *et al.*'s fieldwork [4] found that elementary-school students often collaborate during information-seeking tasks, both due to limited computer resources in classrooms and due to group-based assignment pedagogies. Twidale *et al.*'s study of college students [11] identified several ways in which students collaborated while using the library's database searching terminals.

Researchers have also introduced some device- or domain-specific technologies for facilitating collaborative search. For instance, TeamSearch [6] allows up to four co-located people to use a digital tabletop to search through tagged photo collections. Maekawa *et al.*'s system [5] allows co-located users with Web-enabled mobile phones to improve their visual search efficiency by dividing a Web page up among each of their screens.

CONCLUSION

We have presented data from our survey of 204 peoples' Web search habits, which reveal that users often collaborate over both the process and products of search. We provided detailed findings on the types of tasks that motivate cooperative search among our survey demographic, as well as details of the frequency and group configurations of these multi-user search episodes, the methods used to collaborate, and the obstacles to effective collaborative Web searching. We hope that this information motivates the creation of new interfaces and interaction techniques to support cooperative search. Based on these findings, we have begun to explore this design space by creating the SearchTogether [8], S^3 [7], and CoSearch [1] collaborative search systems.

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