

# Multitasking Web Searching And Implications For Design

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**This paper presents findings from a study of users multitasking searches on Web search engines. A user's single session with a Web search engine may consist of seeking information on single or multiple topics. Limited research has focused on multitasking search and the implications for Web design. Incidence of multitasking search by AlltheWeb.com and Excite Web search engine users were filtered from transaction logs. Findings include: (1) multitasking Web searches are a noticeable user behavior, one tenth of Excite users and one third of AlltheWeb.com users conducted multitasking searches, (2) multitasking search sessions are longer than regular search sessions in terms of queries per session and duration, (3) both Excite and AlltheWeb.com users search for about three topics per multitasking session and submit about 4-5 queries per topic, and (4) there is a broad variety of search topics in multitasking search sessions. The implications of our findings for Web design and further research are discussed.**

## Introduction

Cognitive psychologists have studied many aspects of multitasking or task switching (Carlson & Myeong-Ho, 2000; Miyata & Norman, 1986). Rubinstein, Meyer and Evans (2001) found that multitasking between different types of tasks can reduce productivity. Recent information retrieval (IR) studies suggest that users' searches may have multiple goals or topics (Miwa, 2001) and occur within the broader context of their information-seeking behaviors (Cool & Spink, 2002). Spink, Bateman & Jansen (1999) and Spink, Wilson, Ford, Foster & Ellis (2002) show that users often conduct related searches over time on the same or evolving single topic or *successive search*.

Spink, Ozmutlu & Ozmutlu (2002) show that IR searches often include multiple topics, during a single search session or *multitasking search*. Spink, Batemen & Jansen (1999) found that eleven (3.8%) of the 287 Excite users responding to a Web-based survey reported

multitasking searches. However, limited knowledge exists on the characteristics and patterns of multitasking searches. The objective of the study reported in this paper is to further examine the prevalence and characteristics of multitasking Web searching.

## Research Design

The Web search engines used in this study were the AlltheWeb.com search engine, located in Norway and the U.S. and the Excite search engine located in the U.S. The data for the study was collected on December 20, 1999 at the Excite search engine and February 6, 2001 at the AlltheWeb.com search engine. The Excite dataset consisted of 1.7 million queries, but a random sample of 10,016 queries was selected from the entire dataset. Similarly, a sample of 10,007 queries was selected from the entire AlltheWeb.com transaction log of 1.2 million queries.

In the Excite and AlltheWeb.com data log structure, the entries are given in the order they arrive. New user sessions were identified through a user ID and each query is given time stamps in hours, minutes and seconds.

The analysis included in this study were: (1) the arrival statistics of multitasking user sessions and their queries (2) the duration per user session (2) the number of topic changes per multitasking session and (4) the topics in multitasking Web search sessions.

The multitasking search sessions were sifted manually from the dataset. We qualitatively analyzed each search session to identify different topics in the multitasking search sessions. We classified search sessions as multitasking sessions if the user's topic switch was fairly distinct. For example, a user begins to search for information on black jaguar cars and then shifts to searching on Italian operas.

## Results

### *Session and query arrival statistics for multitasking sessions*

For the Excite dataset, of 1000 user sessions, 114 (11.4%) were multitasking Web search sessions. For the

AlltheWeb.com dataset, 307 sessions (31.8%) of 964 user sessions were multitasking sessions. The 114 multitasking Excite sessions included 1709 queries, whereas the 964 multitasking AlltheWeb.com sessions had 4434 queries.

AlltheWeb.com users seem to be more interested in multitasking searching than Excite users, since they submitted almost three times more multitasking Web search sessions and queries than Excite users. Both groups of users submit almost the same number of queries per multitasking session.

The mean queries per multitasking search session were 14.9 for Excite and 14.3 for Alltheweb.com users. The mean queries per session for the entire Excite sample was 10, making Excite multitasking sessions about 50 percent longer than regular search sessions. The same statistics for the AlltheWeb.com dataset shows that the mean queries were 10.3 for the entire sample and 14.3 for multitasking sessions.

The increase in the mean queries per session was due to the multi-topic query sessions resembling a combination of single topic sessions. The session and arrival statistics can be seen in Table 1. The distribution of queries per multitasking search session for Excite and AlltheWeb.com datasets can be seen in Figures 1 and 2.

Table 1. Session and query characteristics for multitasking search sessions

	Excite 1999 Sample	AlltheWeb.com 2002 Sample
Total sessions	1000	964
Number multitasking search sessions	114	307
Percentage of multitasking search sessions	11.4%	31.8%
Total queries	10,016	10,007
Number of queries in multitasking search sessions	1709	4434
Percentage of queries in multitasking search sessions	17.1%	44.3%
Mean queries per session	14.9	14.3
Mean duration multitasking sessions	8500.8	17190.5 sec.

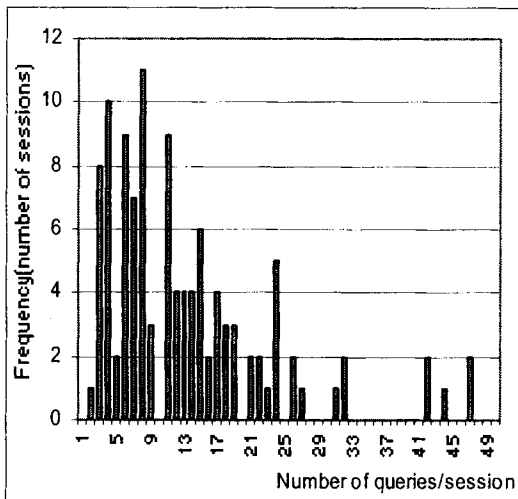


FIG. 1. Distribution of queries per multitasking session - Excite 1999 dataset.

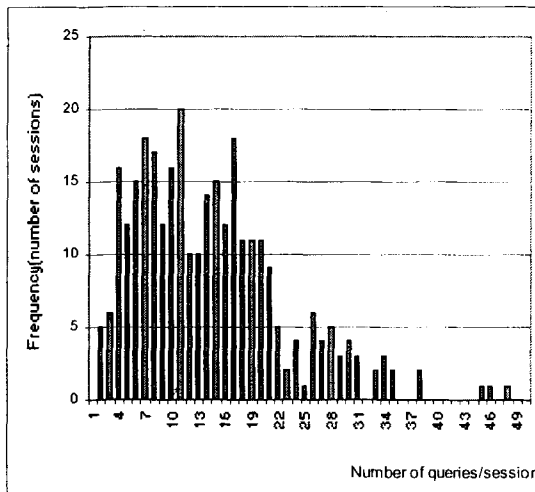


FIG. 2. Distribution of queries per multitasking session - AlltheWeb.com 2001 dataset.

In the Excite dataset, most sessions have between 3 and 25 queries, whereas in the Alltheweb.com dataset most sessions have between 4 and 22 queries. The range of queries per multitasking search session is similar in both datasets, causing very close values for mean queries per session.

*Session duration statistics for multitasking search sessions*

The distribution of duration of user sessions can be seen in Figures 3 and 4.

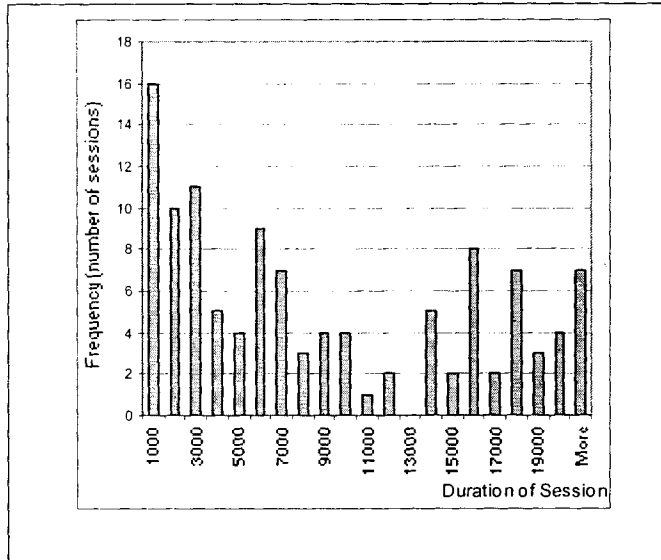


FIG. 3. Distribution of multitasking sessions with respect to duration - Excite 1999 dataset.

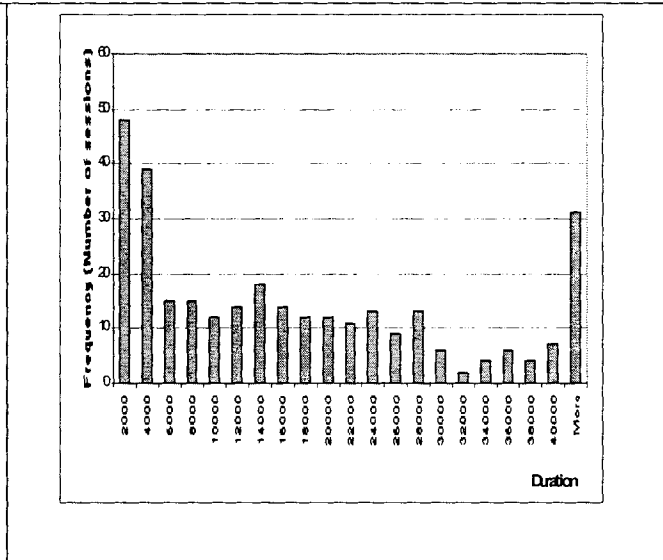


FIG. 4. Distribution of multitasking sessions with respect to duration - AlltheWeb.com 2001 dataset.

The mean duration per session for Excite multitasking sessions was 8500.8 seconds, whereas the duration per regular sessions was 4254.9 for the entire sample. The same statistics for the AlltheWeb.com were 17190.5 and 8238.2 seconds for multitasking and regular search

sessions in the entire dataset, respectively. Both Excite and AlltheWeb.com users spend about twice the time on multitasking Web search sessions than regular session. Table 2 shows the topic changes in multitasking sessions.

TABLE 2. Topic changes in multitasking sessions.

	Excite 1999 sample	AlltheWeb.com 2001 sample
Total topic changes	246	678
Mean topic changes per session	2.2	2.2
Topics per session	3.2	3.2
Mean queries per topic	4.8	4.5

*Topic changes in multitasking search sessions*

For the AlltheWeb.com dataset, there were 678 topic changes in 307 multi-topic sessions, yielding a mean of 2.2 topic changes per session. 2.2 topic changes per session can be interpreted as 3.2 topics per session. The users of the multiple topic sessions investigate more than three topics on average.

For the Excite dataset, there were 246 topic changes in the 114 user query sessions, with a mean of 2.2 topic changes per session that can also be interpreted as a mean of 3.2 topics per session. Both Excite and AlltheWeb.com users search more three different topics per search session.

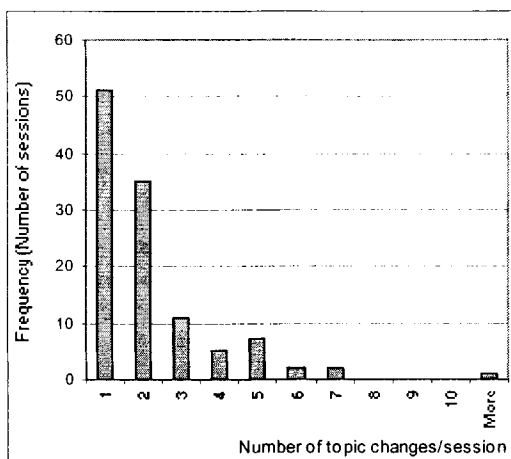


FIG. 5. Distribution of number of multitasking sessions with number of topic changes per session - Excite 1999 dataset.

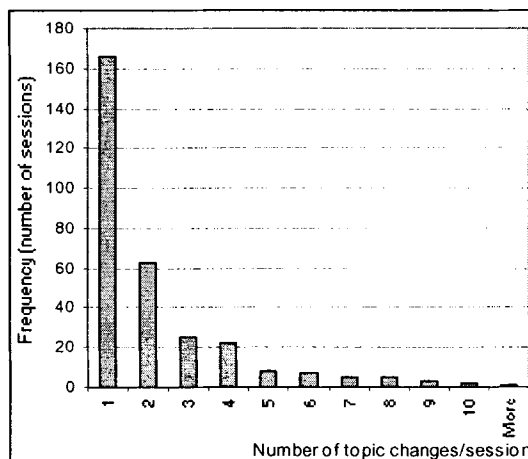


FIG. 6. Distribution of number of multitasking sessions with number of topic changes per session - AlltheWeb.com 2001 dataset.

Most of the Excite and AlltheWeb.com users make 1-3 topic changes (cover 2-4 topics) per session. The mean queries per topic was 4.5 queries for the AlltheWeb.com dataset, meaning that on average users making multitasking searches changed the search topic every 4.5 queries. The relevant figure for the Excite dataset is 4.8 queries per topic. Excite and AlltheWeb.com users submit almost the same number of queries per topic.

#### *User search topics in multitasking Web search sessions*

The queries in multitasking sessions were categorized with respect to the topics provided in Spink, Ozmutlu and Ozmutlu (2002). The categories used in the study and the number of queries falling into each category for the Excite and AlltheWeb.com datasets are given in Table 3.

TABLE 3. Number and percentage of queries in each topic category.

Topic	AlltheWeb.com 2001 Queries	% AlltheWeb.com 2001 Queries	Excite 1999 Queries	% Excite 1999 Queries
News	62	1%	6	1%
Government/politics	91	2%	50	3%
Business	214	5%	213	13%
Medical	127	3%	71	4%
Arts and humanities	214	5%	28	2%
Hobbies	288	6%	332	19%
Entertainment	488	11%	140	8%
Education	124	3%	69	4%
Employment	29	1%	27	2%
Shopping	322	7%	253	15%
Computer	573	14%	72	4%
Individual/family	17	1%	63	4%
Sexual	327	7%	55	3%
Science	100	3%	33	2%
Travel	317	7%	119	7%
General information	855	19%	115	7%
Unexplicit	286	7%	63	4%
Total	4434	100%	1709	100%

The most preferred categories for AlltheWeb.com are general information, computers and entertainment. These categories form about 35% of the queries in multitasking sessions. On the other hand, Excite users preferred the categories of hobbies, shopping and business that form about 47% of all queries in multitasking sessions. The subject categories might reflect topic at the same time. It was found out that multitasking search sessions included more than three topics per search session.

## Discussion

We identified some characteristics of multitasking search sessions: such as multitasking search sessions being twice longer than regular search sessions in terms of duration and the mean queries per Web multitasking search session being 50% higher than that of regular search sessions. Although the reasons for multitasking behaviors were not directly tested in the studies discussed above, one can draw some insights from the data analysis.

First, it appears that users' Web searching behaviors often includes a need to seek and search on more than one topic concurrently due to the complex nature of work or living tasks. Rubinstein, Meyer and Evans (2001) highlight the need for people to multitask in work environments as they use the microprocessor at the same time they talk on the telephone.

People have many tasks at hand at the same time, including information seeking tasks. In these cases, a person may pool their topics together and interact with the Web on more than one related or unrelated topics.

## Implications

The findings from this study have implications for the design of Web systems, the development of information seeking and interactive IR models, and the training and searching practice of end-users.

On the theoretical side, current information seeking models and interactive IR models, and studies of IR system use (that focus on the single search assumption), do not address multitasking search.

In practice, users should be trained to understand how to work concurrently and successively on multiple topics that are not resolved with one IR system search. Spink, Ozmutlu and Ozmutlu (2002) suggest that on average users may need to conduct possibly 2-3 searches to clarify to resolve an information problem.

Some commercial IR systems, have a save search feature based on the assumption that many users come back to the IR system for more than one search on their topic over time. How might multitasking search sessions be supported by Web systems and interfaces? There exists many Web systems that support searching strategy on one task in a single database or support browsing within a

single database (Cutting, et al., 1992) or many Web systems, e.g., meta-search tools (Spink, Lawrence & Giles, 2000).

Largely, current search systems are based on the assumption that users will (or need to) engage in only one search task (topic) at a time during one search.

However, in practice, many users now routinely engage in multitasking searches in the course of a single or multiple search episodes. Users at different information seeking and problem solving stages may conduct different search behaviors. Multitasking is a major systems design research topic (MacIntyre, et al., 2001). Windowing features provide support for interactive multitasking behaviors within operating systems. However, few interactive systems provide effective support for managing multitasking behaviors (MacIntyre, et al., 2001).

We derived some potential Web systems features to support multitasking:

- Provide users with the ability to access, refine and use results from a previous search.
- Help users coordinate multiple topics into effective queries, i.e., search histories, various thesauri or keyword generation tools.
- Provide the ability to create multiple sets of working notes related to different or related search topics, i.e., sketching and note creation tools.
- Enable Web users to submit and track multiple queries concurrently on different or related topics.
- Allow for searching multiple search engines or collections concurrently on multiple topics.
- Enable the reformulation of multiple queries on different or related topics.
- Provide windowing facilities to allow Web users to generate and track separate topic or related topic queries and facilitate task switching.
- Enable the generation and comparison of relevance judgments on different or related searches.
- Allow the tracking, storing and manipulating of retrieved results and printouts related to different topics over multiple searches.
- Help users review search histories from various searches and topics.
- Provide the ability to create clusters of retrieved information related to different or related topics.

## Conclusion

Currently, Web systems and interfaces provide limited support for multitasking search. As the complexity of information structures and problems increases, more complex human information processes and more effective Web technologies are required to sustain effective human information behaviors (Spink, Jansen, Wolfram and Saracevic, 2002). A theoretical framework and models of users' searching behaviors with Web technologies are a crucial step in this process.

We are currently continuing to examine: (1) how multitasking searches differ from regular search sessions (2) if a user's information-seeking stage affects the number and performance of multitasking searches and (3) the relationship between the nature of the user's information problems and how they are coordinated. Further research is also required to compare and characterize information problems that lead to multitasking.

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