



The use of query suggestions during information search



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ABSTRACT

Query suggestion is a common feature of many information search systems. While much research has been conducted about how to generate suggestions, fewer studies have been conducted about how people interact with and use suggestions. The purpose of this paper is to investigate how and when people integrate query suggestions into their searches and the outcome of this usage. The paper further investigates the relationships between search expertise, topic difficulty, and temporal segment of the search and query suggestion usage. A secondary analysis of data was conducted using data collected in a previous controlled laboratory study. In this previous study, 23 undergraduate research participants used an experimental search system with query suggestions to conduct four topic searches. Results showed that participants integrated the suggestions into their searching fairly quickly and that participants with less search expertise used more suggestions and saved more documents. Participants also used more suggestions towards the end of their searches and when searching for more difficult topics. These results show that query suggestion can provide support in situations where people have less search expertise, greater difficulty searching and at specific times during the search.

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1. Introduction

Query suggestion is a common feature of many information search systems and increasing amounts of research has been published about query suggestions (Silvestri, 2010). Most studies have focused on techniques to identify and generate query suggestions. Fewer studies have focused on understanding when and how query suggestions might be useful during search, if query suggestion usage leads to better search outcomes and if and how query suggestion usage and effectiveness change as a result of contextual factors.

The potential usefulness of query suggestions during information search is great. Query suggestions are potentially beneficial because they provide searchers with alternative methods for exploring topics and can help searchers develop better understandings of their topics and richer vocabularies with which to create manual queries. Query suggestions allow searchers to continue to execute searches even when they are unable to formulate their own queries and provide a lost-cost method to access additional information (searchers can click to get new search results rather than engage in manual query reformulation). Query suggestions can potentially support orienteering strategies (e.g., O'Day and Jeffries, 1993; Teevan, Alvarado, Ackerman, & Krager, 2004) by providing searchers with additional navigation links from their current search positions. Finally, query suggestions might be particularly useful for less experienced searchers or for those with less domain knowledge who are more likely to have difficulty formulating and reformulating queries.

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Information search models provide another way to consider the potential usefulness of query suggestions. Kuhlthau's (1994) and Vakkari's (2001) models are anchored by different stages, which are associated with different types and sources of desired information, search tactics and mental models. For example, Vakkari (2001) identified three stages (pre-focus, formulation and post-focus) and found that searchers sought different types of information during each stage (general information, faceted background information, specific information). Query suggestions can potentially assist in all stages of search by helping the searcher get started during the pre-focus stage, explore various facets during formulation stage and follow-up with specific questions during post-focus stage.

In our previous investigations of query suggestions, we found direct evidence that participants used query suggestions as an *idea tactic* (Kelly, Cushing, Dostert, Niu, & Gyllstrom, 2010; Kelly, Gyllstrom, & Bailey, 2009). The concept of an *idea tactic* was introduced by Bates (1979b) as a move to help searchers generate new ideas or solutions to information search problems. Bates noted that idea tactics serve a psychological purpose in that they can potentially improve a person's thinking and creative processes during information search (p. 280). Bates further justified the importance of idea tactics by observing that new ideas are often "blocked or limited by one's current thinking" (p. 281). That is, the searcher's internal model of the information problem can sometimes block their efforts to think of novel and useful ways to proceed with search. Bates (1979b) idea tactics, which emphasize idea generation and pattern-breaking, can help searchers move beyond these initial models. Participants from our previous studies (Kelly et al., 2009; Kelly et al., 2010) revealed during interviews that query suggestions gave them ideas for searching and helped them get started with their searches. They further stated that the suggestions helped them think of other avenues for searching when they exhausted their own ideas and when they were uncertain about how to proceed.

To better understand when and how these participants used query suggestions, we analyze the search behaviors of participants from one of these studies (Kelly et al., 2010). In this paper, we address the following questions: (1) When do users integrate query suggestions into their searches? (2) How does use of query suggestions differ according to search experience, temporal segment of search and topic difficulty? (3) Does the use of query suggestions help users find more relevant documents?

2. Related work

The work described in this paper covers many areas: search tactics; search experience; topic difficulty; search stage, phase and segment; and query suggestions.

2.1. Search tactics

One common and classic way researchers have classified search behavior is according to tactics and strategies (e.g., Bates, 1979a; Chen & Dhar, 1991; Shute & Smith, 1993; Xie, 2000). According to Bates (1979a), a strategy deals with overall plan of the search while a tactic deals with moves made to further a search. Bates (1979a) identified 29 search tactics and organized them into 4 categories (monitoring tactics, file structure tactics, search formulation tactics and term tactics). Bates (1979b) also identified 17 idea tactics, or "tactics to help generate new ideas of solutions to problems in information searching" (p. 280), which were classified as either emphasizing idea generation or pattern-breaking. Idea generation focuses on the stimulation of new ideas, while pattern-breaking tactics help searchers go beyond their current way of thinking about the problem and suggest moves that can be made while interacting with a retrieval system. Although some pattern-breaking tactics are intended to be used by the searcher introspectively, a number of these focus on search behavior and query generation. Bates (1979b) noted that many of the search tactics introduced in (1979a) can also be used as idea tactics, especially search formulation and term tactics.

Bates (1979a) classification of search tactics served as an important conceptual reference for the large number of empirical studies that followed (Fidel, 1985; Shiri & Revie, 2003; Shute & Smith, 1993; Xie, 2008). This research classified moves according to purpose (broadening, narrowing, and topic change) and according to type (physical/cognitive; conceptual/operational). Cognitive moves refer to moves that users make internally such as conceptually analyzing search terms and examining documents for potentially useful search terms, while physical moves refer to external moves made by searchers; for example, clicking on a specialized search feature.

Recent studies of Web search have focused on Bates' search formulation and term tactics (e.g., Jansen, Booth, & Spink, 2009; Rieh & Xie, 2006; Xie & Joo, 2010). For example, Jansen et al. (2009) found that reformulation and system query assistance accounted for nearly 45% of all query reformulations actions. Jansen et al. (2009) speculate that these results show that users often have unclear ideas about how to express their information needs and so submit a series of queries to try to better define their information needs. This speculation is consistent with orienteering strategies (e.g., O'Day and Jeffries, 1993; Teevan et al., 2004) where searchers make a series of small moves to resolve their information problems. Each move is based on the outcome of the previous move. Rather than entering one long query to retrieve the best search results list, searchers instead expect to make a series of smaller moves, often by entering a series of short queries, each of which will lead them in an incremental fashion to results which will potentially satisfy their information needs. Thus, query suggestions seem like a particularly useful type of system support for this type of search strategy.

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