Search Tasks and
Their Role in Studies of Search Behaviors

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ABSTRACT

In experimental studies of search behaviors and evaluations of retrieval systems, researchers generally assign search tasks to the subjects to perform. Since it can be expected that the tasks themselves will influence search behaviors and performance, we need to be able to construct tasks having particular attributes, knowing that our study findings can then be generalized to all search tasks having those attributes. In this paper, we report on an ongoing analysis of the search tasks that have been used in experimental search studies. We review a number of typologies of search tasks currently in use (complex vs. simple, specific vs. general, exploratory vs. lookup, and navigational vs. informational) and make recommendations for designing search tasks for use in future studies.

Categories and Subject Descriptors

H3.3. Information search and retrieval: Search process

General Terms

Experimentation

Keywords

Search tasks, Research design

1. INTRODUCTION

People's search behaviors vary widely. It's likely that some of this variation is *not* related to differences in the characteristics of individual searchers (e.g., domain knowledge or search expertise), but is instead due to differences in the goals that they are trying to achieve. In almost all cases, searches for information are undertaken within the context of some other purpose, goal, or activity. In other words, the person's search behaviors are situated within the context of performing some larger task [28, 31].

These embedding tasks may vary along a number of dimensions, including their complexity, structure, and granularity. For example, consider the difference between the complex and amorphous task of completing a dissertation and the simple and well-structured task of locating the address of a local store. While it is important to understand the characteristics of these tasks, by which people's search behaviors are motivated [8, 27], it is also

important to focus on the attributes of the search tasks[1] themselves, and how those attributes can affect search behaviors.

In particular, it is important to understand the potential influence of the search tasks assigned to research subjects when studying search behaviors and evaluating information retrieval (IR) systems. Naturalistic studies are intended to observe real people searching in order to complete real tasks; however, experimental studies are intended to isolate particular effects on user behaviors. Because of this desire for control in experimental studies, researchers usually assign search tasks, either controlling the task effect by assigning the same tasks to all the subjects or manipulating it as an independent variable. Most studies to date have opted for control over manipulation, but in either case, researchers are handicapped by our lack of understanding of the influence of the search task on the study findings. Given that search tasks can vary along many dimensions, findings may be valid for a particular set of tasks, but we do not know to which additional tasks they may be validly applied.

In order to make additional progress in experimental studies, we need to gain a better understanding of search tasks and their effects. We need to be able to construct tasks having particular attributes, knowing that our findings can then be generalized to all search tasks having those attributes. To this end, we are collecting and analyzing the search tasks that have been used in experimental search studies.[2] This paper is proposed as a starting point for gaining an understanding of these tasks. We will briefly review a selection of studies and compare the ways in which search tasks have been categorized in those studies. We will conclude with suggestions for moving forward on this research agenda.

2. TYPES OF SEARCH TASKS

When designing a study of search behaviors, the researcher needs to decide how much control to exert over the search tasks. At one end of the spectrum, the study subject is allowed to search on tasks of personal interest (i.e., the tasks are fully self-generated [3] or natural [28]). At the other end, the tasks are fully specified by the researcher. Some studies use a combination of tasks generated by the researchers and tasks generated or modified by the subjects

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[1] In this paper, the term, search tasks, will be used to designate the goal(s) to be achieved in a specific search situation. They are distinguished from the more general (work-related or other) tasks that have motivated the search. This distinction is explained in more detail by Byström and Hansen (2005).

[2] So far, we have collected over 100 descriptions of task types from 65 separate empirical studies. In addition, we are examining conceptual papers discussing search tasks.

[26]. In this discussion, we are concerned only with the tasks generated and assigned by researchers.

In past studies, some researchers have not specified the attributes of the assigned search tasks. In other studies, the researchers have described or categorized the tasks in some way (e.g., as complex, simple, known-item, factual, exploratory, navigational, or informational [18]). Attempts to integrate these typologies include Bilal's [3] integration of open- and closed-ended tasks with complex and simple tasks, and Jansen, Booth, and Spink's [16] investigation of Broder's [6] original typology of Web search tasks as information, navigational, or transactional. This section will discuss some of the ways in which search tasks have been categorized in recent studies of search behaviors, providing specific examples of each. This review of varying typologies of search tasks is meant to be suggestive of future research directions, rather than exhaustive.

2.1 Task Attributes Not Specified

In many studies, assigned search tasks are clearly described and, possibly, the full text of the search tasks is provided, yet the tasks are not categorized as being of a certain type. For example, in Woodruff et al.'s [32] comparison of three types of thumbnails during Web searches, the researchers developed and assigned search tasks that were "much like typical Web search tasks" (p.176). The 12 search tasks covered four areas: picture, homepage, e-commerce, and side effects. These groupings may be interpreted as connoting the topic of the search; for example, the side effects category included the search task, "Find at least three side effects of Halcion" (p.177).

Other authors might have categorized these search tasks differently. For example, the Halcion example might be classified as a complex search task, since it is likely that the searcher will need to consult several different Web pages to find multiple side effects. It might also be classified as a factual search task, since facts are the end point of the search process.

2.2 Complex vs. Simple Tasks

Complexity is the most commonly manipulated attribute of search tasks, although it has been defined and operationalized in many different ways [27]. Unlike other more discrete variables, complexity tends to be treated as an aggregate of one or more of the following task characteristics: structure [20, 24], certainty or *a priori* determinability [1, 7, 8, 10], number of facets [11, 2], length of the search path [11, 14], cognitive effort [2, 11] and topic familiarity [2, 7].

As an example of studies of task complexity, Bell and Ruthven [1] undertook a study that drew upon earlier work by Byström [8] and Campbell [10]. They developed sets of three tasks on the same topics but at differing levels of complexity by manipulating the degree of uncertainty. For the most complex task, "it is unclear what information is being sought, how to obtain relevant information, and how the searcher will know they have found relevant information" (p.61). For example, one of the low complexity task scenarios asks the searcher to "find out how the price of petrol in the UK has changed in recent years," while the corresponding high complexity task asks the searcher to "find out how and why petrol prices vary worldwide" (p.62).

The broad range of conceptualizations of complexity can be seen by comparing Bell and Ruthven's most complex task example with that of the most complex task assigned by Browne, Pitts and Wetherbe [7]. They also assigned tasks at three levels of complexity, and the most complex was to find a map of a little-known battlefield. While this task proved to be relatively difficulty to perform, by many definitions of complexity, it is simpler than the simple tasks assigned by Bell and Ruthven [1].

2.3 Specific vs. General Tasks

The specificity of the assigned search tasks is another task attribute that researchers have manipulated. Across studies, "specific" tasks tend to have more clearly defined goals than "general" tasks. Specific tasks may be equated with known-item search tasks (e.g., in [19]), factual tasks (e.g., in [14]), or simple lookup tasks (e.g., in [11, 13]).

Rouet [23] focused a study on the effects of task specificity on searching behaviors. The specific search tasks were defined as asking the study subjects to "locate one piece of information" (p.415); an example is, "Which authors have provided the first clinical descriptions of anorexia"?, to be searched in a hypertext document on anorexia. The general search tasks were defined as requiring "the reading and integration of 2-5 separate passages" from the hypertext document; an example is, "What treatments [for anorexia] may be suggested, and what are their effects?" While it is certainly appropriate to describe these two types of search tasks as specific and general, other researchers might have described them as simple and complex.

2.4 Exploratory vs. Lookup Tasks

Over the past several years, interest in exploratory search behaviors has increased. Users conducting exploratory searches are likely to "submit a tentative query and take things from there, exploring the retrieved information, selectively seeking and passively obtaining cues about where the next steps lie" [29, p.38]. Exploratory searching is defined as searching that supports learning and investigating [22]. It is contrasted with lookup tasks, which are oriented toward finding particular facts or answering specific questions.

White and Marchionini [30] incorporated both exploratory and lookup tasks in their study of a new approach to query expansion. An example of a lookup task was, "You are doing some research for a term paper you are writing and need to find the name of the first woman to travel in space and her age at the time of her flight"; an example of an exploratory task was, "You are about to depart on a short-tour along the west coast of Italy. The agenda includes a visit to the country's capital, Rome, during which you hope to find time to pursue your interest in modern art. However, you have recently been told that time in the city is limited and you want information that allows you to choose a gallery to visit" (p.689).

Interest in exploratory search behaviors and retrieval systems that can better support exploratory search is likely to continue. Thus, additional studies are needed to more clearly conceptualize and define exploratory search tasks, and clear guidelines for designing exploratory tasks are needed to support these studies.

2.5 Transactional vs. Navigational vs. Informational Tasks

The types of tasks already discussed are intended to represent people's information needs [15, Fig.6.8]; they all assume that a person searches because that person needs to find information for a particular purpose. Broder [6] argues that, with the advent of Web searching, we need to broaden our perspective. In addition to informational tasks, people also may be using the Web to

accomplish navigational or transactional tasks. While the purpose of an informational task is to acquire some information, the purpose of a navigational task is "to reach a particular site" and the purpose of a transactional task is "to perform some web-mediated activity" (p.5). Examining query logs from AltaVista, Broder found that about 48% of Web queries were informational, while 20% were navigational and 30% were transactional. Jansen, Booth, and Spink [16] followed up on Broder's work with an attempt to automatically classify Web queries into Broder's three types. In addition, they provided a more fine-grained analysis of Broder's three types of Web queries.

This classification of pre-existing Web queries is now beginning to serve as an empirical basis for studies in which search tasks are designed and assigned to study subjects. For example, Lorigo et al. [21] assigned five navigational tasks and five informational tasks to their subjects in a study of subjects' behaviors during searching and review of results, and Joachims et al. [17] assigned the same 10 tasks to their subjects in a study of the implicit feedback provided by user clicking behavior. An example navigational task was, "Find the homepage for graduate housing at Carnegie Mellon University"; an example informational task was, "What is the name of the researcher who discovered the first modern antibiotic?" (p.6). All of the questions are also depicted as closed-ended, and so did not cover the full range of informational search tasks described in the previous sections.

This typology was useful in developing the two example studies described. However, neither study incorporated transactional tasks. In addition, the findings cannot be generalized to all types of informational tasks because only a homogeneous set of straightforward factual search tasks were assigned.

2.6 What We Can Learn from the Current Task Typologies

The few typologies discussed in this paper include those that have been repeatedly used in studies of search behaviors over several decades of research. They can be interpreted as the research community's common-sense understanding of what's important about search tasks. Thus, we have some sense of the directions that we need to pursue in terms of improving our understanding of search tasks.

While there is some consensus about which attributes of search tasks are most important, there is no consensus about how those attributes should be defined and operationalized. A task that is categorized as simple by one researcher would be categorized as specific by another. A task that is categorized as a lookup task by one researcher would be categorized as an informational task by another. If we ever want to compare results across studies, we must improve our understanding of the search tasks in use as independent variables.

The task attribute that has garnered the most investigation is task complexity. There have been a number of studies that compare simple tasks with those that are more complex, but there are additional task attributes that warrant consideration. These include the topic, domain or subject area of a search task [25] and the informational goal, whether it be to learn about something, make a decision, solve a problem, etc.

3. RECOMMENDATIONS FOR DEVELOPING SEARCH TASKS

Ideally, researchers will develop search tasks that are realistic and that appropriately motivate the study subjects to perform a realistic search. Thus, a logical starting point is to elicit real-life situations and task cases from the population of interest [9, 12]. From these stories of real tasks and the searches they engendered, the researcher can develop search tasks that simulate realistic situations. Using simulated situations to present search tasks, as defined by Borlund [4, 5], increases the validity of the search tasks by decreasing their artificiality.

Borlund suggests that simulated situations be made up of two parts: the simulated work task situation and the indicative request. Byström and Hansen [9] go into even more detail, recommending that three levels of description should be used to specify a search task: a contextual description, a situational description, and a topical description and query. Within the context of a study of search behaviors, the simulated situations are "meant to trigger individual information problems in test persons in a controlled manner" [15, p.284]. The recommendations of these scholars are consistent, in that they all encourage the inclusion of contextual information in the specification of a search task. As search task descriptions become increasingly detailed, it is important to validate the effect of search tasks through pre-testing and/or by collecting user feedback during the study.

In addition, in order to effectively evaluate interactive IR systems, it will be necessary to develop more complex search tasks and more exploratory search tasks. Many IR researchers want to design systems that support a broader range of activities – both more complex activities and ongoing activities. Thus, we need to understand how to develop search tasks that can support experimental research and system evaluation in more realistic contexts.

To support experimental studies of search behaviors, we are initiating a project that will compile and analyze studies employing assigned search tasks. From each study, we are capturing the way in which the search tasks are categorized, as well as the full text of the search tasks themselves. Through this analysis, we hope to be able to more accurately describe the search tasks that have been used in past studies, as well as define the attributes of search tasks which are more likely to influence the outcomes of future studies.

4. ACKNOWLEDGMENTS

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