

Unobtrusively Measuring Information Search & Use Behaviors Using a Naturalistic, Longitudinal Approach

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Our current work is concerned with identifying and using information search and use behaviors as implicit sources of evidence of the user's problematic situation and document preferences. We are interested in discovering which behaviors can be captured unobtrusively through monitoring the user's information search and use behavior in a natural searching environment, across several months time, and determining how these behaviors can be used as evidence of the user's problematic situation and document preference. Thus, our current work focuses on unobtrusively capturing information search and use behaviors using a naturalistic, longitudinal approach, and describing how these behaviors can be used to *infer* and *track* various aspects of the user's problematic situation and document preference over time. The reason for doing this is to construct a model of the user which will allow us to determine which documents are of interest to them during the course of a current search.

Through our own research (Kelly & Belkin, 2001; Kelly & Belkin, 2002) and the work of others (Nichols, 1997; Oard & Kim, 2001), we have identified a range of behaviors that users exhibit during normal information search and use activities. Examples of such behaviors include:

- Viewing time and frequency
- Scrolling time and frequency
- Printing, Saving and Emailing
- Bookmarking (Add, Delete, Select)

It should be noted that these behaviors are related to activities that are exhibited at the document level. This list is not intended to be exhaustive.

Our selection of these behaviors was guided by two criteria: (1) the behaviors had to be available for "free," that is, the behavior had to be exhibited by the user during natural search and use activities and (2) the behaviors needed to be generalizable across systems (the behavior could not be specific to certain search interface features). Our goal in using the latter criterion was to provide behavioral data that can be used across systems to tailor retrieval.

The behavior alone is not enough for our research purposes; we are further interested in determining what information seeking variables these behaviors can be used to measure. For instance, behaviors such as saving and print-

ing are likely sources of evidence for document preference. Viewing time and frequency may also indicate document preference.

Previous information seeking research has demonstrated that users exhibit a range of information seeking behaviors which can change with respect to cognitive states, problem solving stage (c.f. Vakkari, 1999), and the problematic situation (Lin & Belkin, 2000). The problematic situation is a situation where a user's cognitive state is deficient with respect to achieving a desired goal. The problematic situation is characterized by more than just an information need; it is also characterized by various aspects of the user, the task and the information seeking environment. These characteristics combine to produce a range of information seeking behaviors that can vary from one problematic situation to the next. This literature suggests that these characteristics need to be measured and accounted for in order to more accurately use search behaviors as evidence of document preference.

Our previous work has found that several behaviors, such as number of iterations and number of documents saved, can be used to measure one such aspect of the problematic situation, topic familiarity (Kelly & Cool, 2002). Our current research is concerned with developing techniques to measure other aspects of the user's problematic situation with information search and use behaviors. This is particularly challenging since these aspects change over time and the behaviors exhibited by the user are often specific to particular tasks and/or topics. In our current research, we use 7 and 8-point scales to measure several characteristics of the user's problematic situation at various points in time. These characteristics include: task persistence, topic endurance, topic familiarity and problem solving stage. We consider task persistence and problem solving stage to be attributes of tasks, while topic endurance and topic familiarity to be attributes of topics.

We ask our study participants at various time intervals to identify the tasks and topics in which they are engaged and to rate each task and topic according to the attributes identified in the above paragraph. Participants are asked to classify the pages that they view during their information search and use activities according to task and topic. That is, participants are presented with the list of tasks and topics that they identified previously and asked to associate

each document with one or more task(s) and topic(s). In addition, they are asked to evaluate the usefulness of each document with respect to the task and topic, and their confidence in that judgment. After collecting these data, we attempt to relate these characteristics of tasks, topics and documents to the information search and use behaviors that are exhibited by the user with particular documents, at various points in time. Our goal is to discover how these characteristics affect search and use behaviors and how they can be used to more accurately model document preferences over time.

We have conducted several pilot tests to date. These tests have revealed the challenges of using scales to measure and track the variables that represent characteristics of the user's problematic situation. Our pilot tests indicate that scales do not map well to the variables that they are intended to measure; scale anchors and intermediary labels present problems, especially for describing constructs that may be unfamiliar to users like task persistence and topic endurance.

Another problem that we have encountered is the determination of a schedule for measuring these variables given our naturalistic, longitudinal design. What are appropriate intervals for collecting these measurements? How often do these variables change? Do these variables represent constructs that are relatively stable or constructs that are constantly changing? Should these variables reflect the user's progression through a task?

A final issue that our research addresses is the identification, development and evaluation of tools for unobtrusively capturing data about the user's information and search behaviors in natural environments over time. As with all measurement tools, it is particularly important that the tools are both valid and reliable. Each of our study participants receives a laptop computer and printer for the duration of their participation in our study. Participants are asked to use this dedicated machine for all their computer-related activities, except for those for which they desire privacy. We have selected and developed various pieces of client-side and server-side software that monitor and record unobtrusively the user's information search and use behaviors. The majority of the monitoring is performed by the client-side logging software which allows one to track activities with information objects that are performed both remotely, such as requesting a specific document from a server, and locally, such as interacting with a cached or saved document, sending a document to the printer and creating a new document using standard word processing tools.

Our goal in participating in this workshop is to explore the questions posed in the above paragraphs and to identify methods that may be used to measure and track behaviors and characteristics over time. As more and more studies demonstrate that information seeking occurs across multi-

ple information seeking episodes, the resolution of these measurement issues becomes critical.

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