

# Modeling Characteristics of the User's Problematic Situation with Information Search & Use Behaviors

**Diane Kelly & Nicholas J. Belkin**

School of Communication, Information & Library Studies

Rutgers University

New Brunswick, NJ USA 08901

+1 732 932 9547

diane@scils.rutgers.edu; nick@belkin.rutgers.edu

## ABSTRACT

This paper describes a longitudinal, naturalistic study designed to model characteristics of the user's problematic situation using information search and use behaviors as implicit sources of evidence. We hope that by considering several characteristics, such as topic familiarity and persistence, task endurance and problem solving stage, we will be able to model more accurately the user's document preferences using information search and use behavior.

## Keywords

User modeling, implicit feedback, information seeking behavior

## INTRODUCTION

There have been a number of proposals for acquiring representations of user interests through monitoring the user's information search and use behaviors (c.f. Morita & Shinoda, 1994). Collectively referred to as implicit feedback techniques, these techniques unobtrusively obtain information about the user's interests through the observation of "normal" human behavior during information search and retrieval. Advantages of implicit techniques are that they (1) remove the costs of having a user read and rate a large number of documents and (2) are easy to obtain. Implicit measures are thought to be less accurate than explicit measures (Nichols, 1997), but they can be gathered at no cost to the user and in large quantities.

Implicit feedback techniques have been primarily investigated in information filtering and recommendation systems. For instance, Morita and Shinoda (1994) found a strong tendency for users to spend a greater length of time reading those articles they rated as interesting as opposed to those they rated as not interesting. Others have replicated this finding in similar environments (c.f. Konstan, Miller, Maltz, Herlocker, Gordon & Riedl, 1997).

While implicit modeling techniques offer substantial promise with regard to capturing and modeling user preference automatically, they are not without problems. Reading time, one of the most extensively studied behaviors of user interest, has been discovered recently to be not as valid and reliable a measure as once thought (Kelly & Belkin, 2002). While this measure has been used in numerous experimental systems, we found that several characteristics, such as topic familiarity, type of information need, and type of task, confound the general finding in complex ways. For instance, as a user becomes more familiar with a topic, their information search and use behavior with respect to that topic changes (Kelly & Cool, 2002). Similar conclusions have been made by others (Quiroga & Mostafa, 2002).

These findings are consistent with the interactive IR literature that suggests that users exhibit a range of information seeking behaviors which can change with respect to cognitive states and problem solving stage (c.f. Vakkari, 1999) and with the conceptualiza-

tion of the problematic situation in IR (Lin & Belkin, 2000). The problematic situation is a situation where a user's cognitive state is deficient with respect to an information need. The problematic situation is characterized by more than just the 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.

Based on this literature and our previous research, we select four characteristics of the user's problematic situation for further investigation: topic familiarity, topic persistence, task endurance, and problem solving stage. We select several information search and use behaviors: document selection, viewing, scrolling, printing, saving, emailing & bookmarking. In the next section, we describe a methodology designed to measure characteristics of the user's problematic situation and evaluate the relationships between these characteristics, information search and use behavior and document preference.

## METHOD

We have initiated a longitudinal, naturalistic study in order to investigate how the characteristics identified above affect information search and use behaviors.

### Participants

A total of four participants have been recruited from a graduate program in library and information science. The participant group has been selected primarily for reasons of convenience; this study functions as a pilot study for a larger scale study that will be initiated in September 2002.

### Approach

We have chosen a longitudinal approach because many studies that have examined the potential of information search and use behaviors as implicit feedback have had limited time periods. The time period for this study, 4 weeks, has been chosen because it coincides with the time period for a summer course offered at the university. Our larger study is planned to last an entire university semester (3.5 months).

We have chosen a naturalistic approach because this approach allows participants to conduct natural searching activities with tasks that are germane to their personal interests. In sum, a longitudinal, naturalistic approach provides the greatest opportunity for ecological validity.

### Instruments

Each participant is provided with an IBM ThinkPad, running Windows 2000, with 128 MB RAM, 5 GB of hard disk, and a Pentium II processor. Each machine has an internal modem/LAN card, DVD and floppy disk drives. The software available on the machine is customized to the individual. Minimally, each machine

is equipped with the Microsoft Office Suite, WSFTP, Adobe Acrobat, Netscape Communicator and Internet Explorer. In addition to this software, each laptop is equipped with two pieces of client-side monitoring software. The participant's online searching is directed through a proxy server which has an additional piece of monitoring software installed.

#### *Monitoring Software*

The monitoring software records the participant's information search and use behaviors with all applications. After an extensive evaluation period, WinWhatWhere Investigator was chosen as an off-the-shelf logger. This software is launched automatically each time the machine is started and executes in stealth model while the machine is in operation.

A copy of the log is emailed to us every 12 hours. This information is used to customize the questionnaires that the participant completes. In addition to the logging software, the participant's online searching is directed through a proxy server, which saves a copy of each document viewed by the participant.

The second piece of monitoring software is a customizable drive miner that extracts text information from the participant's hard drive. Developed at the University of Massachusetts as part of the collaborative Mongrel Project with Rutgers University (Mongrel), this application traverses the directory structure of the participant's hard drive, saving files. The application executes automatically each time the machine is started. Two output files are generated each time the application executes. These files contain the creation, last modification, and last access time metadata that are generated by the Windows operating system for each file found on the user's hard drive and a list of all of the paths visited by the participant while the machine is in use.

#### *Questionnaires*

Participants complete three types of questionnaires. The first type is administered during the initial meeting with the participant and assesses background information and computer and searching experience. This questionnaire asks participants to identify the various tasks in which they are engaged and the topics that are of interest to them. Participants are required to characterize each task according to endurance, or the length of time the participant expects to be engaged with the task, and stage of completion. Participants are required to characterize each topic according to persistence, or the length of time the participant expects the topic to be of interest, and familiarity. Task endurance and topic persistence are assessed with an 8 point scale, while stage of completion and topic familiarity are assessed with 7 point scales.

The second type of questionnaire is completed weekly. Participants are presented with the tasks and topics that they previously identified, asked to update each list and characterize each task and topic as described in the preceding paragraph. This questionnaire is completed online.

The third type of questionnaire is completed bi-monthly. Participants are asked to evaluate each document that they viewed during the previous two week period and relate the documents to their tasks and topics. The interface for the third questionnaire displays the text of a single document to the participant, along with a console which has two drop-down lists containing the tasks and topics previously identified by the participant. Text boxes are provided in the event that the participant has failed to identify a task or topic on a previous questionnaire. Finally, 7 point usefulness and confidence scales are provided so that participants can rate the documents that they view. This questionnaire is completed online.

Presently, we are designing an algorithm to filter, classify and select the documents that are presented to the participant. It is neither useful nor necessary to ask the participant to rate every page that is viewed. Moreover, regularities in behavior according to type of page may exist; thus, it is useful to classify each page viewed in order to describe more accurately the participant's information search and use behaviors. For the study reported in this paper, the process of classification and filtering was performed manually. From this manual classification, we have created a taxonomy of pages that one might encounter while using the Internet.

#### **CONCLUSIONS**

In order to use information search and use behaviors to model information interests and problems, one must first attempt to account for characteristics of the user's problematic situation that affect this behavior. We have identified several such characteristics and presented a methodology for attempting to measure and investigate these characteristics. We expect the results from our Pilot test to indicate the potential of this approach for personalizing interactions in digital library environments through tailored retrieval and customized interfaces.

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