Modeling the Users of Information Systems: Some Theories and Methods

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SUMMARY. Understanding user needs and the ways in which users utilize information systems is important since it can help us in developing and designing more effective and efficient information systems. This paper examines some of the theories that have evolved to explain what kind of mental processes are required for the use of information systems. Research on users of information systems is categorized into two basic groups (system-oriented vs. user-oriented studies), and reviewed. A sample of methodologies used for examining users and their information seeking behavior is then introduced.
and described. Finally, implications of these theories and methods for librarians and information specialists are discussed. [Article copies available for a fee from The Haworth Document Delivery Service: 1-800-342-9678. E-mail address: getinfo@haworth.com]

INTRODUCTION

In everyday life, we often find ourselves needing information to answer questions posed by ourselves as well as others. Although we sometimes do not know exactly what information we want, we still try to locate and use sources that seem to be capable of providing the information that is "wanted." For this, we often ask for help from other people like librarians, search for the information in places like libraries or take advantage of other available information resources and systems.

With the advent of computer technology, more information databases have become available in machine-readable formats and many information systems have been developed and designed for facilitating information retrieval. Ideally, information systems should make the information search so easy that most information searchers need less and in some cases no human assistance. Since the systems are not as responsive or as flexible as human helpers might be, users are doubly burdened when searching for the information they need. Users must not only figure out what they really want to know but also understand how the system should be used.

As information systems are developed based on different technologies and for different purposes, their ways of functioning vary from one to another. This implies that each system might require the user to be equipped with different psychological and/or physical skills in order to get the best result from the system.

How do individuals use an information system? What kinds of factors affect users' interaction with a system? There are a variety of potential variables, but users' psychological aspects, especially cognitive aspects, have been viewed as some of the more important factors influencing human-computer interaction. These cognitive factors have been investigated for the last 10 to 15 years in numerous studies, and it is not our intent to review them all here. However, the focus of this issue brought together some discussion of the more prominent theories in use presently and seemed to require some description of applicable methodologies that can be applied to further our professional understanding of users' computer interaction behaviors.

In this paper, human cognitive aspects related to the use of information systems will be a primary focus. The guiding definition of human cogni-

Use and Users: Some Theories

USE OF INFORMATION SYSTEMS

Why Do We Use an Information System?

When individuals have an information need or find a gap between their existing knowledge and a new situation, they select an information system and use it in order to find that which seems needed to fulfill the information need or fill in the perceived gap. The system may be an informal one like asking a friend or relative, or a formal one like using a library.

Selecting an information system is influenced by many factors including psychological, social, economic, and cultural factors. Individuals' perceptions of, experiences with, and expectations of a system, the availability and the characteristics of a system are some examples of such factors. The use made of an information system is also affected by those factors. The interactions of user's psychological perceptions and various systems' characteristics seem particularly important since they affect the ways of using a system more directly than others.

Cognitive Aspects Related to the Use of an Information System

Using an information system seems to require three different cognitive processes: (1) information-seeking, (2) knowledge acquisition and (3) problem solving. Information seeking is a goal-driven activity in which needs are satisfied through problem-solving (Brown, 1991). According to Krkeleas (1983), information-seeking behavior begins with a "perceived need," which is much like Belkin's (1980) "anomalous state of knowledge (ASK)," or what Taylor (1968) identified as "a vague dissatisfaction." However described, the gap is caused by something which is strong
enough to move the individual to address the perceived inadequacy of an existing understanding and to move the individual, in the case of a library visit, to some new situation in which to better address the perceived inadequacy. The information-seeking behavior required involves those activities that will satisfy the need. When the need (or gap) is no longer perceived, the individual quits the chosen information-seeking process. The process is dynamic since methods of collecting information can vary in time and depend on the immediacy of results (Krikelas, 1983; Rouse, 1984). The ways of collecting and selecting information are also related to the personal habits of the searcher and can also be influenced by the kind of needs to be satisfied.

Knowledge acquisition is what one might normally call “learning.” Conceptually, learning is the reorganization of knowledge structures. Through the learning process, an individual restructures the knowledge, organized by others, in order to make it fit in his/her own knowledge structure. While using an information system, individuals get to reorganize their knowledge structure based on either accidentally or intentionally retrieved new information. This ability of information to create structural change was argued by Belkin and Robertson (1976) to be the primary phenomenon of this LIS (Library and Information Science) field, but it has been a difficult phenomenon to fully understand and document.

Problem-solving is another cognitive process required for using a system. Problem-solving starts with a perceived problem. Once the problem is stated in terms that can be understood, individuals then apply their knowledge to the problem and attempt to try out possible solutions. When using an information system, individuals develop strategies that they believe will help to get the best result from the system. System users have to figure out how a system works, how to get a wanted result from the system, how to select the “best” result from the retrieved information, etc.

The key to the effective use of systems seems far from trivial. It depends upon the ability to orchestrate all of the aforementioned cognitive processes, and the ability to do that varies according to a variety of cognitive styles. Cognitive styles are defined as the characteristic ways in which an individual organizes and processes information (Goldstein & Blackman, 1978), and cognitive style has been shown to influence the manner in which individuals prefer to learn and receive instructions (Messick, 1976). Cognitive styles are usually described using different dimensions. Martens (1979) provides a detailed identification of many of the dimensions currently discussed in cognitive theory including field dependence/independence, breadth of categorizing, conceptualizing styles, cognitive complexity/simplicity, constructed/flexible control, and so on.

RESEARCH ON INFORMATION SYSTEM USERS

The development of computer technologies has provided a strong physical and conceptual mechanism for assisting information-seeking activities. Online database systems have been developed to help users retrieve desired information more quickly than can be accomplished from printed ones, for example. Many users, however, express difficulty when using these online systems. The need to minimize the difficulties that the user experiences with a system and maximize the effectiveness and the efficiency of their use has never been greater. Central to our ability to do so rests the cognitive theories that try to help intermediaries and systems designers anticipate the behavior of users.

Cognitive Model and User Model

Understanding what a system can do and what the users of a system expect from it can be facilitated by cognitive modeling. Cognitive modeling also helps system designers develop systems that users can more easily understand because they can anticipate what users require to manipulate the system more effectively.

According to Daniels (1986), cognitive models refer to “images that the components of a system have of themselves, of each other, and of the world.” Their focus is not only on cognitive representations of objects but also on the cognitive processes related to these constructed images. These cognitive models “enable individuals to make inferences and predictions, to understand phenomena, to decide what action to take, and to control its [the actions] execution, and above all to experience events by proxy” (Johnson-Laird, 1983).

Cognitive models found in the LIS literature generally consist of three different types: conceptual, mental and user models. According to Borgman (1984), a conceptual model is “a model of the system as the designer wants the user to envision the system” whereas a mental model is “a model that the user builds in his or her head” as he or she interacts with a system. A user model is a third type of cognitive model that Rich (1983) defines as “a model of users interacting with complex systems.” Information of situations and tasks as well as more detailed information about groups of users can also be encoded in these models, the hope being that they will be more predictive of the success that will be achieved if more effective interfaces are developed. Various types of user models have been considered important in many research areas varying from education to software engineering.

There are additional ways of classifying user models. Quantitative vs.
analytical models, process vs. non-process models, and dynamic vs. static models are just some examples. According to Carbonell (1986), quantitative models are “abstract formalizations of a general class of users defined in terms of the design parameters of a user interface.” For establishing this kind of user model, data from the “average” person’s performance in various environments can be collected and used. Analytical models attempt to analyze and model a user’s cognitive behavior and process the data in a qualitative way. The analytical models are often used to explain the user’s cognitive processes on existing systems or to anticipate the user’s reaction toward a new system, whereas quantitative models can only show the user’s reactions as they have already occurred on an existing system.

Dynamic and static modeling has been identified by Sparck Jones (1984). Daniels (1986) continues to describe a dynamic model as a model reflecting “changes of state dependent on interaction with the system,” and a static model as a model “embodiment permanent states of the users.” Static models represent permanent features of users, independent of a system’s operation, features such as user’s gender, domain of knowledge and so on. Dynamic models, in contrast, are concerned with user factors related to the system used, including users’ goals and beliefs within a specific context of the system’s operation.

Sleeman (1985) views user models as either process or non-process models. Process user models refer to a model focusing on users’ structuring process as their mind responds to the outside environment. Non-process user models are those focusing on external variables like tasks to be performed.

These user model classification schemes provide us with a framework for categorizing and assessing different approaches to user studies. In addition, these are closely related to Dervin and Nilan’s (1986) distinction between system-oriented and user-oriented approaches in discussion of the progress in user studies.

System-Oriented Studies

In a literature review on information needs and uses, Dervin and Nilan (1986) identified and contrasted two different paradigms applied to user studies: system-oriented and user-oriented approaches. In studies with a system-oriented approach, users are viewed as passive receivers of information, and users’ external behavior is observed as an isolated situation. These studies assume that user behavior would stay the same across time and space. Variables with which system-oriented studies are concerned are often demographic information on users (age, gender, etc.), social affiliations (to what group/class does the user belong) and life styles of users, tasks to be performed, etc. The system-oriented approach shares similar views with quantitative, non-process and static user models.

Most user studies, at least among those dated before 1986 when Dervin and Nilan’s review appeared, were based on a system-oriented approach. The Cranfield studies in the 1960s and many other IR (Information Retrieval) studies were concerned with the performance evaluation of IR systems by measuring “recall and precision.” These studies were done based on an assumption that the average user would be interested in retrieving large amounts of relevant material. The relevance of items retrieved in the Cranfield studies were determined by content experts and believed to represent relevance no matter who the user was. In looking at the performance of a retrieval system, the Cranfield studies represent some of the most system-centered studies in IR.

OPAC (Online Public Access Catalog) user studies in the early 1980s, supported by CLR (Council on Library Resource), are another, but much more moderate, case of system-centered studies. The research was conducted for identifying demographic information about users and nonusers of OPACs, the users’ satisfaction, preference, problems that users encountered, etc., by using survey, interview and transaction log analysis methods (Markey, 1984; Matthews, 1983). Although this research attempted to understand more about users, it still had more characteristics of system-oriented studies. Users were viewed as passive reactors to system features, studying variables that were external-to-the-user characteristics like interface features and tasks rather than on variables that were internal-to-the-user characteristics like the user’s mental processes.

User-Oriented Studies

User-oriented studies generally view humans as constructive, active users of information and often recognize their psychological as well as societal role in using systems. According to Dervin and Nilan (1986), user-oriented studies are concerned with the more subjective values of information—the values that are perceived by the user. In user-oriented studies, the user is recognized to be in a dynamically changing situation and is held to be moving through the information problematic situation in a way that requires the artifacts of such movement to be interpretation from a more holistic and less reductionistic viewpoint.

Sugar (1995), in a similar review of user-oriented studies, divided recent research efforts into two basic groups: (1) studies with a cognitive approach and (2) studies with a holistic approach. The former is concerned with a user’s cognitive aspects while the latter is framed around a user’s
affective (emotional), psychomotor (physical) characteristics as well as socio-cultural aspects.

Some Cognitive User-Oriented Studies

In system evaluation studies, it is often found that there exist individual differences among users' performance in and reaction to a system, which implies the effect of users' characteristics on user-system interaction. This has led a number of researchers to investigate the relation between human-computer interaction and a user's characteristics, especially those related to cognitive processes.

Spatial visualization ability is a cognitive ability used by an individual to map where he or she is located in a three-dimensional space. Campagnoni and Ehrlich (1989) conducted a research project to investigate the relation between users' spatial visualization ability and their performance in a hypertext system. In their study, participants were given a standard test of spatial visualization ability. They were also asked to find answers to given questions, using a hypertext-based help system. Individuals with good spatial visualization abilities retrieved information faster than those with poor spatial visualization abilities. Apparently, individuals with a good spatial visualization ability were better able to construct a map for the structure of the information space, which helps them save time in finding information in a hypertext system. Campagnoni and Ehrlich also found that the degree of experience with computers affected the ways users had of information-seeking. Users with prior computer knowledge and experience searched information more analytically, exploiting various system features, whereas those with no prior computer experience or knowledge searched in a less systematic manner, essentially "browsing" large displays rather than using system features to minimize retrieved sets.

A user's domain knowledge is another factor that can influence human-computer interaction. In order to examine how "expertise in a subject area" and "expertise in information searching" affect the process and the outcome of information seeking in a hypertext system, Marchionini et al. (1990) conducted an experiment. Participants were divided into three groups according to their level of expertise: (1) a group of novices, (2) a group of experts in a subject and (3) a group of experts in information searching. They were all asked to retrieve information on a given subject in a hypertext system. Both expert groups (subject and search specialists) retrieved information better than the novice group; the subject and search specialists also found more pertinent information and did so more quickly than the novices. Interestingly, no significant difference in the task performance was reported between the two expert groups.

Field-dependence/independence is often studied as influential cognitive style. Identified and intensively studied by Witkin (1978), field-dependence and field-independence refer to an analytical versus a global way of perceiving and both are strongly related to "articulated vs. global cognitive style" (Messick, 1970).

In a study, Korthauer and Koube (1994) evaluated the effects of an individual's cognitive style on the use of a hypertext system. Initially, participants were divided into two groups based on the level of domain knowledge each participant had about a subject: a group of experts (the experienced) was formed and a group of novices (the naïve). The two main groups were divided again into four subgroups based upon their cognitive style—"field-dependence/independence." The four groups of participants were: (1) field-independent experienced, (2) field-dependent experienced, (3) field-independent naïve, and (4) field-dependent naïve. Each group of participants was asked to answer questions on a topic under two different conditions: an explicit and an inherent condition. Under both conditions, participants were asked questions on a topic. Under the explicit condition, a summary of the given topic was provided. Under the inherent condition no summary was provided. Experienced, field-independent participants performed better at using the hypertext system than experienced, field-dependent participants, especially when questions were asked under the explicit condition. The results suggest an existence of complex interrelationships among knowledge structures and cognitive styles of users and task types when using a hypertext system.

Ellis, Ford and Wood (1993) attempted to examine the effects of and possible interactions between a user's cognitive and learning styles on the learning outcomes in a hypertext-based system. In their study, two standardized, tests were used for identifying participants' cognitive style "field-dependence/independence" and learning style "serialist/holist." Holists are characterized as persons who prefer gaining an overview first while serialists are those who prefer establishing details before the overall picture. The participants were, first, asked to use a hypertext-based learning system to learn about given topics. After a learning period, participants' knowledge of the topics was evaluated. The results showed that serialists attempted to answer a higher number of questions and scored a higher number of correct answers in recall tests than holists did. Holists tended to answer fewer questions but more accurately than serialists. Field-independent participants tried a larger number of access attempts to information nodes than the field-dependents did. And the field-dependents were less successful in producing correct answers. Despite these differences, any effect on learning and recall was minimal. During an initial
phase of adjustment to an information system, cognitive and learning styles affected ways of searching for information but eventually all participants managed to find ways to adapt to the new situation and achieved similar end results.

**Holistic User-Oriented Studies**

Studies with a more holistic approach are concerned with user’s internal variables (cognitive, affective, or physical aspects) as well as external variables (social or cultural aspects). Since many user behaviors could not be clearly explained by cognitive aspects alone, researchers started to explore other possibilities.

Nahl and Tenopir (1996) provide a naturalistic study that examined novice’s searching behavior in a full-text database. Seven novice searchers were asked to search information on any topic of interest and to “think aloud” while searching for the topic in a full-text database. Verbal protocols (as these “think aloud” sessions are called) and transaction logs that capture actual users’ keystrokes and system responses were all used to record and analyze the novices’ search behavior. Based on the recorded data, novice users’ information needs and reactions to the information system were categorized into three groups: (1) cognitive, (2) affective, and (3) sensorimotor. Nearly half (48%) of the questions asked by novices were affectively-oriented ones while cognitively-oriented and sensorimotor-oriented questions accounted for about 26% each. These findings imply that the affective domain plays an important role in initiating information search.

Kuhlthau’s (1991) six stages in the information seeking process (initiation, selection, exploration, formulation, collection, and presentation) has been used to shed further light on the affective dimension. She found that an information seeker’s affective behavior changes depending on which stage the user has achieved. The studies of the user’s cognitive behavior far outweigh those on the user’s affective behavior, so there is much yet to be done to fully understand the changes in affective behavior.

Perhaps the best known work in determining the user’s holistic dimension in information seeking is Dervin’s “sense-making” approach which has developed from her perspective from the field of communication. According to Dervin, an information need is perceived when an individual’s internal sense is “run out” (Dervin & Nilan, 1986). Using a three-part model that posits a “Situation,” a “Gap,” and finally a “Use or Help phase,” she attempts to show how information needs vary over space and time. When individuals encounter a situation raising questions about their existing knowledge, they try to fill in the perceived gap or uncertainty by using sense-making. The sense-making effort is a process of using whatever is available to bridge the gap faced by the user, and the result of the process can vary depending on individuals. Jacobson’s study (1991) of NEXIS users is a study on the use of information systems which applies Dervin’s sense-making approach. In his research, participants who were novice users of information systems were asked to search for information on a given topic using NEXIS, a full-text information system. After the search session, participants had a time-line interview during which they were asked to describe their experience with the information system. The time-line inter-view is a method that Dervin developed to see when users perceive gaps and how they bridge the gaps. More detailed information on the method will be discussed later, in the methodology section of this paper. Jacobson found that there were four main stages of a search session: (1) choosing a library (a library in NEXIS denotes a family of files), (2) choosing a file or group within a library, (3) designing a search string and running the search, and (4) displaying the results. A much larger number of events were involved in each stage, and more than half (54%) of the events were perceived by the users to be successful. Information seeking behavior was distributed throughout the time-line of events. About 59% of the information seeking behaviors (or questioning) were observed when participants were successfully processing information with no difficulties in understanding the system. This suggests that questions asked by users while they use a system are not necessarily related to the problems of the system interface. Among questions concerned with the system interface, navigation was to be the most common problem for novice users of the system. Although, the study was not intended to evaluate a system, it provided useful information on the design of an information system as well as user’s information seeking behavior.¹

Uses and gratifications theory, another theory from the field of communication, is worth considering in trying to understand the selection and use of information systems, the next step after identifying an information need. Research on uses and gratifications in mass communication media has focused on trying to explain how and why an audience selects a particular medium.

Cantril (1950) found that books are used for strengthening one’s knowledge or understanding of self whereas films and TV are used primarily for entertainment. This finding was confirmed by Katz et al. (1974). Their study found that printed materials were used for self-learning while television programming was preferred for entertainment. Lometti (1977) attempted to group different communication channels by type, and identified three clusters of channels used for different purposes: (1) printed
materials were used for information gratification, (2) electronic channels for entertainment, and (3) interpersonal channels for behavioral and affective guidance.

In investigating reasons why a certain medium is preferred to others for a certain purpose, several models, mostly concerned with the affective domain of users (expectation, for example), have been developed. However, the current tendency is to explain media use behavior in the larger context, embracing psychological, social and cultural aspects. In the field of LIS, Chatman (1991) used uses and gratification theory to conduct a study observing how individuals in lower working class situations seek information. One of Chatman’s findings was that the janitorial workers used media that could respond to their immediate and practical concerns. Television and newspapers were the preferred media since they provided information on ways to cope with insecurity that the workers experienced and relayed general information about everyday events.

Research on users of information systems, and perhaps even more appropriately the World Wide Web environment which seems to combine the features of an information system with many potentially entertaining visuals has yet to be studied using this gratification theory, but it seems plausible that the uses and gratification theory can enhance our understanding of individual’s selection of as well as use behavior when there are a variety of different information channels from which to choose.

As the view of the user’s position as a unit of analysis moves from a more marginal system component position to a much more centralized component of our field, the amount and type of user behavior research will increase dramatically. The foregoing review has been an effort to show just such a shift. From the early Cranfield studies where relevance was assumed to be static for all users to the most recent efforts concerned with users’ dynamically changing affective responses to information systems, the methods needed have become more numerous and much more complex.

In what follows, we have attempted to highlight some of the methods frequently used for research in the area of users’ information seeking behavior. It cannot be considered an exhaustive collection of methods, but is described here to suggest possible approaches to those who wish to undertake user studies.

**SOME METHODOLOGIES FOR STUDYING USERS**

There are dozens of methods available to examine the behavior of human subjects. In the LIS field, a large number of research studies de-
tive behavior in information seeking is found in Allen (1992). In his study, he used college undergraduates and randomly assigned them to experimental treatments that tested the effects of their cognitive abilities like vocabulary comprehension, logical reasoning, and spatial orientation on their ability to use a bibliographic retrieval system. Particularly, he found that vocabulary comprehension has an effect on the willingness of people to express their information needs in alternative ways.

Good experimental research is difficult in the LIS field because the need to create a single experimental effect often means that subjects recruited must be placed in information use settings where artificial information needs are imposed upon them. To use an information seeker's own information need seems to require more subjective techniques which enable more of a focus on the individual's unique state of being.

Interview Techniques

Focus Groups

Focus groups represent an informal approach to providing a planned discussion designed to determine the needs and feelings of a particular population. Members of the focus group are chosen because they are assumed to represent the population to be addressed. Focus groups are often used as a preliminary step in the development of questionnaires or interviews in order to determine whether definitions, terms, concepts to be used will be appropriate to the sample who will later receive the questionnaire. Sometimes, however, the focus group can be a study in itself, rather than a precursor to other data collection efforts. A focus group usually consists of six to nine individuals and they discuss their experience, suggestions, and other issues related specifically to discussion questions designed by the researchers in advance. A moderator initiates the discussion along these pre-planned guidelines, but needs to provide fairly unobtrusive guidance. For example, the moderator has to identify what issues are to be discussed and set goals for the kinds of information to be gathered, but the flow of the discussion should occur without too many interruptions from the moderator. Focus groups are usually audio taped with the participants' permission and reviewed later for the extraction of themes and content areas that may have emerged during the discussion and that may not have been in the moderator's original plan (Krueger, 1988).

Naturalistic Inquiry

Mellon (1990) was a strong voice in LIS research advocating a group of techniques that first arose in other social science disciplines like sociology and anthropology. These techniques have been variously described as naturalistic, ethnographic, qualitative, symbolic interactionism—and to the various disciplines from which these traditions arose, there are fine distinctions between these differing names. But common to all is the general central ideal of collecting naturally occurring data—that is, data that arise from a natural context and environment. In user studies, this has come to mean going to environments where users experience need for information rather than studying the behavior of users only within an existing information system environment. These more subjective, qualitative methods seek to find broader explanations than can be achieved by looking at the relationship between two highly controlled variables in an experimental setting. The differences between the qualitative and the quantitative approaches are well documented and two well respected guides can be found in Silverman's (1993) and Erlandson et al.'s (1993) works.

Essentially the differences in approach between the qualitative and quantitative camps makes them good partners. Qualitative approaches use narrative description and seek to find categories that emerge as the research proceeds. Quantitative or experimental approaches require that concretely operationalized variables be determined before the study begins and may depend upon some sort of intervention that creates a very unrealistic environment for the respondent so that other variables are kept from interfering. Some compelling naturalistic studies of users' information seeking characteristics have been done by Chatman (1991), Kwasnik (1991) and Erdelez (1995). In these examples, respondents' opinions about information seeking and information organization were gathered through long in-depth interviews. The participants in each of these studies were purposefully selected to reflect a particular group of information users. Such purposive samples are the rule in naturalistic inquiry as opposed to the more randomly assigned participants used in experimental research studies.

Time-Line Interviews (for Dervin's Sense-Making Approach)

Somewhat similar to the naturalistic approach above, the influence of Brenda Dervin's (1992) sense-making has been substantial upon the information user research in the LIS field. Her work, and the many studies which use her sense-making techniques, have argued from the early 1970s that users should not be considered in aggregate groups—that each user constructs sense or meaning from a particularly personal point of view and from a particular moment in time.

According to Dervin, information-seeking can be defined as "gap bridging." The "time-line" interview method has been developed for
gathering information on the gaps and gap-bridging that the user perceives. The "time-line" interview refers to a structured interview during which users are asked to describe what they have experienced in a small segment of time. At times, the respondent is asked to imagine that they are making a movie of the event—-and to imagine what was occurring in scene 1, etc. The "movie" might be conceived as an information search effort. In the time-line interview, individuals are asked to recount what they experienced as if it were "a series of snapshots conveying everything that happened." Then, the interviewer writes down each event on a card. Once all the events are identified and written down, the interviewer goes through the whole series of events one at a time, and asks the respondent more detailed questions about their experiences at each snapshot point.

An effective demonstration of this approach is given in Newby, Nilan and Duvall (1991). They show how this more situational approach can be effective at explaining user behavior as they learn a word processing product. The authors argue that the user-based situational time line does a better job of predicting the information needed for a specific task and also provides system designers with detailed data about the nature of the task process in a dynamic, user-centered form along with a time-based specification of the information needs associated with each step in the task process.

Written User Surveys

According to a recently published content analysis of current LIS research on information use and users by Julien (1996), 44% of the research in this area is still conducted using the survey method. It has been one of the most frequently used methodologies for our field, perhaps because of its convenience and ability to be conducted without undue intervention in the lives of respondents. Information on users can be acquired simply by asking questions of users, but obtaining meaningful data requires careful thought about questionnaire content. Questionnaires can be distributed directly to individuals to be answered as they leave or while they visit an information setting; this approach results in a convenience sample and there are often difficulties generalizing to a broader population from such samples. For this reason, questionnaires are often administered by mail, to a selected sample which is drawn to be more representative of some larger population. The disadvantage is that the recipient may not complete and return the survey, but generally the benefits of allowing the respondent to choose the time when they can best give the questionnaire their attention and provide thoughtful responses outweigh the lack of response disadvantages.

With the advent of Internet technologies, questionnaires can also be e-mailed, or made available through the use of a Web page. Some early examples of efforts to place questionnaires on the Web are Palquist (1996) and Bertot and McClure (1996). In both studies, low response rates affected the success of the Web approach. In the case of questionnaires offered through a Web page, a variety of issues arise—the adequacy of recipients’ computer technology for responding in a technically reliable manner, the accurate identity of the recipient/respondent, the accuracy of the data they supply, the generalizability of results, etc. But the one clear advantage that the Web approach permits is that the same software that formats the questionnaire can also create a database of the responses. This allows an automatically created record of the survey responses that can be passed on to a statistical package, potentially saving hours of laborious coding of the responses.

Transaction Log Analysis

Transaction logging involves the automatic collection of computer use statistics concerning the human-computer interactions that have occurred while the system was being used (Nielsen, 1993). Log analysis is often used for collecting information about the actual use of a system. The advantage of this method is that it can record every keystroke and machine response that system users experience and do so unobtrusively. The disadvantage is that since all transactions are automatically logged it can be difficult to determine when one user completes an interaction and another user begins. Also, without some effort to accompany the transaction log with a user’s verbal “talk aloud” data, the transaction log cannot provide any cognitive or emotional data on the user’s internal state. At best, transaction logs tell us more about systems and should be viewed as a supplement to user study methods rather than a central approach. Additional information through some form of personal monitoring or tapping of a user’s internal state or intention is needed before systems can be more responsive to users.

Unconscious Cognition

A recent dissertation (Ballesteros, 1995) at the University of Texas at Austin has introduced to the LIS literature a new approach to the elicitation of users’ needs. Much of the research in users’ needs assumes the importance of conscious cognition by the user, but Ballesteros felt that the present theory of conscious information needs did not explain sufficiently
the problems demonstrated by users, particularly at the outset of an inquiry, of articulating an information need. In her research, unconscious cognition was tapped with a programmed relaxation device that took the user through a 20-minute, deep relaxation experience that elicited an altered state of consciousness which she monitored with an electroencephalographic biofeedback program. Prior to the relaxation exercise, the participants were asked to describe a present problem on which they were working. The subjects receiving the experimental treatment reported increases in intuition, insight, ideas and a more holistic understanding of their respective problems. While we may be some years away from such equipment at the reference desk, the effect and impact of the method on needs elicitation seems well worth additional research effort.

Usability

The term usability comes from the systems testing work conducted by many commercial software developers. Long aware of the problems that users report concerning software that is less than friendly or that fails to support the users' cognitive view of the task to be completed, software engineers sought to develop techniques for evaluating the usability of a product. Often applied primarily to interface design and development activities, usability studies involve a wide variety of techniques. Of particular merit for the task capturing users' models of software capabilities, a technique called "the cognitive walkthrough" has evolved as an important usability testing mechanism. Generally concerned with novice users, the cognitive walkthrough focuses on only one attribute of usability, the ease of learning a system. Theories of skill acquisition (Anderson, 1987) predict that facilitating learning by exploration will facilitate skill acquisition. Cognitive walkthroughs evaluate each step necessary to perform a task. They attempt to uncover design flaws that would interfere with learning by having the user carry out a task description and assess the sequence of actions that the user goes through to attempt a successful performance of the designated task. Each step in a performance sequence is examined to see if the user associates the correct action with the effect that the user was trying to achieve. Nielsen and Mack (1994) provide a comprehensive guide to a wide variety of usability methods and to a host of published research examples which demonstrated the effectiveness of such methods.

Verbal Protocol Analysis

In the 1980s, the evolution of the interdisciplinary studies called "cognitive science" meant an increased interest in studying the cognitive activ-

ity of many groups—in education, in human/computer studies, in psychology, etc. Concurrent and retrospective verbal reports were seen as methods of determining subjects' cognitive processes while they pursued particular tasks. Often conducted in more laboratory-like settings, these verbal reports have now become a standard research method in many disciplines. Concurrent verbalization was the phrase given to the technique of evoking a temporal sequence of mental events, also called "talk aloud" protocols. The standard approach to getting the subject to verbalize their thoughts concurrently is to instruct them to "think aloud." Retrospective verbalizations have a role to play in the development of oral histories within the LIS literature. Ericsson and Simon (1993) provide an excellent guide to evoking and analyzing verbal protocol data although they do advise the researcher about to examine the wealth of guidance available that there are a wide variety of instructions and procedures used to elicit concurrent and retrospective verbalizations. Their own techniques should not be taken as definitive.

Raya Fidel (1988) used verbal protocols and transaction logs of searches in order to examine professional searchers who were using bibliographic databases as a regular part of their work day. The purpose of her study was to identify, through these verbal "think aloud" protocols, whether searchers developed intuitive rules to guide their decisions about the selection of search terms.

CONCLUSION

As a discipline, library and information science must improve its understanding of the cognitive and contextual needs of information seekers. The intra-personal psychological understandings that move users to address information needs with the use of an information system are still not well understood. Inspired by the interdisciplinarity of LIS research methods, a variety of approaches have evolved which allow particular insights into the users' information-seeking strategies. The movement of the information services toward a less paper-based environment seems to dictate an increasing likelihood that the role of information counselor and trainer will increase for LIS professionals. These roles have previously been less than central to professional tasks since the central issues were based upon the organization and maintenance of the collection. While a more user-oriented research perspective is not new to our field, there have been few identifiable techniques that were available to the working LIS profession and that could be applied toward understanding a particular user community. User data collection has traditionally centered around those elements
of the collection and its organization so that data could be easily collected, and most importantly collected with the least intrusion upon the user. The materials collection, as a defining feature of information service, gave rise to techniques that checked the correctness of users interactions. The profession now needs to shift its emphasis to understanding why the user behaves as he or she does. The data gathered through more traditional collection use studies did more to explain collection-centered questions but did little to identify more individually held user concerns.

We have attempted to review studies on use and users of information systems and to describe research techniques currently in use within the LIS research community. We could not be exhaustive in our coverage and sought to focus on those techniques that seem to hold promise for identifying users internal states of being as they seek information. Future user studies should try to go beyond simply describing users' collection choices, and to aim at understanding and predicting users and their interactions with information retrieval systems. For this sort of understanding, those practicing in the information services should be able to choose from a variety of methods to test existing theories in order to increase our common pool of information of user-centered data with which to build a better understanding of our role and our user communities.

REFERENCES


