

Experienced Web Users' Search Behavior: Effects of Focus and Emotion Control

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This study investigates how users' cognitive and affective characteristics influence the navigational and search behaviors on the Web among experienced Web users. Sixty-seven undergraduate students participated in the study. Two standardized tests and a questionnaire were used to collect information on the participants' cognitive style, problem-solving style, and demographics. Factor analysis was performed on the scores from the two standardized tests (Group Embedded Figures Test and Problem Solving Inventory), and extracted two user factors (Focus Control and Emotion Control). The Focus Control factor seemed to influence users' navigational behaviors, such as the use of links and back buttons, whereas the Emotion Control factor affected search behaviors including keyword searching, and also search performance measured by precision and recall.

Introduction

Supporting a flexible presentation of information and various means of finding information, the Web has become one of the most important information systems. The Web is used for many different reasons, and over 70% of users access the Web in order to search for information (Georgia Institute of Technology, 1998). Research suggests that users' search behavior on hypermedia systems such as the Web is influenced by differences in user characteristics (Qiu, 1993; Ford, Wood, & Walsh., 1994; Palmquist & Kim, 2000; Wang, Hawk, & Tenopir, 2000), which coincides with Nielson's findings indicating that individual differences play a major role in influencing the use of hypertext systems (Nielson, 1989).

Since the Web was introduced to the public in the early 1990's, efforts have been made to study how individuals navigate and search for information on the Web, and also what factors affect their search behavior. In such studies, users' cognitive and affective characteristics as well as task characteristics have been found to have an impact on the Web search behavior (Nahl, 1997, 1998; Allen & Kim, 2000; Bilal, 2000; Wang et al., 2000). Today, an increasing number of users are using the Web, and they have significantly more experience with the Web than in the 1990's. According to Pew Internet Project report (Lenhart et al., 2003), about 60% of Americans use the Internet, and more than half of them are heavy users. As users have gained more experience with the Web, their Web search behaviors are likely to have changed.

This study investigates how experienced Web users search the Web. Are the user characteristics that have been found to influence the Web search behavior among relatively less experienced Web users still influential among the experienced Web users? In this investigation, two factors related to users' cognitive and affective domains were selected. Findings of the study are discussed in comparison with other previous studies. Based on the findings, issues related to user training and Web design are discussed and future studies are suggested.

Background

The way in which individuals search, collect and select information is closely related to personal preferences and styles of the searcher. Among different user variables, cognitive style – individuals' characteristic way of organizing and processing information (Goldstein & Blackman, 1978) – has been known to influence the manner in which individuals receive and process information and instructions (Messick, 1976). Field-dependence/Field-independence (FD/FI) cognitive style, one of the most widely studied cognitive styles, describes the degree to which an individual's perception or comprehension of information is influenced by the surrounding perceptual field (Jonassen & Grabowski, 1993). Previous studies have revealed that the cognitive style influences users' search as well as learning behaviors on a hypermedia-based system including the Web (Ellis et al, 1993; Ford et al, 1994;

Leader & Klein, 1996; Palmquist & Kim, 2000; Ford & Chen, 2000). Although they achieve a comparable level of search and learning outcomes, it has been found that individuals with different cognitive styles tend to adopt different search and learning strategies (Liu & Reed, 1994; Fitzgerald & Semrau, 1998).

In addition to users' cognitive characteristics, their affective characteristics also influence information behaviors (Wilson, 1981; Kuhlthau, 1991; Wang, Hawk, & Tenopir, 2000). Suggesting a more comprehensive model of human information-seeking, Wilson (1999) called for studies exploring user variables that may activate information-seeking behavior, such as problem/coping approaches and self-efficacy. Some researchers paid attention to those variables, exploring effects of self-efficacy (Nahl, 1996, 1997; Ren, 2000), and problem-solving/coping style (Kim & Allen, 2002), closely related to self-efficacy, on Web search behavior.

According to Brown (1991) information seeking is a goal-driven activity in which needs are satisfied through problem solving. Foltz (1996) argued that navigating a hypertext system is a problem-solving process requiring decision-making as well as information recognition. Problem-solving process comprises cognition as well as emotion and behavior. Skills of problem-solving include the ability to search for information, analyze situations for the purpose of identifying the problem in order to generate alternative courses of action, weigh alternative courses of action with respect to desired or anticipated outcomes, and select and implement an appropriate plan of action (Janis & Mann, 1977). This view is supported by Wilson's model of information seeking (1999), which considers the information seeking as a problem-solving process driven to reducing uncertainty. The approach/style that individuals would adopt in solving problems is likely to influence the process of problem solving including information searching.

Wu and his colleagues (1996) define problem-solving style as a tendency to respond in a certain way while addressing problems. In an exploratory study, Kim (1999) found that individuals who focus on problems (*problem-focused*) while solving problems tended to navigate the Web in a non-linear mode, using jump tools often. In addition, they were likely to spend more time for front-end-analysis, checking different nodes on the same level (i.e. "breadth first"). *Emotion-focused* individuals, on the other hand, navigated the Web in a linear mode, mainly following embedded links. Their navigation pattern could be characterized as "depth first" -- traversing several layers of nodes with little effort on the front-end-analysis. Kim and Allen (2002) found that individuals who assessed their problem-solving ability/style differently demonstrated different search behaviors. Users who assessed their problem-solving styles negatively tended to have a higher number of keyword searches and viewed a higher number of Web pages especially in ill-defined tasks such as a subject search task.

Study

Participants

Sixty-seven individuals participated in the study. All of them were undergraduate students from a university. The participants consisted of 30% (n=20) male and 70% (n=47) female students. All of them were experienced Web users. The participants used the Web at least weekly for more than 2 years. Regarding their background, 43% (n=29) of them were from hard science and 50% (n=34) were from soft science. Four participants (6%) did not have a declared major at the time of the study. Twenty-four percent (n=16) of the participants were freshmen, and 24%, 15%, and 37% were sophomore, junior and senior respectively.

Independent Variables

Four test scores were used for this experiment to identify major user factors. Then, two identified factors were used as independent variables. Tests used include Group Embedded Figure Test (GEFT) (Oltman, Raskin, & Witkin, 1971) and Problem-Solving Inventory (PSI) (Heppner, 1988), which are widely used to determine cognitive style and problem-solving style respectively. The PSI score, used for measuring a person's beliefs or appraisals of his/her coping capabilities/styles, is closely related to self-efficacy (Bandura, 1977). PSI consists of three components and yielded scores for each of them: AA (Approach-Avoidance), CON (Problem-solving confidence), and PC (Personal Control). Approach-Avoidance style refers to a general tendency of individuals to approach or avoid problem-solving activities. Problem-solving Confidence is defined as self-assurance while engaging in problem-solving activities. Personal Control, the last component of PSI, indicates the extent to which individuals believe that they are in control of their emotions and behavior while solving problems. In order to extract independent, major factors, a principal components factor analysis was performed on the scores from GEFT and three PSI components. The analysis yielded two major factors with eigenvalues greater than 1.00. GEFT and PC were selected to represent two factors: Focus control (GEFT & AA) vs. Emotion control (PC & CON).

Dependent Variables

Dependent variables were chosen to reflect a participant's navigational and search behaviors. In this study, three groups of dependent measures were adopted: navigational behavior, search behavior, and search performance. Navigational behavior was measured by the average number of times a navigational tool (e.g., embedded link, back, forward) was used for finding a piece of information. Measures of search behavior included the average number of times a search tool (e.g., search engine, keyword) was used for finding a piece of information. Dependent variables used for measuring search performance included precision and recall. In the study, relevant Web pages were operationally defined as pages retrieved and bookmarked by at least 10% of the participants. For calculating the recall ratio, the number of relevant Web pages retrieved by a participant was divided by the total number of relevant Web pages. For the precision ratio, the number of relevant Web pages retrieved by a participant was divided by the total number of Web pages retrieved by him/her.

Procedure

First, the PSI and GEFT were administered. Then, the participant was asked to fill out a questionnaire designed to collect demographic information. A search session began after the participant filled out the questionnaire. When the participant was ready, a topical search task was given to the participant by means of printed instruction. The participant was asked to find Web pages relevant to the given topic, and make bookmarks of the Web pages that he or she found relevant. Making three or more bookmarks was encouraged. During the search session, all the screen displays were recorded. After the search session was completed, participants were asked to complete another questionnaire regarding their search experience, and debriefed.

Data Analysis

The data collected were analyzed statistically. Factor analysis was used to identify main factors of independent variables. ANOVA was used to determine the effects of the user factors on the navigational behavior, search behavior and search performance.

Results & Discussion

Navigational Behavior

A significant main effect of Focus Control was found on two dependent variables: use of links ($F = 8.147, p < .01$) and back button ($F = 6.618, p < .05$). The participants who could control their focus well tended to use links and back buttons more frequently (See Tables 1 and 2).

Table 1. Effect of focus control: Average number of embedded links used

Focus Control	Embedded Links Used
Low	2.38
High	3.55

Table 2. Effect of focus control: Average number of back buttons used

Focus Control	Back Buttons Used
Low	1.55
High	2.52

Search Behavior

A significant main effect of Emotion Control was found on the number of keyword searches ($F = 5.255, p < .05$). That is, those who could not control emotion well tended to use a higher number of keyword searches (See Table 3).

Table 3. Effect of emotion control: Average number of keyword searches used

Emotion Control	Keyword Searches
Low	.758
High	.456

Search Performance

When the participants' search performance was compared, it was found that the participants who could not control their emotion well yielded significantly lower precision ($F = 4.284$, $p < .05$) and recall ($F = 4.722$, $p < .05$).

Table 4. Effect of emotion control: Precision and recall

Emotion Control	Precision	Recall
Low	.34	.19
High	.48	.28

Discussion

It is interesting to note that those who could control their focus, such as the field-independents, used links and back buttons frequently. This pattern is clearly different from what was found previously. In previous studies, the frequent usage of links and back buttons was observed among the field-dependents, especially those who had little or no experience with the Web (Palmquist & Kim, 2000; Kim, 2001). However, it is important to point out that in the previous studies, the frequent use of links and back buttons was always accompanied by the longer task completion time, which was not the case in this study. Those who can control their focus well used links and back buttons more frequently, without spending extra time to complete the task. This implies that the individuals with high focus control use links and back buttons, not because they get disoriented, but because they want to visit more pages. Their visit of an extra number of pages did not result in a poor search performance (measured in precision and recall). Here, it should be reminded that in this study, all the participants were experienced Web users. When this is taken into account, the finding can be interpreted that, among the experienced Web users who are aware of the rather unreliable and low quality of information available on the Web, those with high focus control feel comfortable with the idea of checking more pages to verify the quality of information retrieved. This is a new pattern of the experienced Web users with high focus control (field-independent), and worth further investigation to find out how individuals change their navigational behaviors as they gain more experience with the Web.

Another interesting finding is that individuals who could not control their emotion effectively tended to use more keywords, but their success rate was significantly lower than the others, as reflected in the low precision and recall ratios. It is speculated that those who are influenced by their emotions get anxious more easily, especially when they do not see much progress in their search, and try to launch new searches rather impulsively, without appropriate planning. Despite their effort in initiating new searches, those who cannot control the emotion tend to become less successful than their counterpart.

Overall, the findings seem to suggest that navigational behaviors and search behaviors are influenced by different factors. Focus control factor affects navigational behaviors (e.g., use of navigational tools such as links and back buttons) while Emotion control factor influences search behaviors (e.g., use of keyword searches). The Focus control factor is related to individuals' competency in navigating a hypermedia system that is known to be complex enough to cause getting-lost and disorientation problems. Those with high focus control tend to freely adopt any navigational behavior if they think such behavior is adequate for their tasks. The Emotion control factor, on the other hand, seems to be related to the planning of search behavior – an approach to solving information search problems. Those controlled by their emotions tend to be less effective in problem-solving as they try to solve problems impulsively without seriously thinking about and planning for the given problems. Their lack of planning usually results in a poor search performance despite the seemingly active search behavior (e.g., frequent keyword searches). Those who are more likely influenced by their emotions seem to need a special attention from the user

trainers and interface designers. Their search behaviors might be improved through a training program that helps them master the effective search planning process and also through more accessible and easy-to-use "help" screens that provide search tips to the searchers. Self-efficacy, related to users' self-assessment of their ability (Lazarus, 1966), would be one of the user characteristics related to the Emotion Control factor, which can be nurtured through effective user training.

The study findings suggest that users' information-seeking behavior changes as they gain more experience with the system they use, such as the Web. It seems that users' cognitive and affective characteristics interact with their search experience, and this dynamic interaction and its effect on user behaviors deserve further investigation. The study also suggests that different user characteristics influence different aspects of user behaviors. Some are more closely related to the execution level and others to the planning level of information search. For the experienced users who can use the system with little or no difficulty, educators and system designers will need to put more efforts on helping them in a more intellectual level, such as the planning of an effective search. This will include offering guidelines/helps in the selection of appropriate keywords, the formulation of effective queries, and also the appropriate evaluation of the search results, rather than a simple facilitation of the system navigation.

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