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EVALUATION OF WWW USABILITY AND USER PERFORMANCE

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Abstract

This paper explicitly investigates the influence of hypertext structure and user interface formats on usability of hypertexts in different tasks, searching and browsing. In this study, the way in which different combinations of potential hypertext factors can affect the usability of a hypertext system will also be evaluated. For this study, eight conditions of hypertexts are distinguished. The subjects will complete 10 searching/browsing tasks, in which information must be found in the hypertext document collection as quickly and accurately as possible. Another experiment will then be carried out with real world web sites to measure the hypertext usability by applying the similar tasks as the previous experiment. Very few studies explored hypertext usability with experimentation of World Wide Web (WWW). Previous studies usually investigated these factors separately and, therefore, failed to reveal the interaction among factors. The current study explores the simultaneous effect of factors together.

Introduction

Hypertext is subject to usability problems (Dias, Gomes, and Correia, 1999; Dillon, McKnight, and Richardson, 1990). Several studies have measured hypertext usability in terms of the efficiency with which users perform some defined task, using measures of task completion time, accuracy of task performance and errors (Lin, Choong, and Salvendy, 1997; McDonald and Stevenson, 1999). Other studies measured hypertext usability in terms of orientation and navigation (Wright & Lickorish, 1989; Babiker, Fujihara, and Boyle, 1991). Nielsen (1989) compared 92 published benchmark measurements of various usability issues related to hypertext and identified the two most important issues: individual differences among users, and differences among tasks.

This paper studies hypertext usability by measuring in terms of the mental effort and attitude of the user, and how the user interacts with the product. This paper explicitly investigates the influence of hypertext structure and user interface formats on usability of hypertexts in different tasks, searching and browsing. In this study, the way in which different combinations of potential hypertext factors can affect the usability of a hypertext system will also be evaluated. The purpose of this study is to determine whether perceived web usability differs across users, two types of links structure (hierarchical and mixed), two types of task types (searching and browsing), and two types of user interface format (map-based and text-based) from a usability perspective. Figure 1 indicates the conceptual model of this study.

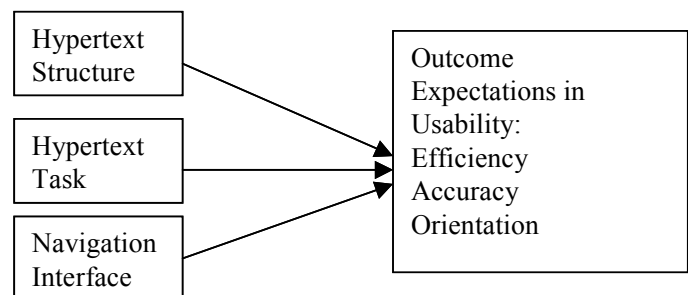


Figure 1. Conceptual Model

Background

A number of attempts have been made to simulate browsing behavior of hypertext by varying the nature of the task. Two main task types have been identified: “searching” tasks, which require the user to find information from one place in the structure, and

“exploratory” tasks, which require the user to find related items of information within the structure (Monk, 1989;). Nielsen’s extensive survey of studies (1989, 1990) covered most of the important literature on hypertext, and related topics in information retrieval. These studies primarily investigated hypertext design concepts and mechanics of implementation (e.g., the impact of interface software, hypertext versus scrolling test, hypertext versus traditional computing systems, hypertext versus paper, subjective judgments about hypertext, searching and information retrieval, the uses of hypertext in education, individual differences, conceptual models, logging user interactions, observing users, and interface refinement).

There are a number of strategies that can be used in navigating through hypertext. It is complex to compare linear, hierarchical, and network linking structures by using experimental evidence (Westerman et al., 1995). It would appear that the nature of the task (Nimwegen, Pouw, and Oostendorp, 1999; Gordon et al., 1988), the organization of information (Vries and Jong, 1997), and the combined effects of the information content the hypertext and cognitive structure applied by the user (Westerman et al., 1995) are all factors that influence the optimal structure.

Researchers in various disciplines have shown interest in studying human computer interaction and user interfaces. The popularity and expansion of hypertext and the World Wide Web (WWW) has accelerated and unprecedented growth in the computer-based information (Rumpradit and Donnell, 1999). Since a variety of techniques have been utilized, and if we know how user interface elements are suited to a specific task, we can develop and enhance user interface designs that are more satisfactorily and applicable to the users (Gay et al., 1991; Hix and Schulman, 1991).

Graphical presentation of information often permits faster information transfer between computer and user (Lai and Waugh, 1995; Tauscher and Greenberg, 1997). Graphical maps, browsers, table of contents, and multiple windows have been used in early empirical hypertext studies to examine their effects on hypertext usability (McDonald and Stevenson, 1999; Rumpradit and Donnell, 1999). In the current study, a text-based interface will be compared with a map-based interface. Through an image map, users can be provided with a graphical overview of any set of information resources; by clicking on different parts of the overview image, they can transparently access any of the information resources (possibly spread out all across the Internet).

Methodology

The following propositions are generated from the literature review.

P1: Users using a mixed link structure will be more accurate, more efficient, and more oriented than users using a hierarchical link structure.

P2: There is a significant difference in accuracy, efficiency, and orientation between browsing and searching.

P3: Users using a map-based interface will be more accurate, more efficient, and more oriented than users using a text-based interface.

Independent variables of the study are hypertext link structure, user task type, and user interface type. Dependent variables include accuracy, efficiency, and orientation. In the measurement of accuracy, subjects will be asked to find information, from which to answer a set of 5 browse questions and 5 search questions, and to record their answers to these questions. This will be measured partly following the method used by McKnight, et al. (1989), giving a value of zero for an incorrect or missing answer, 0.5 for a partly correct answer or ‘almost correct’, and a score of 1 for a correct answer. When a user is efficient in solving hypertext tasks, the user should complete a task accurately within a reasonable period of time without getting lost. Following from Babiker et al. (1991) and Canter et al. (1986), the comparison of the total amount of time to complete a task was used as a measure of efficiency in this study. The time each subject takes to complete each task will be recorded based on task starting and finishing time. The record will be extracted from the server log. Less time indicates more efficient. To measure the orientation, a method of path measurements following from Smith (1996) will be utilized. The number of different nodes accessed (N) will be compared with the total number of nodes accessed (S). A value of N/S close to zero shows many repeat operations to the same nodes, whereas a value 1 shows that every node visited was a new one. In other words, as users become increasingly disoriented the value of N/S tends to zero, while for users who are not disoriented the value of N/S tends to 1. The summary of measurements of dependent variables is shown in Table 1.

Table 1. Summary of Measurements of Dependent Variables

Variable	Independent Variable	Measurement
Accuracy	Link structure (hierarchical and mixed), task types (searching and browsing), and interface type (text-based and map-based)	giving a value of zero for an incorrect or missing answer, 0.5 for a partly correct answer or 'almost correct', and a score of 1 for a correct answer.
Orientation	Link structure, task types, and interface type	Path measurement for completing tasks N/S: the number of different nodes accessed (N)/ total number of nodes accessed (S) (0: disoriented, 1:oriented).
Efficiency	Link structure, task types, and interface type	the total amount of time to complete a task (less time: more efficient)

Discussions

The experimental system covers topics on the Internet and WWW. It includes: a) fundamentals, concepts, and facts on the Internet, b) the way the Internet works and technologies, c) applications used on the Internet, d) WWW, and e) multimedia. Each major area is further subdivided into next level, which branches down to four to five levels. The experimental hypertext system available electronically in a Hypertext Markup Language (HTML) format has four versions with the same contents and the same amount of information. The differences lie in the type of structure (hierarchical vs. mixed) and the type of interface (map-based vs. text-based).

The experiment will consist of 5 search tasks and 5 browse tasks. Subjects are requested to locate answers to the task questions in the experimental system and write them down on the answer sheet. Subjects are given 3 minutes to complete a search question and 5 minutes to complete a browse question. The researcher will time each task with a stopwatch and notify subjects to advance to the next question if the time limit exceeds. At the same time, the subjects' performance of information access will be recorded and evaluated.

Another experiment will then be carried out with real world web sites to measure the hypertext usability by applying the similar tasks as the previous experiment. Subjects will be given four web sites on the Internet and target information to be found. This experiment will serve as an aid to increase the generalizability of the first experiment. The four sites will represent four combinations of the experimental cube: hierarchical hypertext structure with text-based interface (HSxTI), hierarchical hypertext structure with map-based interface (HSxMI), mixed hypertext structure with text-based interface (MSxTI), mixed hypertext structure with map-based interface (MSxMI). Then the experiment will consist of eight conditions as the first experiment does by differing user task types (searching and browsing).

Several hypertext studies have been carried out to examine the factors that influence user performance. Very few studies explored hypertext usability with experimentation of World Wide Web (WWW). The factors that have been previously considered as impacting user behavior were mainly search experience and search tasks. However, those studies usually investigated these factors separately and, therefore, failed to reveal the interaction among factors. The current study explores the simultaneous effect of factors together by using an analysis of variance.

Table 2. Summary of Second Experiment

Hypertext	Hierarchical Hypertext structure with text-based interface (HSxTI)	hierarchical hypertext structure with map-based interface (HSxMI)	mixed hypertext structure with text-based interface (MSxTI)	mixed hypertext structure with map-based interface (MSxMI)
Web site	www.ed.gov	www.dell.com	www.ebay.com	www.disney.com

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