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Usability of World Wide Web Browsers by Persons with Visual Impairments

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ABSTRACT

The results of this study indicates the World Wide Web (WWW) has significant barriers to persons with visual impairments. The study compared performance of four visually impaired with four matched able bodied subjects on five WWW related search tasks. It took the visually impaired subjects almost 3 times longer to access WWW pages the first time they use the page. After the fourth session the performance difference was about 2 times longer. One task of accessing information from a HTML formatted table was impossible for most of the visually impaired subjects to access even after the fourth session.

BACKGROUND

One of the main issues facing persons with disabilities is access to the WWW and other information technologies. There is serious concern over current accessibility of the WWW and design guidelines are being developed to improve the accessibility of the WWW (1,2,3). The study presented in this paper was conducted to quantitatively determine the magnitude of the problem faced by persons with visual impairments accessing the WWW.

RESEARCH QUESTION

The purpose of this research is to study the accessibility of WWW browsers by people with visual impairments, and how they use browsers for completing search tasks through different types of HTML formatted documents. The main question of interest is to identify completion time and behavior differences between persons with visual impairments and their able body peers.

METHOD

In this study, subjects are asked to perform search tasks on the WWW in a series of four sessions, with six tasks per session. These tasks are performed using NCSA Mosaic version 2.0 for Windows 3.1. Sessions are recorded using a direct video feed and microphone, so the images on the monitor and all sounds in the room are recorded onto videotape. The six tasks for each session are counterbalanced across subjects and sessions. Statistical tests can only control type II error to $p < 0.0625$ due to the small sample size (4 subject pairs). All statistical tests we based on the binomial distribution of probable outcomes.

Subjects

The subjects consisted of a test group of four persons with severe visual impairments and a matched control group of abled bodied persons with normal vision (20/20). Subjects are matched by academic major or type of employment, age, and level of computer experience. Two pairs of subjects are female and two pairs are male. Two pairs of subjects had no experience with WWW browsers prior to participation in the study. One pair of subjects was composed of experienced computer users who used Web browsers regularly prior to participation in the study. One pair was composed of expert computer users who use Web browsers extensively and have written and maintained Web pages. Subjects received no monetary compensation or class credit for participation.

Tasks

For each of the four sessions, the subjects were asked to perform five tasks. Each set of tasks was presented on a Web page that the subject returned to throughout the session. Each set of tasks was of similar structure with slightly different content. The following are descriptions of the types of tasks used in the study:

Task 1: Involves using the Yahoo™ search engine to find a piece of information. Using search engines is a common activity among people who use Web browsers and is an important skill in using the Web effectively. This task looks at how effectively the subjects perform keyword searches.

Task 2: Involves using the Internet Movie Database to look up the year of birth of a specified actor or director. The purpose of this task is to explore how effectively the subjects are able to use forms.

Task 3: Involves finding a picture of a cast member using the Seinfeld homepage. The Seinfeld pages feature a number of graphics and icons.

Task 4: Involves using the Home Automation Catalog to find a price for a specified product. For this task, the subject has the option of navigating graphic or standard links, or using a search form.

Task 5: Involves using a HTML formatted table of course listings to find information on a specified course.

Procedures

In an orientation session, the investigator introduces the subject to the NCSA Mosaic Web browser. If the subject has a visual impairment, the browser is configured for the subject, adjusting text size and text and background colors. In each of the four test sessions, the subject is given a review of the orientation material. The subject is then shown a WWW page containing a set of six tasks. The subject is asked to follow the instructions given on the WWW page using the underlined links to perform each task. The sessions are videotaped for later analysis.

RESULTS

Session Performance by Group

For each matched pair of subjects a percent differences score was calculated, with the time of the abled body subject for each pair used as the basis for the percentage. The formula used to calculate the percent differences is (TVI - TAB) / TAB. Figure 1, Percent Difference of Session Times shows that the combined percent time difference per session between the AB group and VI group is 143% in the first session but that number decreases steadily with each subsequent session to 70% in the last session. In short, the V subjects were significantly slower for overall average performance difference ($p < 0.0625$) and for performance differences during sessions 1, 3 and 4 ($p < 0.0625$) as a group than the AB subjects. For pairs 1 and 4, the novices, the gap seems to narrow as they became more experienced. For the experienced Pair 2, and expert Pair 3, there is not a clear trend. Note that the highest session percent difference (750%) was seen with Pair 3, the expert computer users, in Session 1. In Session 2, the only case occurred in which a VI subject completed a session in less time than the corresponding AB subject. This occurred with Pair 3, the expert users.

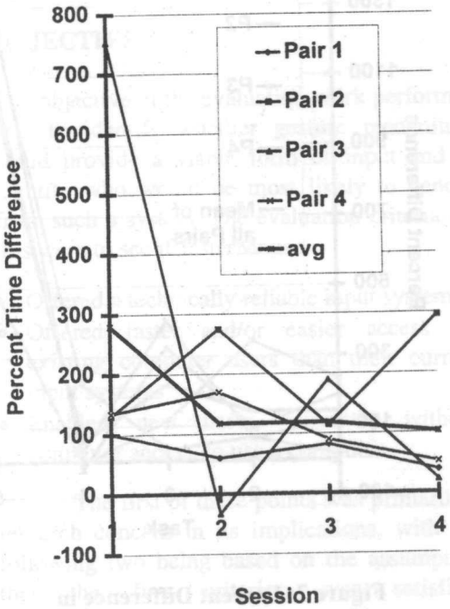

Figure 1: Percent Difference in Total Completion Time by Session

Task Time by Group

Figure 2 shows the average Percent Time Difference Between Pairs for each task. There are significant differences between the subject airs for sub tasks 1, 2, 3 and 5 ($p < .0.0625$). From the mean values it can be seen that for tasks 1, 2 and 3 percent differences are fairly consistent with the visually impaired subjects

taking 139, 140%, and 218% more time the matched sighted subjects. The task with the smallest performance difference of 55% occurred in Task 5. The largest percent difference of 1075% occurs in Task 6, (involving the HTML formatted table of course listings) . The percent differences for Task 6 range from 343% (Pair 2) to 2459% (Pair 3). Demonstrating that the table lookup task was trivial for the sighted subjects, but almost impossible for the visually impaired subjects.

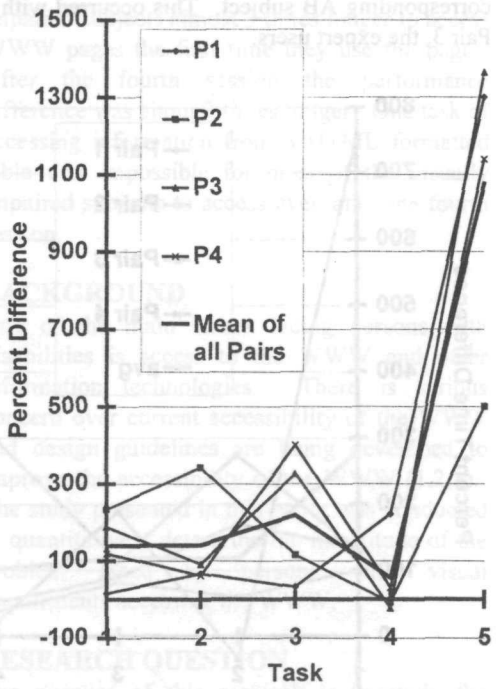

Figure 2: Percent Difference in Completion Time by Task

DISCUSSION

The results of this study indicate that there are significant barriers to persons with low vision to access the WWW. Persons with visual impairments do improve their performance with practice. But the largest differences in performance occur during the visually impaired subjects first encounter of a WWW page (almost 3 times longer). Given the dynamic nature of the visually impaired users are going to be at a disadvantage since they will always be encountering new WWW pages even at familiar sites. New tags like FRAMES and Java applets will continue to compound the visual orientation problems of persons with visual impairments as visual displays become more complex and mix text with graphics.

To improve the accessibility of the WWW two approaches need continued development. One is to improve the accessibility of the source document to provide information that is more accessible(4). The second is improving the design of WWW browsers to provide additional controls to make it easier for persons with low vision to access the structural components of HTML(4).

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