

Improving Usability of E-Commerce sites by Tracking Eye Movements

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Abstract: Usability evaluation techniques such as user-observations, cognitive walkthroughs, or heuristic evaluations can be applied to evaluate the usability of multimedia interfaces of computer systems. Although user observations involve observing end-users or representative users interacting with the system these evaluations are limited in the amount of information they can provide. For example, if the user has difficulty interacting with the user interface in order to complete a task, it is not always obvious from the evaluation data, where and why the usability problem occurred. Additional information, such as the user's cognitive processes and eye movements through the interface as he interprets the information on the display is required. Recording the user's eye movements while he is completing a task is an objective way of collecting information about how the user is interacting with the interface. Eye movement recordings can provide a record of the pattern of fixations, the time the user spent looking at various elements of the user interface, and insight into the user's visual attention.

Keywords: Usability, Eye Tracking, E-Commerce, Usability Evaluation

1 Thesis Synopsis

The growth in usability evaluation of user interfaces of computer systems has prompted researchers to look at how eye movements could be used to help understand how users view, search and process an interface (e.g. Baccino & Colombi, 2001). This thesis proposes the tracking of eye movements as a complementary technique for conducting usability evaluations by illustrating the application of the eye tracker in evaluating E-Commerce sites. The technique is described in detail in the following section.

2 Eye Tracking

Eye movement analysis has been based on the assumption that eye movement patterns reflect internal cognitive processes, for example how characteristics such as graphics and coloured text on the interface influence user information processing behaviour (Goldberg & Kotval, 1999).

The focusing of the eye on an object is termed a *fixation*. A fixation typically lasts about 300ms. After a fixation the eye goes through a movement – termed a *saccade*- to fixate on another part of the

same object or on a new object. Such saccades last approximately 150-200ms from planning to execution (Palmer, 1999). There is no information obtained during a saccade as there is insufficient time for visual feedback to guide the eye to its final position. Information can be extracted during a fixation when the eye stabilizes the retina over an object of interest on the user interface.

The number and duration of fixations indicate how difficult it is for the user to interact with the user interface. If it is difficult for the user to interact with the user interface and to process the information being displayed then fixations will be longer and there will be more fixations closer together (with relatively short saccades) than if the display is easy to process (Cowen et al., 2001).

For example, when a user is asked to find specific information on a flash designed web site, eye movements reveal the frustration or difficulty the user is experiencing due to the flash animations that distract him from finding the relevant information. The number of fixations and their location will reveal the user's discomfort.

In the next section, the eye tracking equipment that I am using in my PhD is described.

3 Project

3.1 Eye Tracking Equipment

The SensoMotoric Instruments (SMI)'s Head-Mounted Eye tracking Device II (HED-II) will be used to collect the eye movement data. The eye tracker uses two small cameras (the eye camera and the scene camera) mounted on a bicycle helmet. No physical contact is made with the participant's eye. An infrared light shines into the participant's eye so that the front surface of the eyeball is illuminated. This produces two effects: the bright pupil and the corneal reflection (SensoMotoric Instruments, 2003).

The iView software on the computer to which the eye tracker is connected analyses the transmitted image creating the Point of Regard which is a dot representing the pupil of the user's eye. An MPEG file of the video recording is produced by the dot overlaid scene which is saved for further analysis. The iView software consists of data analysis tools for statistical analysis of measurements such as number and duration of the fixations and saccades.

3.2 Research Objectives

The aims of this research are:

- To demonstrate the usage of eye movement data in comparison with other traditional usability evaluation techniques such as user-observations and heuristic evaluations to uncover potential usability problems in the design and usability of E-Commerce sites;
- Based on the empirical work on E-Commerce sites performed as a part of the previous aim, to develop guidelines for integrating visual elements and for structuring their presentation on an E-Commerce site.

3.3 Work Done So Far

In the last three months since I started my PhD (from October 2002), I have conducted an extensive literature review on eye tracking and its applications in usability evaluations of computer systems.

Eye movement research requires specialised knowledge and expertise to use the eye tracker equipment. As the equipment (eye tracker) is sophisticated and state of the art, there is a steep learning curve for its usage. Prior to registering for a Ph.D., I was working in an Information Design Company, where I used similar equipment and data analysis tools for conducting usability evaluations of E-Commerce sites and documents (e.g. telephone

bills, bank statements). This prior experience has helped save a lot of training time and enabled me to launch myself into empirical work.

In addition to my on-going literature review, I have conducted a set of pre-pilot studies on E-Commerce sites. One of the pre-pilot studies focused on determining the gaze patterns that the users have when visiting unfamiliar and familiar websites. The participants in the study were asked to find specific information on five different E-Commerce sites. The majority of the participants looked at the top menu bar instantly as a 'first look' method when visiting the web pages that they hadn't visited previously. When the participants were asked to find specific information on Web sites they had previously seen or used, they looked straightaway at the relevant link without looking on the top of the menu bar.

The results of this study have revealed differences in the eye movements of the users while visiting familiar and non-familiar Websites. Users find information easily when they visit a Web site they have seen before and apply a similar method of information searching when they visit another Web site for the first time. These pre-pilot studies have helped me to gain experience with using the eye tracker equipment available at the Open University, setting up evaluation sessions, and exploring the advantages of using the eye movement data for evaluating user interfaces.

3.4 Current Activities

I am currently involved in conducting further studies on E-Commerce sites to identify design elements/layout features of the site that I would like to concentrate on for my research. Some of the issues that I have been exploring are - where do users look on the Home page of a Web site to find latest news / information; where do they expect to find marketing messages such as special offers and deals; or the contact details of the organisation.

I am also in the process of identifying the eye movement metrics which I will be applying for the analysis of the eye movement data. Some of the key measurements are:

- *Number of fixations*: The number of fixations is thought to be negatively correlated with search efficiency (Goldberg & Kotval, 1999). A large number of fixations may indicate less efficient searching, possibly resulting from a poor arrangement of display elements.
- *Gaze % (proportion of time)* on each area of interest: The proportion of time looking

at a particular display element may reflect the importance of that element.

- *Scan path (sequential analysis of fixations)*: This metric studies the transition probability between areas of interest. Where do users first look at the interface, then next, and so on?

3.5 Research Work Planned for the First Year

- Write a review paper based on the ongoing literature review;
- Write the review chapter of the thesis;
- Identify the key elements of an E-Commerce site that I would like to focus on in my research;
- Plan and conduct studies on E-Commerce sites using the eye tracker, and compare the outcomes of these evaluations with those obtained by applying other usability techniques, such as user-observations and heuristic evaluations.

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Personal Background

I have a background in Applied Psychology and Human Factors. I have worked in the industry as a usability researcher for two years. During this period I was introduced to the fantastic and interesting area of eye tracking as a usability evaluation technique, which I am now developing in my Ph.D.