

# Web Browsing Experience and Viewpoint: An Eye-Tracking Study

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## Abstract

The purpose of this study is to examine the factors that affect Web page browsing patterns by using eye-tracking data. Josephson and Holmes (2002) examined Web-viewing patterns from a Web page layout viewpoint. This study focuses on users' understanding of functional areas of a Web page and examines related factors, specifically Web site category, user experience. Two Web user groups (heavy users  $n=9$ , light users  $n=6$ ) browsed Web pages from three Web site categories (portal, news, and advertisement) while the total gaze times for functional areas were measured to characterize the users' browsing patterns. A three-way ANOVA was performed on the total gaze times. As a result, it was confirmed that Web experience and the area functions of Web pages had affected the observed browsing patterns. It is suggested that not only page layout but also the area functions of Web pages, as well as the users' experience, are important factors in fully understanding Web browsing patterns.

## Introduction

The ability to get information rapidly and accurately in a cluttered visual environment is an important skill today. This is especially true for the World Wide Web, which has become an important source of information along with traditional media such as books, newspapers, and television. As part of a visual perception study, Josephson and Holmes (2002) studied Web-viewing behavior, focusing on categories of the Web pages' visual design. They performed eye-tracking experiments during repeated Web page viewing tasks, using three kinds of web pages with typical layouts: portal, news, and advertisement. Their results show that a unique viewing pattern was formed during Web page browsing. They suggest that user eye movements were affected by the following two factors: (1) the visual design of the Web page, and (2) habitually preferred paths across visual stimuli.

A Web page is made of a number of functional areas, such as 1) welcome and site identity, 2) navigation, 3) content of interest, 4) advertising and sponsorship, 5) self-promotion, 6) filler, as defined by Nielsen and Tahir (2002). How to use these functional areas differs from site to site. Each site has a specific purpose, with the functional areas used to represent that purpose most effectively. Josephson and Holmes (2002) focused on the layout of such functional areas to examine Web browsing patterns using eye-tracking data. However, as a user's goal in Web browsing is to get information, we surmise that both the physical layout of the functional areas and their meanings affect a user's Web viewing patterns. Furthermore, how the users understand the

meanings of the functional areas of Web sites depends on the users' experience. The more the users visit a site, the better they understand the meanings of the area functions that that site uses. Our previous research (Habuchi, Takeuchi, & Kitajima, 2006) confirmed this assertion. We demonstrated that Web-viewing patterns, as measured by the total gaze times in the above-mentioned six functional areas, were affected by the Web site category (portal, news, or advertisement) and the user's Web experience.

## Hypothesis

This paper extends Habuchi et al. (2006), and reports a new eye-tracking experiment to verify the following three hypotheses.

### **Hypothesis 1 (Web site category factor):**

The total gaze time is affected by the Web site category.

### **Hypothesis 2 (User experience factor):**

The total gaze time is affected by the user's Web experience.

### **Hypothesis 3 (Area function factor):**

The total gaze time is affected by the area function of Web pages.

## Methods

### Participants

Fifteen internet users were recruited from Tsukuba University, Japan, based on their internet usage. Participants ranged in age from 19 to 27 years, and had normal or corrected-to-normal vision. They were divided into two groups, heavy users ( $n=9$ ) and light users ( $n=6$ ), based on their frequency and style of Internet use. The heavy user group consisted of comparatively heavy internet users who browse and use various sites for more than 10 hours per week. The light user group consisted of comparatively conservative users who use a regular portal site for fixed purposes and whose internet usage is less than 6 hours per week. There was a significant difference between the two groups in internet usage per week,  $t(10)=5.83$ ,  $p<.05$ .

### Apparatus

The experiment was controlled by a DELL Inspiron/9200 computer. Stimuli were presented on an EIZO Flex Scan L985EX display. Participants' eye movements were collected with a Tobii x50 eye-tracking system (Tobii Technology).

## Materials

Fifteen Web pages in three categories, portal, news, and advertisement, were chosen for this study. The three categories were different visually and functionally. The content area of each web page was classified into six functions after Nielsen and Tahir (2002): 1) welcome and site identity, 2) navigation, 3) content of interest, 4) advertising and sponsorship, 5) self-promotion, and 6) filler.

## Procedure

The participants were instructed to look at the Web pages carefully and to evaluate the usability of the pages. They viewed 15 Web pages in three categories: portal, news, and advertisement. Gaze time data were collected using an eye-tracking system during the task. Each Web page was randomly presented for 20 sec. After the task, participants filled out an internet usage questionnaire.

## Results

From the eye-tracking data collected from 225 Web pages in total (3 categories  $\times$  5 pages  $\times$  15 participants), we extracted visual fixations lasting more than 100 msec as gazes for further analysis. The fixation duration ranged from 100 msec to 3,069 msec. The average number of gazes per page was 48.6. In order to analyze the data, we summed the gaze times in each functional area of the five Web pages from the same Web site category and averaged over the participants with the same Web experience (heavy or light). Figure 1 plots these data.

A standard three-way analysis of variance was performed on the total gaze times, there being one between subjects factor of Web experience and two within subjects factors, Web site category and area function. The results are presented in Table 1. We report results regarding the main data.

For hypothesis 1, the analysis shows that Web site category alone has no significant effect ( $p=.18$ ). However, the analysis demonstrates significant two-way interaction effects between Web site categories and area functions ( $p < .001$ ) and the three-way interaction between Web site category, user experience, and area function is significant as well ( $p < .001$ ). Thus, hypothesis 1 was supported with combination of factors.

For hypothesis 2, the analysis shows that users experience are significant factors ( $p < .01$ ). Thus, hypothesis 2 was supported.

For hypothesis 3, the analysis shows that the area function are significant factors as well ( $p < .001$ ). Thus, hypothesis 3 was also supported.

In sum, the statistical analyses indicated that three hypotheses were supported.

Table 1: ANOVA Analysis of gaze time factors.

Factor	Significance Level ( $p < .05$ )
Web site category	n.s.
User	s.
Area function	s.
Web site category* User	n.s.
Web site category*Area function	s.
User*Area function	s.
Web site category* User*Area function	s.

## Conclusion

This paper demonstrated that Web browsing patterns, as characterized by gaze times for functional areas, is a useful measure for understanding how Web users browse Web pages. However, the gaze times we used in this paper do not convey information that depends on a sequence, such as the scan path. These time-dependent variable should also be affected by the parameters we focused on in this paper, i.e., Web site categories, Web users' experience, and Area function. We plan to extend our approach to the examination of these issues.

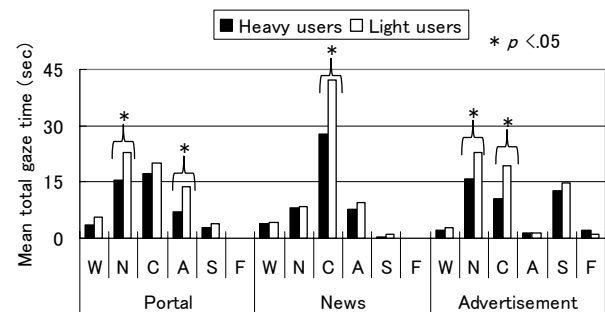


Fig. 1: Mean total gaze time in each functional area (sec).

*Note.* The symbols stand for six functions: Welcome and site identity, Navigation, Content of interest, Advertising and sponsorship, Self-promotion, and Filler.

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