Where Do Web Visitors Look and at What? – An Eye-Tracking Study

Yoshiko Habuchi, Haruhiko Takeuchi, and Muneo Kitajima

National Institute of Advanced Industrial Science and Technology (AIST),
Tsukuba Central 6, 1-1-1 Higashi, Tsukuba, Ibaraki, 305-8566, Japan
{habuchi.y, takeuchi.h, kitajima.muneo}@aist.go.jp

Abstract. The purpose of this study is to investigate Web-visitors' viewing behavior by using eye-tracking data. Users' eye-scanning strategies were analyzed in terms of user experience, Web-site categories, and location and function of Web-page components. Two Web user groups, eight heavy users and eight light users, were asked to browse a total of eighteen Web pages from three Web-site categories, portal, news, and corporation. We assumed that the participants would exhibit either location-based Web page viewing behavior, characterized by the absolute location of viewing areas, i.e., left, middle, and right, or function-based Web page viewing behavior, characterized by the function of viewing areas, i.e., contents, navigation, and advertisement. The total number of fixations for each area was measured. The results demonstrate that the users adopted a function-based viewing strategy when the site purpose was obvious, otherwise they adopted a location-based viewing strategy.

Keywords: Web page viewing behavior, eye-tracking.

1 Introduction

An important question for Web-site developers when designing a Web site is where and at what a visitor looks when he/she visits their sites for carrying out his/her tasks such as reading news, purchasing products, and collecting information about a company. For the last decade, a number of eye-tracking studies have revealed some regularities in Web-viewing behavior. The Stanford-Poynter project dealt with internet news-reading behavior [1], a large-scale eye-tracking study found an F-shaped pattern for reading Web content [2], and patterns of scan-paths were investigated in terms of the Web-page layout [3]. However, these studies tended to ignore individual differences in Web-viewing behavior that might be caused by the individual differences of Web-using experience, motivation to view the Web pages, familiarity with the topics provided by the visited Web site, and so on. These factors, however, are necessary for answering the what-and-where question. A more detailed understanding of Web visitor viewing behavior is required in order to make Web contents more accessible to the intended individual visitor who may exhibit different interactions caused by the above factors.

The purpose of this study is to investigate Web-viewing behavior by using eye-tracking data. The eye-movement patterns of a visitor on a Web page are expected to

be a mixture of location-based viewing and function-based viewing [4]. Location-based viewing refers to a spatially organized eye-scanning strategy, such as viewing the central area first, irrespective of how the contents are arranged, and this concerns the "where" question. Function-based viewing refers to a semantically organized eye-scanning strategy, such as looking in an area where the user knows the information he/she is looking for should exist, and this deals with the "what" question.

A hint for answering the what-and-where question resides in the top-down processing of Web-page contents. A Web-site visitor performs top-down processing guided by his/her cognitive schema when viewing a Web page [5]. Several reports have provided supporting evidence for Web-viewing schema [6], [7]. We conjecture that the what-and-where question would be answered by articulating the Web-viewing schema that Web visitors with varying degrees of Web experience would apply when visiting a specific Web site with a specific viewing purpose. There are two types of Web-viewing schema: one represents where to look and the other, what to look at. Thus, the analyses of eye-tracking data to be described later focus on clarifying conditions when each type of Web-viewing schema becomes dominant.

2 Experiment

2.1 Methods

Materials. We used three categories of Web sites for our study: portal sites, news sites, and corporation sites. In the eye-tracking experiment, our participants were provided with six Web pages from each of the three Web-site categories and instructed them to evaluate their usability. We assumed that the locations where the participants look would reflect the application of the Web-viewing schemas.

The selection of the three Web-site categories was based on the following considerations. When experiment participants are provided with a news site, they would easily initiate the common goal of "read news," and thus they would focus on the text area and ignore unrelated information [1], exhibiting dominant use of a function-based Web-viewing schema. In contrast, participants provided with an unfamiliar corporation site would not be able to initiate a function-based Web-viewing schema because the purposes of corporation sites are diverse and unidentifiable at first glance, and thus a location-based Web-viewing schema would dominate. Portal sites are in-between, i.e., participants would easily be able to initiate viewing goals since they would be familiar with the portal sites, but the goals might be diverse, and thus we expected a mixed application of the Web-viewing schemas.

Figure 1 illustrates the six layout templates specially designed for our study. Three functional contents for defining a Web page, navigation, contents, and advertisement, are arranged in three columns, left, middle, and right, resulting in six different configurations. As depicted in Fig. 1, the contents area is wider than the navigation area and advertisement area in the ratio of 55:20:20. Each of the six Web pages from each Web site category was presented by using one of the six layout templates.

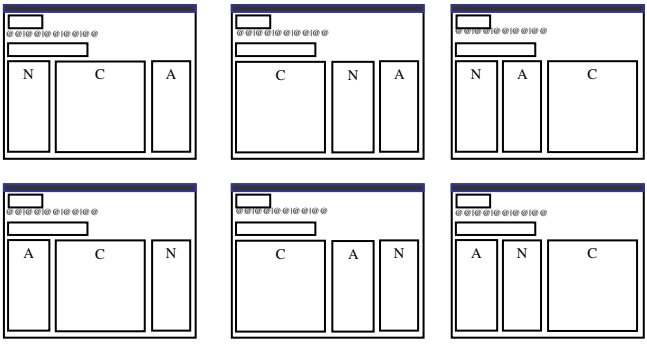

Fig. 1. Six layout templates of materials used in this study. *Note.* N: Navigation area, C: Contents area, A: Advertisement area

Participants and design. Twenty-two participants from two user groups, heavy internet users and light internet users, were recruited from near AIST, Japan, and ranged in age from 20 to 48 years. They had normal or corrected-to-normal vision. The heavy users, n=13, were comparatively heavy internet users who browse and use various sites for more than 10 hours per week. The light users, n=9, were comparatively conservative or out of touch with internet users and used the internet less than one hour per week.

The experiment employed a 2x3x3 mixed factorial design. The user's internet experience has two levels, heavy or light; the Web-site categories, three levels, portal, news, and corporation; and the last factor was interchangeably assigned to the function of Web-page components in three levels, navigation, contents, and advertisement, or the location of Web-page components with the three levels of left, middle, and right.

Apparatus. The experiment was controlled by a DELL Dimention/9150 computer. The stimuli were presented on a 17-inch TFT display with a resolution of 1024x768 pixels. The participants' eye movements were recorded using a Tobii 1750 eye-tracking system (Tobii Technology).

Procedure. The participants were instructed to look at the Web pages carefully and to evaluate their usability. Each Web page was presented for 20 seconds. Each participant was asked to evaluate eighteen Web pages. After the task, participants filled out an internet usage questionnaire.

2.2 Results

For further analyses, we used the eye-tracking data from 288 Web pages, which were recorded by sixteen participants, eight heavy users and eight light users who viewed six Web pages from three Web-site categories. The remaining data were discarded due to high rates of invalid data. We counted visual fixations that lasted more than 100msec during the 0 to 15 sec period of each Web-page evaluation. The number of fixations was adjusted by normalizing the area size by reducing the number of fixations in the contents area by a factor of 64% (1-20/55). We then summed the

number of fixations in each area of the six Web pages from the same Web-site category and averaged these over the participants.

Two analyses were performed. One analysis sought to understand the Web-viewing behavior in terms of a location-based Web-viewing schema, and the other, in terms of a function-based Web-viewing schema. For each, a three-way analysis of variance was conducted with user experience as a between-participants variable and with the other two variables, Web-site categories, and the function of Web page components or the location of Web page components, as within-participants variables.

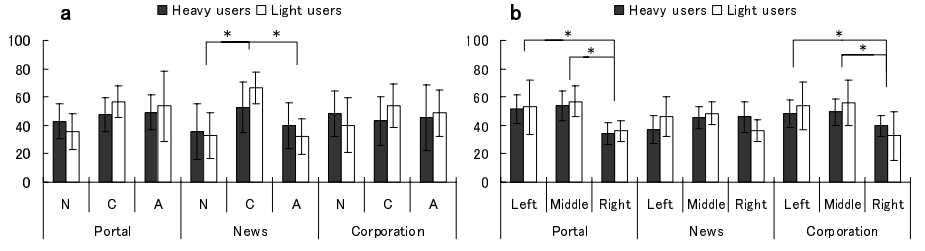

Fig. 2. Adjusted mean total numbers of fixation points as a function of users experience, Web site categories, and Web site area. **a**, area functions. **b**, locations.

Application of function-based Web-viewing schema. Figure 2a depicts the average adjusted number of fixations on each functional area, navigation, contents, and advertisement, of each Web-site category, portal, news, and corporation. The results of an ANOVA indicated a significant main effect of Web-site categories; $F(2,28)=9.01$, $p<.05$. A multiple comparison suggested that the participants looked at news sites less often than they looked at other sites. The main effect of area functions was marginally significant, $F(2,28)=2.64$, $p<.10$. A trial multiple comparison demonstrated that the participants looked at the content area more often than they looked at the navigation area. The fixation patterns produced a significant interaction between Web-site categories and area functions, $F(4, 56)=6.85$, $p<.05$. As seen by the analysis for the news site in Fig. 2a, the participants looked at the content area significantly more often than they looked at the advertisement area or the navigation area. There was no difference among the three area functions for the portal site and the corporation sites. The main effect of user experience was not significant, $F(1,14)=.29$, *n.s.*

Application of location-based Web viewing schema. The results of an ANOVA indicated a significant main effect of Web-site categories, $F(2,28)=9.12$, $p<.05$. The main effect of location was significant, $F(2,28)=8.62$, $p<.05$. A multiple comparison revealed that the participants looked at the right area less often than they looked at the other locations. The fixation patterns also indicated a significant interaction between Web-site categories and locations, $F(4, 56)= 3.54$, $p<.05$. As seen in Fig. 2b, the number of fixations in the right area of the corporation site was significantly less than that of the middle area and that of the left area. This also holds for the portal site. In contrast, the news site exhibited no difference in the numbers of fixations among the three locations.

3 Conclusion

In this study, we investigated user Web-page viewing strategies by manipulating user experience, Web-site categories, and location and function of Web-page components. The results demonstrated that both heavy and light internet users exhibited site-specific strategic viewing behavior. At the news sites, both groups focused on the content areas irrespective of their location. In contrast, at the corporation sites, both users focused on the middle areas irrespective of their function. These results suggested that the users adopt a function-based viewing strategy when the site purpose is obvious, e.g., the news sites, otherwise they adopt a location-based viewing strategy.

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