The Determinants of Web Page Viewing Behavior: An Eye-Tracking Study

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Abstract

The World Wide Web has become a ubiquitous information source and communication channel. With such an extensive user population, it is imperative to understand how web users view different web pages. Based on an eye tracking study of 30 subjects on 22 web pages from 11 popular web sites, this research intends to explore the determinants of ocular behavior on a single web page: whether it is determined by individual differences of the subjects, different types of web sites, the order of web pages being viewed, or the task at hand. The results indicate that gender of subjects, the viewing order of a web page, and the interaction between page order and site type influences online ocular behavior. Task instruction did not significantly affect web viewing behavior. Scanpath analysis revealed that the complexity of web page design influences the degree of scanpath variation among different subjects on the same web page. The contributions and limitations of this research, and future research directions are discussed.

CR Categories: H.5.2 [Information Interfaces and Presentation]: User Interfaces – User-Centered Design; H.1.2 [Models and Principles]: User/Machine Systems – Human Information Processing

Keywords: web page, eye tracking, individual differences, World Wide Web

1 Introduction

The World Wide Web has increasingly become a ubiquitous information source and communication channel. With such an extensive user population, it is imperative to understand how web users view different web pages in order to provide a cognitive basis for interface design. Web pages are different from other visual stimuli, as they incorporate a combination of textual, pictorial, and multimedia content. Eye movement behavior involves different levels of cognitive processes, including oculo-motor and semantic processes [Henderson et al. 1999]. Personalization and customization have been widely promoted by interface design theories. However, it is still not clear how different web users view web pages differently. Studies on web use behavior largely concentrate on navigation and search with exploratory generalizations [Hsieh-Yee 2001]. Very few academic studies have been conducted on eye movement behavior on web pages with a small number of exceptions [Stanford Poynter Project 2000; Josephson and Holmes 2002; Goldberg et al. 2002]. The present research investigates the determinants of ocular behavior on a single web page, both in terms of standard ocular metrics such as mean fixation duration, gazing time, and saccade rate, and also in terms of scanpath differences. The key research question is whether these measurements were determined by individual differences, different types of web pages, the order of a web page being viewed, or different tasks at hand.

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2 Background

Initial inquiry into eye movement research began in the early 1900s [Rayner 1998]. In this section we reviews relevant research in the measurement of ocular behavior and also examine relevant research on eye tracking in the web context.

2.1 Ocular Behavior Measurements

Several behavioral definitions have been widely adopted in the study of ocular behavior, including fixations and saccades. Eye tracking research generally defines fixations as a relatively motionless gaze which lasts about 200-300 millisecond (ms), in which visual attention is aimed at a specific area of a visual display [Rayner 1998]. Saccades are continuous and rapid movement of eye gazes between fixations with a velocity of 500 degrees or more. Saccades are quick eye movements to direct a viewer's eye to a visual target. Information processing is suppressed during a saccade, though some peripheral information may be available [Rayner 1998]. Fixations have been linked to intense cognitive processing. According to Viviani [1990], at least three processes occur during an eye fixation: encoding of a visual stimulus, sampling of the peripheral field, and planning for the next saccade. Rayner [1998] has shown that eyes are attracted to the most informative areas of a scene because they are physically distinctive and informative. Similarly, Loftus and Mackworth [1978] have asserted that the eyes are drawn to informative areas, which can be measured using dwell time within an Area of Interest (AOI). Fitts et al. [1950] have also concluded that fixation frequency in an Area of Interests (AOIs) is an indication of the degree of importance whereas fixation duration is an indication of the complexity and difficulty of visual display. The nature of the search task also influences eye movement behavior [Rayner 1998]. Buswell [1935] found that different instructions led to different sequences of fixations even though all the subjects fixed on the same important elements in the picture [Buswell 1935]. Yarbus [1967] showed that a viewer's eye movement was influenced by his/her intent. Pelz et al. [2000] has shown that the complexity of tasks influences fixation durations. Hayhoe et al. [2002] demonstrated task-specific fixation patterns in natural environments and have shown that there is a large degree of regularity between different subjects.

The term scanpath was first proposed by Noton and Stark [1971]. They defined scanpath as a habitually preferred eye movement path when a subject is reexposed to a visual stimulus. The concept of scanpath has also been accepted as a sequence of fixations and saccades and as a movement of attention. Josephson and Holmes [2002] used sequences of Areas of Interest (AOIs) as scanpaths and used a string-editing method to calculate the differences between any two scanpaths. However, current research has yet to develop conclusive findings relating cognitive processes to the determinants of scanpath behavior.

2.2 Recent Research on Web Page Viewing Behavior

Several studies have recently been conducted regarding ocular behavior on web pages, including eye movement research on news web sites [Stanford Poynter Project 1998], analysis of scanpaths on web pages [Josephson and Holmes 2002], and ocular behavior when web users were completing tasks on a web portal page [Goldberg et al. 2002]. Against the popular accepted view of "a picture is worth a thousand words", the Stanford Poynter Project [1998], investigating reading behavior on news web sites, concluded that text was frequently the first-entry points for a majority of online news readers. Rayner et al. [2001] reported similar findings in which viewers of print advertisements spent more time on text than pictures. By investigating eye viewing behavior of eight university students on three different web pages, Josephson and Holmes [2002] showed that the subjects have habitually preferred scanpaths and they also demonstrated that features of web sites and memory might also be important in determining scanpaths. Goldberg et al. [2002] used eye tracking methods to test the performance of the subjects in completing several tasks on a web portal page. Their research demonstrated that: (1) there are more regular horizontal eye movements between different portlets on a page than vertical ones; (2) the headers in a portlet were not usually visited before the body; and (3) that searches did not become more directed as a screen sequence increased. Implications for improving the design of the web portal were provided in their research.

3 Methodology

This research focuses on ocular behavior on web pages from different types of sites using eye movement metrics and scanpath analysis. The goal is to test the determinants of eye movement behavior: whether it is determined by the tasks the subjects are engaged in, the demographic variables of the subjects, different types of web sites, or the order of web pages being viewed.

3.1 Dependent Variables

In order to explore the determinants of ocular behavior on web pages, the study incorporated an analysis of three eye-tracking metrics as dependent variables: mean fixation duration, gazing time, and saccade rate. Mean fixation duration is frequently used in eye tracking studies, and taken as an indication of information complexity and task difficulty [Rayner 1998]. Gazing time has been defined as the rate of gazing (e.g. fixation) across the total observation period, which is negatively related to task difficulty [Nakayama et al. 2002]. Saccade rate (saccade occurrence rate) was defined as the number of saccades per second, which decreases when task difficulty or mental load increases [Nakayama et al. 2002]. In the current research, these variables were explored as a function of subject variables (demographic variables and site familiarity), site types, task instructions, and the viewing order of web pages within the same site. This research also explores the scanpath variation on the same web pages from different subjects, in which scanpath was defined as a sequence of fixations in Areas of Interest or lookzones. The differences in scanpaths were calculated by the string-editing method [Josephson and Holmes 2002].

3.2 Subjects

The subjects were students of various majors in communication classes at a large university in the Northeast. They were given extra credits for their participation. Thirty subjects among 34 completed the experiment without missing data, including 13 females and 17 males. Two subjects were over the age of 25 while the remaining subjects were between 18 to 25 years old. The subjects included 1 African American, 4 Asian Americans and 25 Caucasian Americans. All but one subject had used the Internet every day. In a typical day, the majority of the subjects had used the Internet for 0-2 hours; 11 used the Internet from 2-4 hours. Various majors were represented across the participant pool. These included business, engineering, communication, psychology, biology, natural resources, labor relations, animal science, urban and regional planning, and plant science.

3.3 Apparatus

The subjects' eye movements were recorded using ASL's 504 commercial eye-tracker (Applied Science Technologies, Bedford, MA) which utilizes a CCD camera mounted under the computer screen. The eye tracker exploits the Pupil-Center and Corneal-Reflection method for the reconstruction of eye position. It collects two reflections on the eye, the corneal reflection and the pupil reflection. From these two points, the ASL software computes pupil diameter and line of gaze for each eye fixation. It also collects timing information to produce length of fixations and length of total time spent on the page. All timing and position data collected are sent via a serial data stream to ERICA's GazeTracker software. GazeTracker is an eye-movement analysis application that runs separately from the tracking system. GazeTracker monitors the communication received over the data stream and allows analysis of the received data [Lankford 2002].

Web sites were displayed on a 15 inch flat panel monitor with a resolution of 1024 by 768 pixels. The participant's computer stored the web pages to be viewed during an experiment. The tester's computer housed the ASL software, the head tracker software, and the subject's computer ran the GazeTracker software [Lankford 2002].

Table 1. Four Types of Web Sites

Site Type	Web Address	Site Type	Web Address
Business		*News*	
	jobtrak.com		cnn.com
	macromedia.com		msn.com
	w3.org		netscape.com
Search		*Shopping*	
	google.com		amazon.com
	yahoo.com		ebay.com
	cnet.com		

Figure 1. A Web Page with Lookzones

3.4 Stimuli

Eleven most popular web sites were identified as the test stimuli based on a previous research [Gay et al. 2001], and categorized into one of four web site types: shopping, business, search, and news (Table 1). Two pages from each web site were selected. The first page was the main or front page of the site, and the second page was an internal page closely related to the purpose of the site. For example, a news article for a news site or a search results page for a search site. Each student was assigned to four different web sites, in which each web site was randomly picked from the two or three web sites in each of the four types. In total, each student viewed eight web pages from four different types of web sites. ERICA's GazeTracker software was used to divide each web page into specific Areas of Interest, which were termed lookzones in this research. Nine different types of lookzones were used to categorize the content on each web page, including title, navigation, link, content, search, still advertisement, moving advertisement, still picture, and moving picture, though not all web pages contained all nine types of lookzones (see Figure 1 for an example of the lookzones on Amazon front page).

3.5 Procedure

The web pages were downloaded and saved on the hard drive of the participant's computer. The viewing order of the four web sites was randomly selected. For each web site, the front page was always viewed first and the internal page second. The participants were given 30 seconds to view each page. Half of the participants were given specific instructions to remember the content of each web site and they would be asked to recall this information on a subsequent test. The other half of the participants were simply told to browse the web pages at will. While viewing the page, participants were encouraged to scroll up and down the web pages as they normally would. After viewing the last page, participants were asked to fill out an online survey regarding their demographic information and another paper survey, which asked various questions including how familiar they were with each web site and what they could remember from the web sites they had just viewed. One entire experiment session including calibration took between twenty to thirty minutes.

4 Analysis and Results

4.1 Data Definition and Data Reduction

The GazeTracker system samples eye movements and records information approximately every 17 to 20 ms. A fixation in this study is defined as any series of 3 or more samples that remain in a radius of 40 pixels for at least 200 ms. Saccades are defined as samples between fixations. GazeTracker generates a sequential list of fixations for each subject on each web page. Every record in this list includes pixel coordinates for each fixation, fixation duration, and duration of the following saccade. If any fixation is inside a lookzone, the name of the lookzone is also listed. While each of the web page viewings lasted for 30 seconds, only the first 15 seconds of data were analyzed. Prior research has indicated that important information is processed during the first few seconds. The 15-second time frame has also been adopted in a previous research [Josephson and Holmes 2002].

Two types of analysis were conducted in this research. In the first analysis, the contributions of variances from various independent variables to the variances of mean fixation durations (the average fixation duration in a viewing session), gazing time (the percent of time a subject spends on fixations instead of saccades), and saccade rate (the number of saccade per second) [Takahashi et al. 2000; Nakayama et al. 2002] were calculated using mixed models [Neter et al. 1996]; in the second analysis, differences among scanpaths on web pages were calculated using the string-editing method [Josephson and Holmes 2002] and compared with the complexity of web pages.

4.2 Analysis on Eye Tracking Metrics

Descriptive analyses of all the independent and dependent variables were first conducted. The subjects' demographic and background variables, such as the subjects' education levels, age, computer and Internet use experience, and their familiarity with various web sites, were dropped from the analysis since there was little variability in this sample. The data was finally analyzed as 2 (gender) X 2 (task condition) X 2 (page order) X 4 (site type) mixed models since the experiment involves both fixed factors (gender, task condition, page order, and site type) and random factors (subject factor and random web site selection from each of four categories of web sites) [Neter et al. 1996; Littell et al. 1996]. The full factorial of interactions between gender, task condition, page order, and site type, was tested on each of the three dependent variables.

PROC MIXED model in SAS Version 8 was used to analyze the mixed models [Littell et al. 1996].

4.2.1 Mean Fixation Duration

Table 2. Mixed Model on Mean Fixation Duration

Effect	Numerator DF	Denominator DF	F Value	Significance
Gender	1	98.8	5.22	.02
Page Order	1	104	16.66	.00
Types of Sites * Page Order	3	104	5.95	.00

Table 3. Different Values of Mean Fixation Duration (in Seconds)

Group	Mean Fixation Duration
Male	.374
Female	.357
First Page	.377
Second Page	.353

Table 2 shows the significant effects of independent variables on mean fixation duration[1]. The analysis reveals that the gender of a subject, the viewing order of a web page, and the interaction between page order and site type all significantly contribute to the differences in mean fixation durations. Table 3 is the least square estimates of significantly different means. It demonstrates that female subjects had shorter mean fixation durations than males in general. The subjects had longer mean fixation durations on the first pages than on the second pages. Since mean fixation duration is the indication of task difficulty and information complexity [Rayner 1998], it implies the first pages of web sites demand more cognitive effort. While different types of web sites do not solely affect the mean fixation duration, the interaction between site types and page orders is significant (the interaction effects will be discussed in more detail in 4.2.4). Finally, contrary to a previous research [Pelz et al. 2000], those subjects given task instructions do not have significantly different fixation durations compared with those participants who were instructed only to browse.

4.2.2 Gazing Time

Table 4. Mixed Model on Gazing Time

Source	Numerator DF	Denominator DF	F Value	Significance
Page Order	1	104	4.3	.04
Type of Sites * Page Order	3	104	10.04	.00

The results from the analysis of the mixed model on gazing time indicate a significant effect of page order, and a significant interaction effect between site type and page order (see Table 4). Subjects spent relatively more time on fixations on the first pages (front pages) than the second pages (internal pages) on the same web site (Table 5). Gender, task condition, and site type factors alone did not have a significant effect on gazing times.

Table 5. Different Means of Gazing Time (Percentage)

Group	Mean Gazing Time
First Page	66.7
Second Page	64.3

4.2.3 Saccade Rate

Table 6. Fixed Model on Saccade Rate

Source	Numerator DF	Denominator DF	F Value	Significance
Type of Sites * Page Order	3	104	5.530	.00

The results from the analysis on saccade rate revealed only a significant interaction effect between types of web sites and page order (see Table 6). Gender, task, condition, and page order did not influence saccade rate.

4.2.4 The Effects of the Interaction between Types of Web Sites and Page Order

The interaction effect of page order and site type significantly influences all three measurements of ocular behavior. In this section we explore the nature of the interaction effects and their implications. Figures 2, 3, and 4 and Table 7, 8, and 9 illustrate the nature of the interaction between site type and page order for all three dependent variables by outlining the least square estimates of different values under different interaction conditions and their significance testing.

Figure 2 shows that subjects had shorter fixation durations on the second pages of news sites and shopping sites, but had rather constant fixation durations on the search and business sites. Table 7 lists the results of the testing on different slices of page order and site type. It shows that mean fixation durations are significantly different on the first pages but not on the second pages; the dependent variable is significantly different on the two pages of news sites and shopping sites but not on search sites and business sites. Since fixation duration is the reflection of the complexity and informativeness of the stimuli [Rayner 1998], the result indicates that informativeness and novelty may remain fairly high on the second pages of business and search sites. On the other hand, the contextual cues [Chun 2000] provided on the initial pages of news and shopping sites may reduce the novelty of subsequent pages.

Figure 3 shows interaction effects on gazing time and Table 8 lists significance test for the different levels of page order and site type. The results demonstrated that the subjects spent significantly less time fixating information on the second pages of news and search sites, but spent more fixation time on the second pages of business sites. Since gazing time is negatively related with task difficulty and mental load [Nakayama et al. 2002], this result suggests that the second pages of news and search sites demand less cognitive effort while the second pages of business sites demand more. Table 8 also shows that the four types of sites

1 Because of the limitation on the length of the paper, insignificant fixed effects and interactions are omitted from the reports of the results.

differ significantly on gazing time on the first pages but not on the second.

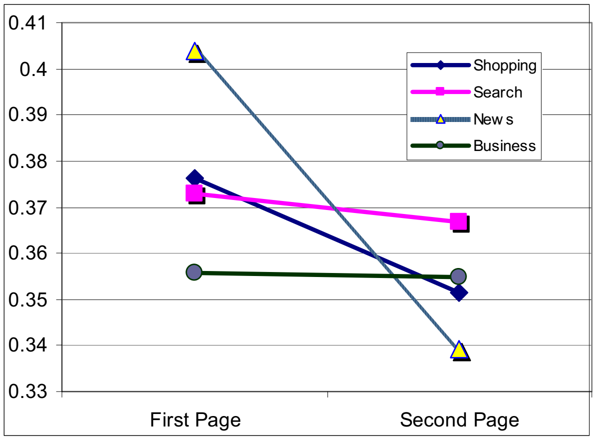

Figure 2. Interaction Effect on Mean Fixation Duration

Table 7. Test of Effect Slices on Mean Fixation Duration

Slices	Numerator DF	Denominator DF	F Value	Significance
First Page	3	26.2	2.94	.052
Second Page	3	26.2	0.95	.429
Shopping Sites	1	104	4.24	.042
Search Sites	1	104	0.28	.600
News Sites	1	104	29.86	.000
Business Sites	1	104	0.01	.922

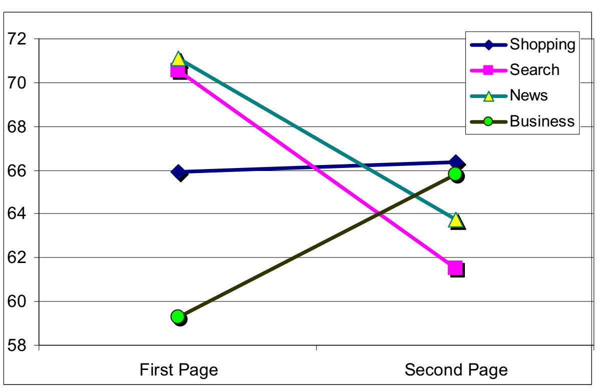

Figure 3. Interaction Effect on Gazing Time

Figure 4 and Table 9 show that saccade rate is reduced on the second pages of search sites, but increases on the second pages of business sites. Significance testing on different levels of page order and site type indicated that the saccade rates of four types of sites are significantly different on the first pages but not on the second. Since saccade rate is also negatively related with task difficulty [Nakayama et al. 2002], this finding indicates that the second pages of search sites demand more cognitive effort to viewers than first pages while the second pages of business sites demand less efforts than first ones.

Table 8. Test of Effect Slices on Gazing Time

Slices	Numerator DF	Denominator DF	F Value	Significance
First Page	3	11	4.53	.027
Second Page	3	11	0.73	.554
Shopping Sites	1	104	0.04	.851
Search Sites	1	104	15.78	.000
News Sites	1	104	10.30	.002
Business Sites	1	104	8.22	.005

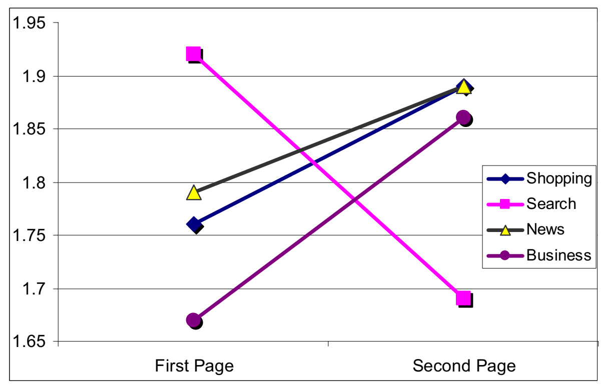

Figure 4. Interaction Effect on Saccade Rate

Table 9. Test of Effect Slices on Saccade Rate

Slices	Numerator DF	Denominator DF	F Value	Significance
First Page	3	19.8	3.24	.044
Second Page	3	19.8	2.79	.067
Shopping Sites	1	104	3.65	.059
Search Sites	1	104	11.15	.001
News Sites	1	104	2.02	.158
Business Sites	1	104	7.69	.007

Overall, the interaction effect between page order and site type on the three metrics yielded mixed results. Analysis on mean fixation duration and gazing time of news web sites revealed consistently that the second pages demand less cognitive effort; however, analysis of gazing time and saccade rate on search sites and business sites resulted in contradictory conclusions: one measurement indicated that the second pages are easier while the other shows they are more difficult. The conflict suggests that the construct of "mental workload" is likely to be multidimensional which can not be measured using one single metric; alternatively, there might be other mental constructs besides "mental workload" which may affect ocular metrics on web viewing behavior. The visual and semantic complexity of web pages from different web sites may contribute to different dimensions of mental workload; it may also influence other mental constructs which may determine subjects' ocular behavior besides mental workload.

However, one consistent finding of the interaction effects is that web page viewing behavior was significantly more variable on the first pages of all four site types than the second pages. Table 7, 8, and 9 show that there is significantly more variability among the four types of web sites on the first pages than on the second ones. Since the first pages are novel stimuli and also provide contextual clues for the following web page, this variability may stabilize once the individual adapts to the "information landscape" [O'Day and Jeffries 1993]. Even if the two web pages have very different content and structure, the subjects' prior experience with those web sites might provide them with appropriate anticipation on the content and layout of the second web pages on the same web sites.

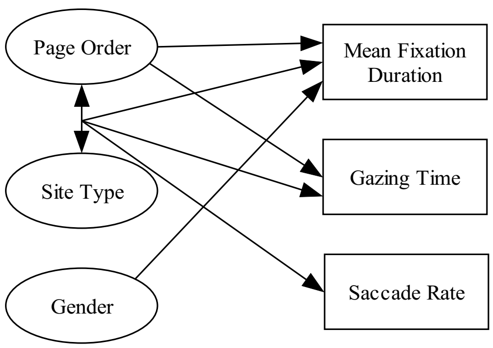

Figure 5. Overall Results

In general, the analysis on several ocular measurements indicates that eye movement behavior on web pages is influenced by the individual differences of subjects (the gender of the subjects specifically). Ocular behavior also changes as a function of page sequence, and that the direction of this change is influenced by the types of web sites being viewed. Figure 5 shows the significant relationships between gender of subjects, page order, and the interaction between site types and page order, with mean fixation duration, gazing time, and saccade rate. However, inconsistent findings from this research also suggest the complex nature of web pages as visual stimuli may add other dimensions to the construct of "task difficulty" or "mental workload".

4.3 Scanpath Analysis

Using the string-editing method [Josephson and Holmes 2002], scanpath analysis was conducted to determine the influential factors in determining the differences in scanpaths on different web pages. String-editing method views the sequence of lookzones the subject went through as strings, for example, a sequence of left-menu-bar, right-main-content, top-menu-bar, and right-story-title constitutes a string. It can be compared with another sequence of lookzones on the same web page by optimal matching analysis, which counts the number of basic units of operations needed (additions, deletions and/or substitutions) to match one string to another. The obtained number is the indication of the distance between the two scanpaths.

The Excel spreadsheet generated by GazeTracker software was recoded to generate lists of sequences of lookzones. The string-editing toolkit WinPhaser designed by Holmes [1996] was used to calculate the differences of scanpaths from different subjects on the same web page [Josephson and Holmes 2002]. Because of the incomplete factorial design of the study, each web page was viewed by only 9 to 16 subjects (see Table 10 for an illustration).

Table 10. An Illustration of Differences in Scanpaths

Subject	Subject	Amazon Front Page	Amazon Inside Page	…
2	1	1.81	1.17	…
3	1			…
3	2			…
4	1	2.23	0.96	…
4	2			…
…	…	…	…	…

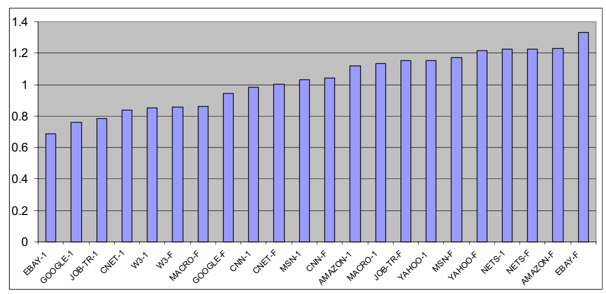

Figure 6. Variance of Scanpaths for Different Web Pages

Since each value in Table 7 reflects the differences in scanpaths for different subjects on one web page, we can aggregate the differences along the web pages and then average them by the number of subjects who viewed the page to compute the variance of their scanpaths. Figure 6 shows a graph of difference variance values of different web pages. Figure 7 depicts the two web pages with the smallest variances and Figure 8 shows the two web pages with the largest variances. For the Amazon front page and the Ebay Front page, the complex structure of the web page layout contributes to the large variances of scanpaths. On the other hand, the Ebay inside page and the Google search result page have a more simplistic structure. The scanpaths on these two web pages are rather similar to each other. In addition to the three ocular metrics, this result also suggests that visual complexity contributes to eye movement behavior, in this case, scanpath variability.

5 Conclusions and Discussions

The findings of this research indicate that web page viewing behavior is driven by the gender of subjects, the order of web pages being viewed, and the interaction between site types and the order of the pages being viewed. The results of the scanpath analysis revealed a possible relationship between scanpath variability among individuals and the structural/visual complexity of the web page. The present research confirmed previous work in that individual characteristics of the viewer as well as the stimuli both contribute to viewers' eye movement behavior [Rayner 1998].

Figure 7. Two Web Pages with the Smallest Scanpath Variances

One user difference reported here was that males exhibited significantly longer mean fixation durations than females. Gender differences in perceptual processing have also been reported by Jones, Stanaland, and Gelb [1998]. In that study males and females reacted differently to images, which in turn affected subsequent memory performance. Meyers-Levy and Maheswaran [1991] demonstrated that males and females differ with respect to selection processes: females often engage in comprehensive processing of all the available information, while males tend to focus their attention on a fewer number of areas. The gender differences reported here provide further support for the notion that different design guidelines might be beneficial to websites who cater specifically to one gender or the other.

The most interesting finding from this research is the complex interaction effect of page order and site type on the three measurements of ocular behavior. In the process of web navigation, the viewers' eye movement behavior changes over time even on a single web site, and the change in direction and magnitude were influenced by the type of web sites. The greater variability of eye movement indices on the first page suggests that "context cueing" [Chun, 2000] may have provided the context and initial domain knowledge for subsequent pages.

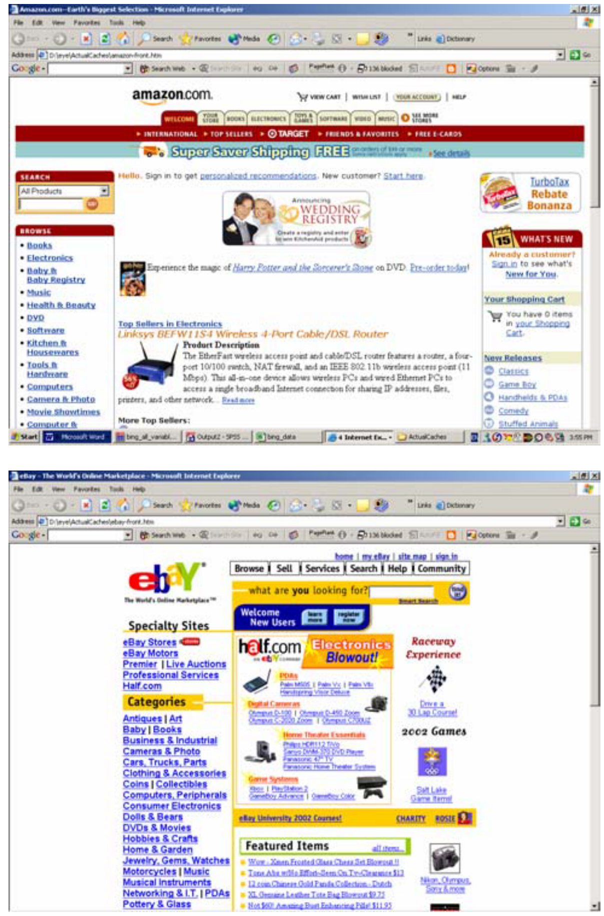

Figure 8. Two Web Pages with the Largest Scanpath Variances

Also different from previous research, this study did not find significant effects for other individual variables, or an effect of task instruction on ocular behavior. The subject population was admittedly homogeneous, and hence lacked the variability on other demographic variables. Our research didn't confirm significant effect of task variables on ocular metrics as previous research has revealed [Rayner 1998]. One possible explanation might be that asking the subjects to remember the content on the web pages is not a significant task which demands much cognitive effort. The participation in the experiment itself requires the subjects to pay a lot of attention. Future research with a more complex and goal-oriented task (for example, finding the contact phone number on a company's home page) may reveal significant effects compared with merely asking the subjects to remember the content of the web pages.

Additionally, the conflicting results of different metrics obtained from this research suggest that mental workload is a multi-dimensional construct. Different indices of mental workload may be needed to accommodate the multiple information processing required by these complex visual stimuli. It may be that these indices of mental workload are assessing different aspects of complexity (i.e. spatial, semantic, and visual) of the visual stimuli or even the viewers' psychological/physiological state which influence different dimensions of mental workload or other types of mental constructs besides mental workload (such as domain knowledge).

One major limitation of this eye tracking research is that we know "what" and "how" about the subjects' ocular behavior but we hardly know "why". We can record their eye movements and compare the metrics but we are not sure of the cognitive processes happening. The cognitive processes alluded to in this research are more contemplative than factual. The future research can include additional research methods, such as verbal protocol, videos of facial expression, and post experiment interviews, in order to gain greater insights into the cognitive processes involved in the changes in ocular behavior observed here. The contemplation of the effects of other factors or multi-dimensions of mental workload on ocular metrics might be tested in a subsequent experiment on web sites with same cognitive difficulty but different semantic contents.

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