

Explore Eye Movement Patterns in Search Result Evaluation and Individual Document Evaluation

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ABSTRACT

This study aims to explore users' eye movement patterns in their evaluation of search results and the corresponding individual webpages. Eye-tracking logs, questionnaires, and interviews were applied to collect data. Descriptive statistics, correlation analysis, and social network analysis were utilized in data analysis. Two transition networks for search result evaluation and individual document evaluation were obtained by social network analysis tool. The findings show that in search result evaluations, participants examined abstract, title and URL the most among all the elements, while in individual document evaluation, full text was examined the most. The transition networks further indicates the most frequent transition action is shifting from title to abstract. For individual document evaluation. The findings will help the enhancement of interface design of search result pages and individual document pages in order to promote search effectiveness and efficiency.

Keywords

Information behavior, eye movement pattern, search result evaluation, individual document evaluation.

INTRODUCTION

With the increase of online information, nowadays search is one of the most efficient means for users to seek information (Guan & Cutrell, 2007). To satisfy users' information needs, various search engines, online databases, digital libraries are created and different search services are provided to offer approaches for information retrieval. In the entire information retrieval process, evaluation, including both search result evaluation and individual document evaluation, is one of the key activities

(Xie & Benoit, 2013). Xie and Benoit (2013) compared these two types of evaluation behaviors in relation to evaluation criteria, elements, evaluation activities, and so on. They found that although there are differences between these two types of evaluation in criteria and element aspects, they are interrelated to each other and can be transformed and integrated. Furthermore, visualization tools such as UCINET were also used to illustrate the relationships between elements and actions in information searching (Han, Joo & Wolfram, 2014; Xie & Joo, 2010).

Eye-tracking approach, one of the most popular approaches in user behavior studies, has been applied in observing users' information behavior in the past decade. Some of the main findings demonstrate that typical eye movement patterns occur during the relevance judgment process, such as the impact of task type on the number and length of fixations when evaluating search results (Lorigo et al., 2008; Buscher, Dumais and Cutrell, 2010). Besides, Sherman (2005) and Nielsen (2006) both reported "F" shaped eye movement patterns in search result evaluation. Balatsoukas and Ruthven (2012) examined the relationship between the use of relevance criteria and users' eye movement in predictive relevance judgments. However, in eye-tracking studies social network analysis was barely utilized.

Based on the literature review, there is a gap that the importance of elements in search results and document evaluation is not investigated, also the transition patterns of users' eye movements is not explored yet. Therefore, four research questions are stated:

RQ 1) What elements (e.g. title, URL, abstract) are examined the most by users in search result evaluation and individual document evaluation?

RQ 2) How do users transit from one element to another in search result evaluation and individual document evaluation?

RQ 3) What are the most frequent transitions in search result evaluation and individual document evaluation?

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topic, and Advertisement occupy the top three places in both rankings, which means they were examined the most by users in individual document evaluation. Footer, and Time were ranked the last two positions with quite small values comparing to the other elements. It means these two elements were viewed least by users in individual document evaluation.

Element on Individual Document Page	Total Fixation Time		Total Fixation Count	
	Value (ms)	Rank	Value	Rank
Full text	978169	1	2726	1
Related topic	75527	2	215	2
Advertisement	65333	3	210	3
Directory	59313	4	136	5
Subtitle	48951	5	141	4
Title	38887	6	122	6
Abstract	33432	7	95	7
Not related	31695	8	81	9
Image	26178	9	89	8
Tab	19180	10	63	10
Interaction	16709	11	40	11
Head	11508	12	33	13
Direction	10881	13	28	14
Classification	10445	14	34	12
Content	4889	15	13	15
Author	4202	16	10	16
Search box	3379	17	9	17
Footer	1707	18	5	18
Time	275	19	1	19

Table 2. Total Fixation Time, Total Fixation Count and Rankings of Elements on Individual Document Pages

Table 1 and 2 display that there are many more kinds of elements viewed in individual document evaluation than search result evaluation. At the same time, the ranks of certain elements differ from each other in the two rankings. For instance, Abstract ranks the first place in search result evaluation, but occupies the 7th position in individual document evaluation. To compare the ranks of the same elements in search result evaluation and individual document evaluation, Spearman's Correlation tests were used. When comparing the rankings in terms of total fixation time, the correlation coefficient was 0.539, and the p-value was 0.108. When testing the correlation in terms of total fixation count, the results were exactly same. It indicates that users' eye movement patterns in search result evaluation and individual document evaluation are different in terms of the time spent on each element.

Transition Networks

Figure 2 and 3 present the transition networks of search result evaluation and individual document evaluation, respectively. The color of a node stands for its betweenness centrality. Nodes with higher betweenness centrality are darker. The size of a node stands for its eigenvector centrality. Bigger nodes have higher eigenvector centrality. The width of an edge represents the frequency of the corresponding transition action.

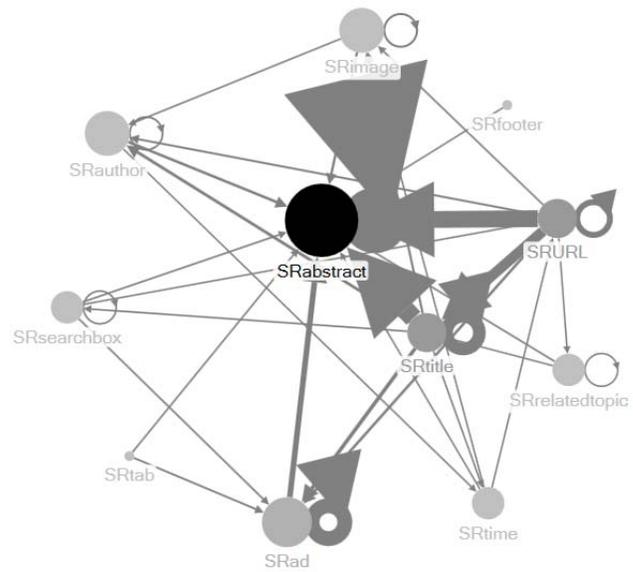


Figure 2. Search Result Evaluation Transition Network

Figure 2 shows that Abstract has the highest centrality values among all the elements in search result evaluation, which indicates its importance in search result evaluation. The analysis indicates that Abstract has 11 in-degree, and one out-degree. For the only one out-degree, it refers to itself, which means users usually shift from other elements to Abstract, and after viewing it, they usually stop or go to another webpage. URL and Title have the same values for all the metrics (betweenness centrality=7.33, eigenvector centrality=0.14), which means they are as important as each other in this network. Abstract, Title, and URL are the three most important elements in the search result transition network. However, Tab (betweenness centrality=0, eigenvector centrality=0.03) and Footer (betweenness centrality=0, eigenvector centrality=0.02) are the least important elements in terms of the centrality metrics.

There is a clear triangle in Figure 2 which consists of three elements, including Title, Abstract, and URL. It implies that users frequently shift among these elements. The thickest edge is the one between Title and Abstract, and its direction is from Title to Abstract, which indicates that users shift from title to abstract a lot. At the same time, Abstract, Title, and Advertisement have many self-loops. It indicates these elements contain critical information for the users. However, usually Advertisement does not provide useful information. Hence, it is possible that users waste a lot time examining the Advertisement. Although in the interview most participants stated that Author was an important element, they did not view it a lot. The primary reason is that the Author element on the page was not highlighted.

In Figure 3, there is only one outstanding node, which is the Full text element. It has the highest centrality values (betweenness centrality=79.76, eigenvector centrality=0.09) among all the elements, which means it is the most important element in the individual document transition

