

Navigation in Websites: Side effects of tools?

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Abstract

We present an experiment which investigated the impact of simple tools on supporting the navigation in a complex hypertext. We constructed three conditions for supporting orientation, navigational action or both. Subjects had to solve information retrieval tasks. To find the right solution they had to scroll. We measured the time and the number of steps between clicking a defined starting point and clicking the target link. We found no improvement in subjects' performance against the non supported condition. Regarding subjects' behaviour to scroll the window we got hints for scroll-stops, which we have included during the integration of the simple tools in the hypertext. Therefore we implemented a second experiment to check whether we are able to change subjects' subjective perceived area to scan a page (for the needed information or for navigational options). We constructed five conditions by including different screen elements (no change, paragraph, simple line, navigation bar, line of links) and counted how often subjects performed a scroll action before they clicked on a link the first time. Our findings show that a screen element like a navigation bar can serve as a cue for the end of the page. Consequences are discussed.

Introduction

Searching of information is one of the most important topics in using the internet and the World Wide Web. Although search machines can be helpful in finding information, manual searching is still an essential component in

users behaviour. To find the right information in an efficient manner we have to navigate using a short path and a little amount of time.

If we compare the search in web-sites or web-based systems with the search in traditional media we have to make a distinction between media which give us information permanently without any selection (e.g. television) and media with *pressure to select* for receiving new information (e.g. web-sites; Wirth and Schweigert 1999). Regarding the usability of web-sites *pressure to select* is an important concept to make clear where the problems are located. To receive new information users are forced to make a decision between all the available options (commonly *links* to other documents). Unfortunately we know little about the usefulness of our decision before we can check this by clicking the link. There are a lot of factors which have an influence on such decisions under uncertainty as the number of options (e.g. links), the number and kind of their attributes (e.g. title, colour, appearance), complexity (e.g. number of relevant and irrelevant elements), structure (e.g. arrangement of options and other content) or presentation mode (e.g. textual links or links as images).

Using explicit information search tasks we investigated, which factors (e.g. number, visibility, and similarity of links) improve or deteriorate the solution. We found that working on such tasks is more difficult, if the document contains a large number of links and the target link (activating the link shows a document that contains the wanted information) is invisible. To read a invisible link, user had to scroll the document.

Furthermore we wanted to find out, how tools for navigational support can improve information search in such a poorly designed hypertext. An effective tool for navigational support should reduce disorientation and cognitive overload (Conklin, 1987). Such a tool has to support both, orientation and cognitive relief. There are different tools for this claim (ranging from simple lists of links to the hyperbolic tree; Lamping and Rao, 1996). They facilitate orientation by visualising the information space and the navigational act by supporting navigation within the structure. But the use of these tools themselves requires additional cognitive capacities, because they are located in another browser window or in a frame.

We developed an experimental setting to investigate the usefulness of simple tools, which are included in the document and support both orientation and the navigational act (Experiment 1). Because of the unexpected results we prepared a second investigation to identify factors, which possibly influence the usefulness of simple tools (Experiment 2).

Experiment 1

Experiment 1 was designed to find out whether a simple navigational tool can improve subjects' performance and which kind of tool is more suitable to support (the navigation act, the orientation or both). Furthermore we wanted to compare the results with the results of a prior experiment.

Material

We used the same material as in the prior experiment: a hypertext concerning the psychology of advertising and two information retrieval tasks. Because we were interested in the helpfulness of the different tools we chose the two most difficult tasks regarding time and number of steps for successful solving in the prior experiment.

Finding the correct solution of the given task required the activating of a link, which was located in the non visible area of the document. Thus subjects had to scroll to find this link. We integrated additional elements in every document as shown in figure 1.

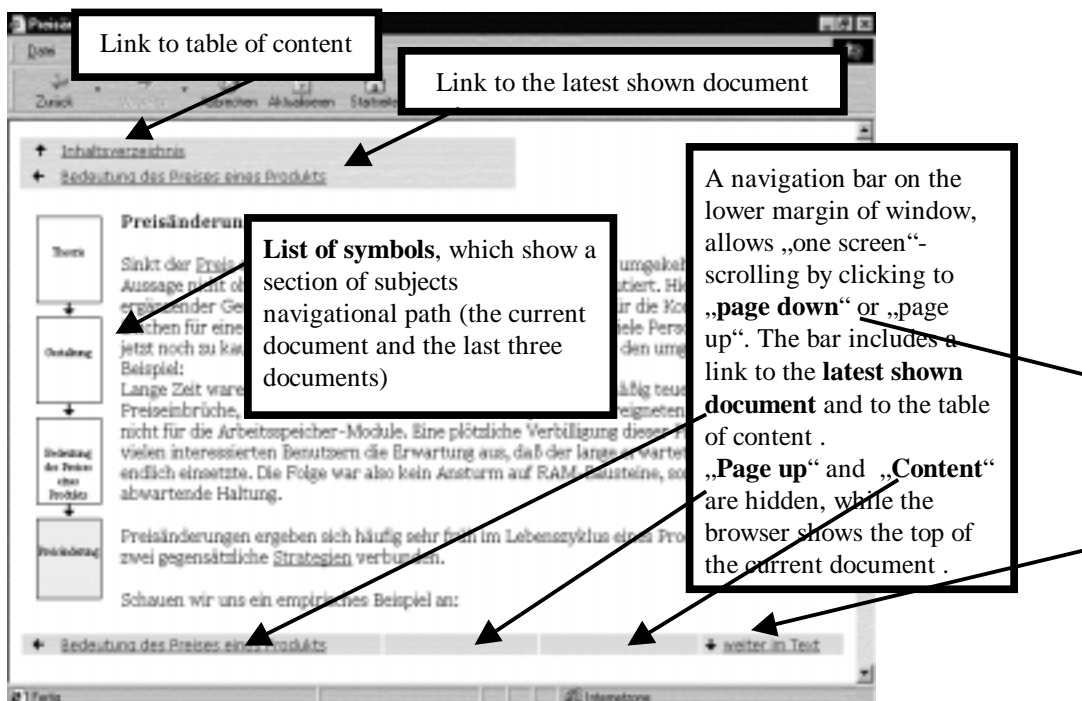


Figure 1 Simple tools (example for condition ‘Ori+/Act+’)

A navigation bar on the upper margin of the document contained a link to the table of content and a link to the latest shown document. Four symbols

represented the current document and the three documents shown before (a section of subjects' individual navigational path). A further navigation bar on the lower margin of the window allowed access to the table of content and the latest shown document. In addition this bar included elements for scrolling exactly one screen up or down.

Independent variable We constructed three different conditions. In condition 'ORI+' (orientation) we supported only aspects of orientation by including the symbols. The navigation bars were replaced by superficial similar place holders, which contained concepts of advertising. Condition 'Act+' (navigational act) contained all navigation bars and place holders for symbols to support only aspects of performing the navigational act. Condition 'Ori+/Act+' focused on both, aspects of orientation and action (see figure 1).

Procedure

33 undergraduates participated on the computer-based experiment. After a short questionnaire (experience with hypertext and www) subjects received the hypertext in one of the three conditions randomly (between subjects design). Afterwards they had to solve two information retrieval tasks.

An exact description of peoples behaviour while navigating for both, macro-navigation (navigation between documents) and micro-navigation (navigation within the document), requires recording of user-induced events, such as 'mouse click', 'mouse over', 'scroll' or browser functions (e.g. 'back') including time-stamp and the actual state of system-properties (e.g. size of screen). We used the method *web-supported experimentation* (Polkehn and Wandke, 1999) to log all interactions with the browser in a file. Web-supported experiments use internet-technology in a lab (web in the lab) to investigate subjects' behaviour.

Dependent variables According to our prior experiments we measured the time subjects needed to get from a defined starting point to the target link. In addition we counted the number of steps (every call of a new document defines one step) and the number of scrolls while working on the task.

Hypothesis We expected that an increasing support would cause a decrease in time as well as the number of steps.

Results

In contrast to our assumptions the time for correct solution extends by increasing support (no support → symbols → navigation bar → both). Fewer steps go along with more time per step. However, there is no significant effect. The large amount of variance in our data seems to be caused by differences in subjects' usual behaviour (e.g. time for reading).

Table 1
Results of Experiment 1

Condition	Time (s)	Steps	Time/Step	Scrolls
No support	173,8	6,7	30,3	144,7
Ori+	184,7	5,5	45,3	122,0
Act+	193,9	4,7	56,5	80,1
Ori+/Act+	245,8	5,5	54,4	84,1

All differences become clearer (but not significant) by analyzing tasks separately. If the task is difficult the time difference between the conditions 'no support' and 'Ori+/Act+' increases, while the number of steps decreases. However, although we included different kinds of supporting navigation, we have not found any significant difference.

Discussion

The results demonstrate that the use of simple navigational tools does not improve subjects' performance necessarily. An interaction between the degree of support and the difficulty of tasks seems plausible. Cognitive overload (Conklin, 1987) is a plausible explanation as well.

However, the evaluation of scrolls leads to another possible interpretation: The rapid decrease of the number of scrolls especially in condition 'act+' and 'ori/act+' indicates a change in subjects' search behaviour. It might be that the surface layout kept the attention only to the visible area of document. This could explain the decreasing number of scroll actions. We argue that the special layout of screen elements influences the subjective perceived area for scanning (sensu Morkes and Nielsen, 1997)?

We prepared a second experiment to vary the arrangement of elements and to investigate the consequences for subjects' scroll behaviour.

Experiment 2

The experiment was designed to find out whether we can change subjects' subjective perceived scannable area of a document by including additional elements with enclosure cues like a navigation bar.

Material

We chose ten documents of the hypertext used in Experiment 1 and constructed information retrieval tasks for all of them. The documents were prepared to be structural equal, that is all documents contained ten links, distributed over the whole page.

Finding the correct solution of the given task required the activating of a link, which was located in the non visible area of the document, in five documents. Thus subjects had to scroll to find this link. The other five documents contained the target link in the visible area to avoid subjects having to scroll in every task.

Table 2
Variation of experimental material

Condition 1	Condition 2	Condition 3	Condition 4	Condition 5
Plain Text	Paragraph	Simple line	Navigation bar	Line of links

Independent variable We constructed five versions of every document by including additional elements (see Table 2) directly above the bottom of the window (for example Figure 2).

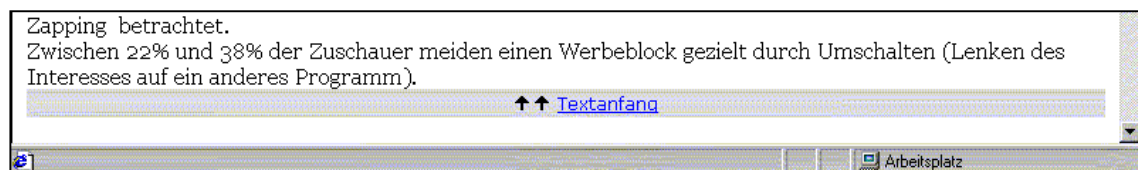


Figure 2 Screenshot of Condition 4 ('navigation bar')

Procedure

40 undergraduates received the ten documents and information retrieval tasks one after another (within subjects design) after a short questionnaire (the same as in Experiment 1). The conditions were assigned to the documents randomly. All interactions with the browser were logged.

Dependent variable We counted the number of subjects who performed a scroll action before they had clicked on a link the first time ('scroll-first').

Hypothesis We expected a systematic decrease of the 'scroll-first'-frequency from condition one to five (increase of the strength of closure)

Results

Unfortunately, we did not find a significant over-all effect for the variable 'scroll-first'-frequency. However, we found differences between 'navigation bar' and the other conditions, apart from condition 2 (Table 3).

Table 3
Results of Experiment 2: 'scroll-first' - frequency in %

Condition 1	Condition 2	Condition 3	Condition 4	Condition 5
Plain text	Paragraph	Simple line	Navigation bar	Line of links
85 %	77 %	85 %	67 %	87 %

Compared with condition 4:

$p = 0.06$	$p = 0.23$	$p = 0.03$	-	$p = 0.01$
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Discussion

The results give hints for the assumption that the arrangement of screen elements might influence perceptual closure. The navigation bar plays a special role as scroll-stop. This finding is compatible to the results of Experiment 1. Other possible effects could be hidden by co-variables like task-difficulty or differences in subjects' standard scroll behaviour.

General discussion

The results of both experiments demonstrate that we can not support orientation or navigation in web-sites without taking into account the single page design. The integration of supporting tools within a single page will influence users' ability to skim the page for options to navigate. Elements like the navigation bar in Experiment 2 could serve as subconscious cue for the end of page. In this case the user can not skim the page completely and has an incomplete base for the next navigational decision. Spool, De Angelo, Scanlon, Schroeder & Snyder (1998) describe some hindrances to perform skimming successfully like white spaces or horizontal rules. However,

scrolling itself is not a barrier to skimming (Spool et al., 1998; van Nimwegen, Pouw and van Oostendorp, 1999). The crucial point seems to be *the subjective perceived area for scanning*. Therefore we have to ensure the absence of 'end-of-page' cues to perform successful skimming. This is the prerequisite for a page to be scannable in the sense of Morkes and Nielsen (1997).

Using supporting tools does not cause a better performance necessarily. We can not be sure whether symbols on a single page support the orientation in a hypertext or not, because we found that other impacts play an important role. Further research is necessary. How can we identify 'end-of-page' cues and avoid them in the engineering of web-sites or web-based systems? How can we support both, users orientation in the hypertext (*macro-structure*) and his perception of all the navigational options on the current page (*micro-structure*)? Finding answers to these important questions will determine our research in the near future.

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