A Comparative Study about Children’s and Adults’ Perception of Targeted Web Search Engines

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ABSTRACT
In this paper we describe an eye-tracking study where we compare children’s and adults’ search behavior and perception of search interface elements on search engine results pages (SERPs) during an informational and a navigational search with Google and a search engine for children. Our first results indicate that children employ an exhaustive scanning strategy combined with cued visual jumps. Then they navigate to the next result page and only then modify their query. Adults only scan the first three results, following the F-shaped gate to the next result page and only then modify their query. Children pay less attention to textual summaries and more to thumbnails than adults do. Children take notice of a navigational menu with categories while adults do not.

Author Keywords
Search engine; User study; Eye-tracker; Children.

ACM Classification Keywords
H.3.3. [Information Search and Retrieval]: Search process; H.5.2. [User Interfaces]: Evaluation/methodology

INTRODUCTION
Many children have access to the Internet and explore the Web from a young age. The German 2010 KIM study [9] reports that about 60% of the children of ages six to thirteen use the Internet and 70% of them use search engines. Children exploit the Internet for entertainment, e.g. to play online games, but also to research for their school activities [6]. More than half of the children search the Internet predominantly alone [9]. Therefore, there are special search engines that aim to support children, e.g. quinturakids.com. Unfortunately, these search engines do not address children’s cognitive, fine motor and other abilities and they have some usability issues [5]. To increase the usability of search engines for children, understanding their search behavior and interface perception is essential and can be achieved with help of user studies.

Previous research shows differences between kids and adults in their search behavior. However, these findings were mainly based on observational studies, e.g. [1, 8], or log file analysis, e.g. [6]. Furthermore, a recent study [7] found that kids’ performance on children’s interfaces is not better than on Google. However, the mentioned studies do not provide details about differences in children’s and adults’ perception of the search engines’ interface elements during information seeking. In case there is no difference in perception, one could argue that standard search engines like Google have equally appropriate user interfaces for both user groups and no improvement is required. To complement existing findings, eye-tracking devices can be used. Eye-tracking provides information about users’ eye positions and movements, i.e. information about what web interface elements caught users’ attention, for how long and in which order.

There exist eye-tracking studies either about adults’ or children web search behavior. For example, adults’ reading behavior was studied across many different web sites and search tasks [10]. It was found that they follow a reading pattern in the shape of an “F”. Dinet et al. [3] studied young users in the age from 10 to 17 and observed their search behavior on Google SERPs. They found that the visual exploration of young children is influenced by highlighted terms. Younger children tend to use a “cued visual jump”-strategy, i.e. after reading a highlighted keyword they jump to reading the next one. Whereas older children often exhaustively read search result’s title, snippet and URL. To our knowledge, there exist no comparative study between children and adults perception of targeted web search engines. Therefore, we study the information seeking behavior not only on results pages of a standard search engine, but also on SERPs of a web search engine for children. Our main research question is: Do children and adults have different perception of web search interfaces? The answer to this question provides information whether there is potential in improving search engines’ user interfaces for children and how to do this.

In this paper we describe the design and first results of an eye-tracking user study with children of primary school age and adults to study their seeking behavior and search engine perception during informational and navigational search (in terms of Broder’s taxonomy [2]). The purpose of informational search is to find information about a topic. Children tend to employ informational search [6]. Meanwhile, most frequent queries of adults are navigational with the immediate intent to reach a particular website [6]. Therefore, we study both search variants. We focus on children in third and fourth school grade. At this time children already have enough reading and writing skills to perform a web search,
however they are only superficially familiar with web search engines [9]. Therefore, they are an appropriate user group to study how intuitive search engines are. Druin et al. [4] also call these children “developing searchers” who have challenges with spelling, typing, query formulation and results interpretation.

STUDY DESIGN

In our study we used a German search engine for children Blinde-Kuh.de (Fig. 1a) and Google (Fig. 1b). Blinde-Kuh.de (BK) offers a keyword search (A) along with navigation in different categories provided on the left side (B). These categories lead to informational pages about the corresponding topic. BK returns at most ten results per page as a vertical list. Search results are separated through boxes in contrast to Google where no separation is done. Each BK surrogate contains a picture (C), textual summary (D), rank (E), information about the result’s category (F), the target age group in categories “S”, “M”, “L”, “XL” for children from six to thirteen (G) and does not use any keyword highlighting. To see the BK search result’s page, one can click on the title (H), picture or a link below (I).

Within Participants Design was used in our study. In particular, we used a two-stage experimental design with two factors, type of web search engine (standard web search engine and children’s web search engine) and search task type (informational and navigational). We also applied latin square design where each participant interacted with both search engines but in a different order to avoid different biases due to usage order, tiredness etc. We used two informational (Info) and two navigational (Nav) search tasks. Each participant was given one navigational and one informational task. However, due to differences in the provided results between the two search engines and to construct appropriate search scenarios, different search tasks with similar complexity were used for different search engines (see Table 1).

Procedure: We tested one participant at a time. Using a structured pre-interview, we gathered user’s demographic data and Internet experience. Users were told that first they would receive search results for a query provided by the supervisor1. Thus, participants began on the same SERP, but were allowed to proceed in any way they chose. We used Tobii Eyetracker T60 that is integrated in a 17” monitor to gather the data. Each subject received a search task to solve within 10 minutes for each search engine. After each search task, we also asked the participants about their own assessment of the search task difficulty. At the end, a structured post-interview about users’s preferences in search engines was performed. The search tasks and corresponding initial queries used in the study are presented in Table 1. The scope of a task is designed so that it can be solved in a reasonable amount of time, but the solution is not trivial. Initial queries were selected such that they had at least two SERPs, and that the correct answer could be found in one of the first 20 results. For navigational tasks there was only one correct result web page. The initial SERPs contained significant SUI elements. We ensured the search consistency in order for the search conditions to be the same among all participants. In specific, the same SERPs were presented to the users using initial queries. As SUIs could be altered by the search engine owners, we fixed the first two SERPs for the pre-specified queries we used in our study2. After each session, the browser history

1Initial SERPs were necessary for the eye-tracking experiment to be able to compare users’ gaze data and aggregate the results.
2This procedure was done for Google. The search engine for children was static.
was automatically deleted to avoid highlighting of previously clicked search results. All browser cookies were automatically deleted to disable the personalization of search results.

Participants: The user study was conducted in February 2013. We collaborated with a primary school in Biederitz (Germany) and used a separate school room there. 14 children participated in the study. Unfortunately, not all the eye-tracking data were valid as children are very agile and some of them moved too close to the monitor during the session so that the eye-tracker could no longer capture their eye movements. Our further analysis is based on 11 young users. They are between eight and eleven years old (9.27 on average, $\sigma = 0.79$), 64% were boys. 55% of the children are from third and 45% from fourth grade. 80% of fourth grade and 33% of third grade children use the Internet at least once a week. Thus, older children spend more time online. 63% of the pupils use the Internet without any supervision (83% of the third grade and 40% of the fourth grade), whereas the rest of the participants share the company of their parents or older siblings. 54% of the young participants use the Internet mostly to play online games and watch videos. 36% also search for information. 9% use the Internet only to search for information, for example, to do their homework. More than 80% are familiar with Google and 45% also know BK. Children like both Google and BK because they can provide “a lot of information.”

Adults were recruited mostly from an academic context and tested in our lab. 17 adults also participated in the study. They were between 22 and 59 (29.81 on average, $\sigma = 8.93$). 65% were male. 70% of adults are students in computer science or working in the IT sector. This introduces one side effect. These adults can be considered as search experts, while the children are novices in web search. All the adults use the Internet every day without any supervision. 18% use the Internet only to search for information. The rest also use the Internet for other activities such as chatting etc. All the adult participants usually use Google to search for information. 29% of the adults use other search engines such as Yahoo, Bing or DuckDuckGo along with Google. Adults told us that Google is “concise and user-friendly,” and it offers “a good balance between speed and quality of search results.”

STUDY RESULTS

To analyze the users’ perception of SERPs we created heat maps. Fig. 2 and 3 show several aggregated heat maps both for children and adults, i.e. accumulated number of fixations from all the selected test persons. Red color indicates the regions with a highest number of fixations and green the least, with varying levels in between. The heat maps show a difference between the children’s and the adults’ search behavior.

Both search engines: On both search engines, the adults only fixated on the first search results. The fixation areas get smaller for results ranked lower. This pattern is consistent with the F-shaped strategy [10]. In case the answer is not found within the first search results, the adults reformulated the query starting a new search. Young users exhaustively explored all the ten results and used the navigation buttons between results pages to continue further examination. We assume that navigation is easier for children than query reformulation due to children’s low capacity for abstraction [11] that makes it difficult for children to create own queries. Children reformulated the query mostly on the second SERP.

The heat maps for children on both Google and BK contain relatively closely spaced, circular, color-highlighted areas, which are spread across all titles of the search results list. This scan pattern indicates a partial reading of the search results titles. Due to this reading style relevant information can be overlooked, so that children often navigate to the next SERP. Our findings are consistent with Dinet [3] who found a tendency towards a cued visual jump strategy of younger children, however we also found that children tend to scan the whole result list using jumps between highlighted words especially in titles. During navigational search the children paid more attention to snippets than during informational search both using Google and BK. This can be explained by the fact that navigation tasks are more difficult to solve and require an extensive reading of the snippet content [12]. Children paid more attention to media elements such as pictures and video elements embedded in a search result than adults.

Google: The Google search engine provides query suggestions placed on the bottom of the page. However, only children paid attention to query suggestions and adults did not. Furthermore, children employed visual-jump strategy from a highlighted word in the title to the next one available.

BK: In contrast to adults children looked at the navigational menu with categories on the surface of the BK. Some chil-

<table>
<thead>
<tr>
<th>ID</th>
<th>Search task (Initial Query)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Info-1 (Google)</td>
<td>How many animals does the zoo in Magdeburg have? (Zoo Magdeburg)</td>
</tr>
<tr>
<td>Info-2 (BK)</td>
<td>What is the name of the largest Saturn moon? (Saturn Monde)</td>
</tr>
<tr>
<td>Nav-1 (Google)</td>
<td>Find the homepage of the photographer Michael Jordan. (Michael Jordan)</td>
</tr>
<tr>
<td>Nav-2 (BK)</td>
<td>Find the online-game page of ZDF Tivi portal. (ZDF Tivi)</td>
</tr>
</tbody>
</table>

Table 1. Search tasks and corresponding initial queries used in the study.
CONCLUSION
We found differences in the perception of search engines SERPs between children and adults. Based on the findings of this study we provide the following suggestions to design better search user interfaces for children in the future. As the children paid attention to thumbnails and embedded media, these elements should be used in SERPs and provide relevance cues. As the children only partially read the results’ snippets, it may be unnecessary to present a long text in each snippet of a search result. Instead snippets should be short and provide relevant typographical cues to avoid frustration of children when reading long texts and to help children in finding relevant information. As the children used navigational elements and at least looked at the menu with categories, these elements should be part of a search engine and support children who have difficulties to formulate a new query. In the future, we are going to analyze participant’s efficiency, effectiveness and user preferences during the search and further eye-tracking parameters such as gaze plots.

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REFERENCES