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Engage!: Co-Designing Search Engine Result Pages to Foster Interactions

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ABSTRACT

In this paper, we take a step towards understanding how to design search engine results pages (SERP) that encourage children's engagement as they seek for online resources. For this, we conducted a participatory design session to enable us to elicit children's preferences and determine what children (ages 6–12) find lacking in more traditional SERP. We learned that children want more dynamic means of navigating results and additional ways to interact with results via icons. We use these findings to inform the design of a new SERP interface, which we denoted CHIRP. To gauge the type of engagement that a SERP incorporating interactive elements–CHIRP–can foster among children, we conducted a user study at a public school. Analysis of children's interactions with CHIRP, in addition to responses to a post-task survey, reveals that adding additional interaction points results in a SERP interface that children prefer, but one that does not necessarily change engagement levels through clicks or time spent on SERP.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; • **Information systems** → *Presentation of retrieval results.*

KEYWORDS

children, web search, participatory design, interface

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1 INTRODUCTION

Children regularly turn to mainstream search engines (**SE**), like Google or Bing, in addition to child-specific SE like EdSearch [1] or Kidtopia [2], for seeking online materials. Regardless of the SE used, children are known to struggle to effectively navigate search engine result pages (**SERP**) in order to find the information they need [6, 8, 11]. For the most part, children tend to click the top-2 results retrieved in response to their queries, "seem[ing] to make less deliberate choice[s] in choosing which result to click" [12], even if those results do not necessarily respond to their search intent. Additionally, children oftentimes do not look beyond the top-6 results due to their perception that those results are more trustworthy or popular [12], potentially overlooking results that are more appropriate, e.g., results that are more understandable and readable, but placed lower in the SERP. When traversing a SERP, children also opt for a linear exploration approach, clicking results sequentially from top to bottom, instead of reading snippets in order to judge the potential relevance of retrieved resources, regardless of their ranking position [12, 14].

To date, there has been no concrete solution for SERP interfaces for children [9], and research focused on how children engage with SERP is not extensive. What has been done indicates that interfaces enriched with icons could benefit searchers by providing additional ways to identify relevant resources [3]. In fact, Landoni et al. [13] state the need for future work involving icon-enhanced SERP for children using SE in classrooms as a takeaway from their user study to explore what children see as clues for relevance, i.e., their perceptions of relevance. Before relevance can be considered, we first need to explore ways to prompt children's interactions with SERP as a step towards them being more willing to engage with any resources or extended aid presented in response to their online inquiries. We posit that augmenting SERP with interactive functionality is a natural next step. Inspired by these works, we endeavor to involve children in the design of a SERP to meet there aesthetic expectations, as we believe that children will be more inclined to interact with a SERP designed by their fellow children.

We seek to gather what children (ages 6–12) envision a SERP to look like and begin to explore whether children will engage with a SERP designed to meet their aesthetic and interactive expectations. For this, we performed a two-phase investigation. The first phase involved a participatory design session with an inter-generational team, considering the children as design partners, where participants were prompted to identify positive and negative features of mainstream and child-oriented SERP. This design session informed the development of CHIRP, **Chi**ldren's **R**esult **P**ages, a new interactive SERP that has larger *navigation buttons* than a traditional SERP and includes icons to *like*, *dislike*, or *bookmark* a search result. In the second phase, we performed a study in a public school during which children in the 3^{rd} and 6^{th} grades (ages 8–9 & 6–12) performed search tasks related to their classroom studies using different search interfaces. From search logs generated during the study, we computed several measures of engagement, e.g., session

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length and result click; from post-task surveys, we inferred participants' prior experience searching and SERP preference. We used trends arising from engagement measures and survey responses to determine if children preferred a SERP containing elements their peers co-designed and if they actively engaged with CHIRP.

With this preliminary exploration, we pursue answers to these research questions: **RQ1:** How do children envision a SERP tailored for them? **RQ2:** Do interactive elements foster engagement with SERP? **RQ3:** Do SERP with interactive elements encourage children to deviate from their traditional SERP interactions? Our findings reveal that children want more dynamic means to interact with results, e.g., ways to remove results and better navigation between pages. Interestingly, while children consistently favored CHIRP, their level of engagement with the enhanced SERP differs by age – children in the 6^{th} grade produced more interactions than 3^{rd} graders, who in the study were very vocal about liking the bird logo, but not as vocal about the interactive elements. This could serve as indication that older children preferred CHIRP for the new interactive options, whereas the younger ones preferred CHIRP for its appearance. Outcomes from this preliminary work can support future research in Human Computer Interaction and Information Retrieval including the design of adaptive interfaces that respond to kids' needs while searching in the classroom via engagement, without distracting them.

2 PHASE 1: CREATING CHIRP WITH PARTICIPATORY DESIGN

In the first phase of our investigation, we conducted a participatory design session with an inter-generational team (Kidsteam), consisting of 6 adults and 7 children (ages 6–11) who employ cooperative inquiry techniques [5, 7] to design technology for children. The abilities of the children in Kidsteam with respect to technology is varied.

We divided child participants into three groups with adult design partners. Each group followed the same session protocol. First, children were asked to run two queries (the name of the state they lived in and "largest country") using two different SE: Google and **CAST** (Child Adaptive Search Tool[1]). The former is a mainstream SE; its SERP includes snippets and a link to the corresponding resources. The latter is a custom SE designed to assist children when searching by incorporating a larger search bar and tailoring spellchecking towards young searchers; its SERP mimics that of a mainstream SE, but includes images alongside the links and snippets [4]. Note that for two of the younger children, the adult facilitators performed the typing during the search. We presented children with both SE to foster discussion about which elements they liked from each SERP interface and what they would like to see changed in SERP. Driving the discussion were adult facilitators asking children to explain their likes, dislikes, and desired changes. For the younger participants, this feedback was solicited in response to the children's observations instead of direct interactions with the SERP. Lastly, all groups came together into a large group to share the ideas discussed in the individual groups on how to alter SERP, to do informal frequency analysis and organization of the "Big Ideas" that came out of each group, and to validate these ideas with the full group.

Among the more frequent and interesting design ideas, children reached consensus on more efficient browsing, either by adjusting the results to match the age of the searcher or by allowing users to edit the results (e.g., deleting unwanted results or promoting results perceived as more relevant). The need for large visible navigation buttons to allow users to easily move between results pages was also agreed on. From these more frequent ideas in the feedback, we designed and deployed a prototype SERP, which we call **CHIRP**.

As shown in Figure 1, CHIRP includes four main interaction points. The *like* icon is represented by a hollowed out *heart*. When clicked, the heart is filled in and the result is moved to the top of the page along with other "liked" results. The liked results remain at the top of CHIRP for the current query, but will disappear upon query reformulation or if a new query is submitted. The *dislike* icon is in the shape of a hand giving the *thumbs down* sign. When clicked, the hand is filled in and the result is removed from CHIRP for the current query. The results below the disliked result are moved up. The *bookmark* icon, represented with a *star*, saves a result for later reference, i.e., stored in a slide out window on the left of the browser. Bookmarks are saved as cookies and can be accessed for the life of the cookie. There are two *navigation buttons* at the bottom of the page. They are large navigation buttons to allow for children to click on them easily. The page navigation buttons also include the words next and previous as well as arrows indicating the direction.

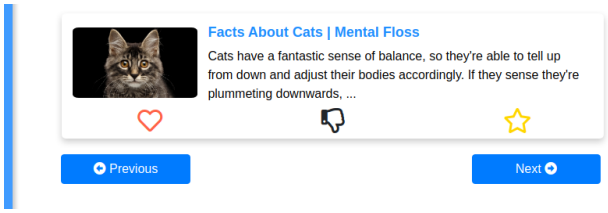
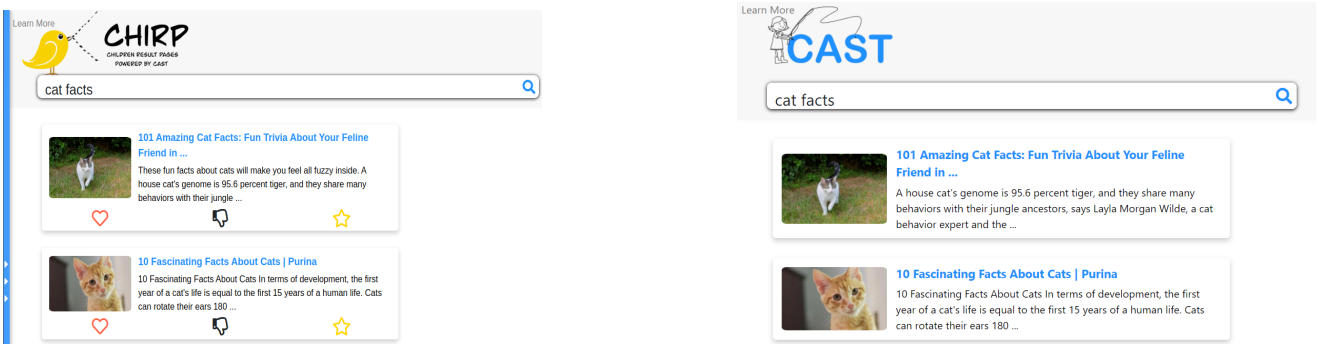


Figure 1: Interaction enhancements on CHIRP: Like, dislike, and bookmark icon, along with navigation buttons.

3 PHASE 2: ASSESSING USER ENGAGEMENT WITH CHIRP

To assess children's engagement with the interactive elements of CHIRP, we conducted a user study with a 3^{rd} (n=10) and 6^{th} (n=13) grade class in a public school with children ages: 8 (n=3), 9 (n=7), 11 (n=5), and 12 (n=8). Classes containing children aged 6–7 and 10 did not volunteer to participate in this study. Each class followed the same session protocol. The classes were presented with two SE, CAST (Figure 2(b)) and CAST with CHIRP (Figure 2(a)). The information discovery task was decided upon by each class through discussion with their respective instructors, and then students selected a topic they had been studying. Third graders chose to search for animals, 6^{th} graders for Norse mythology. A within subject design was utilized where each class was divided in half: one half was assigned CAST and the other half was assigned CHIRP. Upon completion of the first information discovery task, the children switched SE, from CAST to CHIRP or CHIRP to CAST, to perform

[1]https://cast.boisestate.edu/about/



(a) CAST enhanced with the CHIRP interface

(b) CAST using default SERP

Figure 2: SERP generated in response to the query "cat facts".

the same task. Children also filled out a post-task survey where they were asked about their experience with SE, if they noticed the new icons, and their preferred SERP interface.

We used search logs collected during this phase to compute several measures of engagement: length of search session, number of clicks on result links, number of icon clicks, number of navigation clicks, and position of the first click of result links and icons across; each averaged by all participants and per grade. As shown in Table 1, children clicked on average 3.22 result links while using CHIRP, in contrast to 2.22 with CAST. When looking at different groups, we see that, while not significant, 3^{rd} graders clicked on more result links with CAST than CHIRP, which is contrary to our expectation that icons would increase click volume on result links. The opposite was true for 6^{th} graders, who clicked more result links on CHIRP than CAST (paired t-test, $p < 0.05$), pointing to older children engaging with result links when presented with a SERP including interactive elements. Since the inclusion of the icons was a design requirement determined in Phase 1 (see §2), it is possible the icons did not attain the intended engagement with the different age groups and could be designed differently to further motivate engagement.

We also investigated the position of the clicked results, focusing on the first such click. On average, the first click occurred on the fourth result regardless of whether the children were using CAST or CHIRP. This differs from the findings in [12] regarding children clicking on top-2 results when using mainstream SE, which we partially attribute to both SE used in our study being child-oriented. A further study comparing CHIRP to the SERP of a mainstream SE would increase certainty. The lower click position seems to indicate that interactive elements do not influence where children first clicked on the SERP. This is counter to our hypothesis that the icons would allow the children to explore more results outside the top-6, especially as lower results can be moved up through the removal of unwanted results with the *dislike* icon. The icons may still be better implemented as they did not seemingly have an impact on our findings beyond the observation that some children enjoyed the novelty of clicking on them to see what happens.

Engagement through clicks on interactive elements and search session duration were different between the two grades. We see that the children spent more time searching with CHIRP. We anticipated that the inclusion of icons would increase session time by providing more ways to interact with a SERP. However, we see from the session duration times that children spent, on average, more time using CAST. When we look at session length between the two grades, the 6^{th} graders had the longer session. The combination of the longer search sessions of older children using CHIRP with the fact that they clicked on more icons and result links with CHIRP would imply that the presence of interactive icons can increase engagement. We partially ascribe the combination of lower clicks and longer sessions to the fact that the 3^{rd} grade children were plausibly distracted by the CHIRP interface. This is illustrated by one of the survey responses, where a 3^{rd} grader simply typed "BIRD!!!!!!!!!!!!!!!!!!!!!!!!1" when describing why they liked CHIRP.

While the reported results are not significant when comparing CAST to CHIRP (paired t-test; $p > 0.05$), from responses to the post-task survey, it comes across that, in their majority, children prefer interactive icons (see Figure 3(c)). Nevertheless, 40% stated not noticing the new icons that are part of CHIRP (see Figure 3(b)).

4 DISCUSSION AND LIMITATIONS

We discuss below the answers to the research questions guiding our work; in addition to encountered limitations.

RQ1: How do children envision a SERP tailored for them? From the participatory design session, we found that children want SERP to contain more interactive elements, giving them more control over the results. However, further input on the specific design and appearance of the interactive elements is needed as a majority of the children noticed the icons but did not necessarily click on them, leading us to question if the icons selected for CHIRP matched what the children expected. We also experienced that trying to extract and understand what children want can be a difficult exercise, further limited by the need to interact with them remotely.

RQ2: Do interactive elements foster engagement with SERP? As captured in Figure 3(a), most participants involved in Phase 2 of our study claimed to posses prior experience with SE, yet we start to see differences in interactions between the two grades. For instance, 6^{th} graders clicked more result links than 3^{rd} graders when using CHIRP as opposed to using CAST, but have shorter search

Table 1: Engagement measures. * denotes significance w.r.t CAST, as verified by the paired t-test (p<0.05.)

Engagement	CHIRP			CAST		
Measures	3^{rd} Grade	6^{th} Grade	Overall	3^{rd} Grade	6^{th} Grade	Overall
Result Click	2.0	4.31*	3.21	3.44	1.82	2.21
Favorite	0.3	1.3	0.87	—	—	—
Dislike	0.4	2.15	1.39	—	—	—
Bookmark	0	0.54	0.30	—	—	—
Next Page	0.5	2.31	1.52	—	—	—
Previous Page	0	1.37	0.74	—	—	—
Session Duration (in sec.)	397.07	423.37	411.93	340.17	578.71	475
Pos of 1^{st} Result Click	4.44	3.69	4.0	3.33	4.72	4.1
Pos of 1^{st} Favorite	4.5	2.33	2.88	—	—	—
Pos of 1^{st} Dislike	1.0	3.6	3.17	—	—	—
Pos of 1^{st} Bookmark	0	3.17	3.17	—	—	—

sessions than the 3^{rd} graders. This difference could potentially be attributed to the fact that the icons move result entries around the SERP. With the *like* icon moving items up and the *dislike* removing them, the children avoided the need to scroll, an action children are known to rarely take, thereby making it possible for more results to be viewed easier. We posit the difference could also be ascribed to the more relevant result being presented as the user moves results through icon interaction. However, as we did not measure success of the search task, further study would be needed to verify this hypothesis.

RQ3: Do SERP with interactive elements encourage children to deviate from their traditional SERP interactions? The fact that children click the fourth ranked result link on both CAST and CHIRP points to interactive elements not pushing children to deviate from the norm. Both CAST and CHIRP display only three full results above the fold so to click the fourth ranked result, the children would have had to scroll. This is in contrast with past findings that children tend not to use complex interactions like scrolling [10]. While participants in Phase 2 seemed to scroll results, neither age group first clicks a result link outside the top-6. Further follow up prompting the reasons driving which result links were clicked may provide additional insight on this behavior.

5 CONCLUSIONS AND FUTURE WORK

In this work, we took initial steps toward designing a SERP that can better support children searching. Leveraging outcomes from a participatory design session with children we created CHIRP, a new SERP interface meant to be more responsive for children than a traditional SERP. We then conducted a study at a local school to get feedback on CHIRP's design, in addition to scrutinize interaction with SERP via measures of engagement. From analysis of collected data we found that CHIRP interactive elements did not affect all age groups in the same way. This calls for more research, including using the protocol to collect more measures of engagement and responses from children. This would allow us to produce enough data to better determine the significance of the effect of a SERP with interactive elements. Additionally, given that we had low engagement with interactive icons, we will conduct further design sessions to help us find icons that more naturally encompass the requested functionality and make it easier for children to interact with, as we did not elicit input from children as to which icons to use for the liking, disliking, and bookmarking.

While out of scope for this work, from Phase 1 observations we noted that children felt that the results were not entirely relevant to them, e.g., when they searched for the state, they got information regarding contact numbers and local office addresses, instead of the history of the state or something similar to what they would receive in a classroom setting. Children also mentioned the would like to further filter the results using an age selection screen or some other mechanism . Indeed, an interactive adjustment of results based on age could be a very fruitful area of future research. Further, children expressed a desire to easily locate and interact with the navigation buttons. This prompted the large navigation buttons on CHIRP that remain situated left at the bottom of the SERP. Due to children's tendency to interact with the top-ranked SERP results, it may be beneficial to examine search behavior with the navigation buttons that are in an always visible floating position, either at the top of the search results or at bottom of the window.

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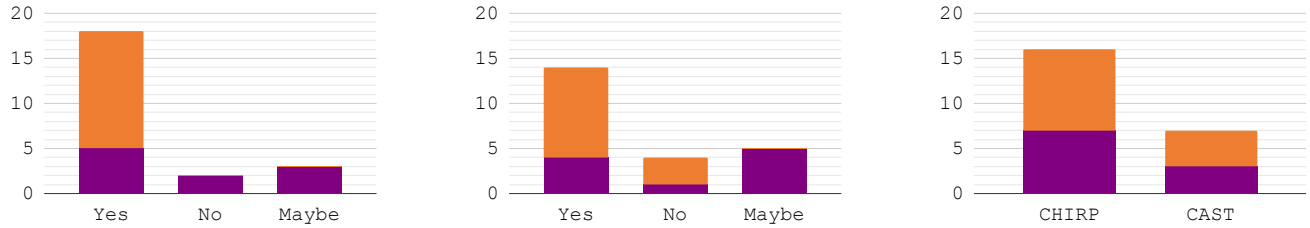

(a) Have you used a search engine before?

(b) Did you notice three different icons?

(c) Which search results page did you like more?

Figure 3: Responses to post-task survey administered in Phase 2 of the study. 6^{th} graders in purple, 3^{rd} in orange.

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