2018

Investigating Query Formulation Assistance for Children

Oghenemaro Anuyah
Boise State University

Maria Soledad Pera
Boise State University

Jerry Alan Fails
Boise State University

Investigating Query Formulation Assistance for Children

Oghenemaro Anuyah
People & Information Research Team
Dept. of Computer Science
Boise State University
Boise, ID 83725 USA
oghenemaroanuyah@boisestate.edu

Maria Soledad Pera
People & Information Research Team
Dept. of Computer Science
Boise State University
Boise, ID 83725 USA
solepera@boisestate.edu

Jerry Alan Fails
Dept. of Computer Science
Boise State University
Boise, ID 83725 USA
jerryfails@boisestate.edu

IDC '18, June 19–22, 2018, Trondheim, Norway

ACM ISBN 978-1-4503-5152-2/18/06...$15.00
https://doi.org/10.1145/3202185.3210779

Abstract
Popular tools used to search for online resources are tuned to satisfy a broad category of users—primarily adults. Because children have specific needs, these tools may not always be successful in offering the right level of support in their quest for information. While search tools often provide query assistance, children still face many difficulties expressing their information needs in the form of a query. In this paper, we share results from our ongoing research work focused on understanding children's interactions with query suggestions and their preferences with respect to suggestions offered by a general-purpose strategy versus a counterpart designed exclusively for children. Our goal is to inform researchers and developers about when it is necessary to turn to technologies tailored exclusively for children and to further outline needs that should be addressed when it comes to designing query-formulation-related technology for children.

Author Keywords
Internet search, query suggestions, children.

ACM Classification Keywords
• Information Systems~Query Suggestion
• Human-centered computing~Human computer interaction (HCI): HCI design and evaluation methods~User studies

Introduction

Technology is increasingly used by children to access the immense and ever-growing amount of online content currently available; from videos, games and story books to educational materials [14]. Although these resources are readily accessible, children still need to be able to find them. The initial step to the search process when using web tools is to formulate a query. However, due to children's limited vocabulary and difficulty in identifying the right keywords to express their information needs, they often experience problems formulating effective queries [8].

In order to address these issues, a typical approach would be to provide some form of assistance or to guide children through the query formulation process. Traditionally, this could be done through the guidance of an experienced individual or peers, when searching [11]. A technology-based alternative instead involves functionality built into search tools that can aid children as they create queries. This has received attention from developers and researchers [2,3,6], especially in the form of *query suggestions* (QS)*,* which are the words that pop-up underneath a search text entry box that users can select to help them formulate their query. The aim of QS is to predict a user's search intent, which better reflects the user's information need [4].

QS functionality is available in search tools, such as Google and Bing. Their suggestions, however, are often geared towards the assumed primary user: an adult [7]. The same is true for the strategies discussed in the literature, as they are based on techniques that depend upon general corpora [1,15], which can be of limited availability when it comes to child-oriented content, or click-through data from query logs [5,13], that are likely to target the interest of a general population, therefore making non-traditional users like children under-served in terms of responding to their specific needs. To address some of these limitations, researchers have dedicated efforts to developing QS algorithms that explicitly target children [8,10,16]. Unfortunately, a standard of practice in this area is yet to emerge—to our knowledge, there is no de-facto query formulation strategy favored by children.

To better understand how existing strategies address children query formulation problems, their limitations, and the varying ways to help children create queries, we ask: How can children get help when formulating queries? Do children favor QS that specifically targets them?. In this paper, we discuss initial findings that result from our pursuit of answers for these questions. We present insights from the analysis of children's interactions with suggestions generated by Bing and a QS algorithm tailored for children [16]; offer lessons learned; and outline next research steps.

User Investigations

We present the QS algorithms we considered in our initial study, how participants were selected, and the three sessions we conducted to explore children's interactions with QS functionality.

Investigated Query Suggestion Algorithms

To infer if and when children turn to QS when initiating information discovery tasks, we conducted three user studies. In all three studies we considered two QS algorithms: one explicitly targeting *children* and one for *general users*. For the former, we used ***ReQuIK*** [16], a state-of-the-art QS strategy. Unlike other child-oriented counterparts, ReQuIK analyzes candidate suggestions from multiple perspectives to identify those that better reflect children's vocabulary and topics of interest.

Figure 1. Children performing search tasks during user study search sessions.

Figure 2. Initial generic search interface.

Figure 3. Suggestion interface to indicate which query suggestions were good and which were not.

ReQuIK offers suggestions that are child-friendly and have the potential to lead to resources with text complexity levels compatible with those expected for children in the 1st to 7th grades. Moreover, ReQuIK's API is available upon request for research purposes. For the latter, we used suggestions powered by ***Bing***, a popular search engine with a developer-friendly API.

Selection and Participation of Children

Child participants are members of an intergenerational design team that meets twice a week after school. They were recruited via public postings in the proximity of the building where the team meets, as well as via a localized social media platform that allows neighbors to share information. The purpose of the team is to collaboratively work to design new and improve current technologies for children, which was explained to participants and their parents. Parents signed consent forms to allow their children to participate, and children assented to participating on the team. At the time of this study there were 5 girls and 3 boys; ages 6-to-10. While this is a co-design team, in the studies presented herein the children are acting as testers. The children vary in computer abilities (novice to intermediate).

Experimental Setup

We conducted experiments in three different sessions on different days: *S1*, *S2*, and *S3*, respectively. Each session lasted 90 minutes and included informal snack time; introductions of additional design partners (graduate students and faculty who work in information retrieval), an overview of the day's specific goals and tasks; conducting the research; debriefing; and writing of reflective thoughts towards the end. During all sessions, the grade of the child performing each task was recorded. We show a picture of some of the kids performing search tasks in Figure 1.

S1: Initial Comparison of QS

In S1, children were each seated at a computer and used a generic search engine. While the interface (pictured in Figure 2) looked the same, the engine on every other computer applied a different algorithm—Bing or ReQuIK. During this session, a facilitator gave verbal prompts to search for different things. Then, children worked on their own but had other adult facilitators if they needed additional help or reminders to indicate which suggestions were the most fitting. After 15-20 minutes, children rotated to a different computer and were given another set of query prompts. This counter-balanced the presentation of suggestions generated by the different algorithms.

After completing both rounds of search prompts, children were asked some survey questions, including questions comparing their experiences using the search interface during the two rounds, which version they preferred, which gave better suggestions, etc. The survey utilized tools from the Fun Toolkit [17] like the Smileyometer and also had open ended questions. The reason for not doing something after each condition was to not bias them before the second condition. The goal of this session was to allow children to utilize both sets of suggestions in order to see what differences or similarities there were when children conducted searches equipped with different QS mechanisms.

S2: Indicating Effectiveness of QS

In S2, the focus was on the suggestions. There were two different instruments that triggered QS: One (labeled S2a) after the child entered the first term, i.e., after first space; the other (labeled S2b) after the child typed a random number of characters—at most 20, as we expect that children will normally form a meaningful word with a maximum of 20 characters. When the

suggestions popped-up the query box was disabled to enable children to focus on the suggestions. The QS displayed were the top five from Bing and ReQuIK. Similar to S1, children were presented with query prompts and used each instrument for half of the time. The order of presentation was counterbalanced.

The goal of this session was to identify the relative effectiveness of QS. As such, after indicating which suggestions were good and which were not, the search interface reset to allow children to enter in a new search query. There was a debrief session at the end, but survey questions were not administered.

S3: Improved Indication Effectiveness of QS
In S3, the focus was also on QS; however, unlike S2, children would see the result of their search. After a certain amount of time (10 seconds) suggestions would pop-up, but children could still change the query (see the suggestions for a child-initiated query in Figure 3). Children were then asked to indicate which suggestions they liked and which they did not. After indicating their preference, the results for the first positive QS would be shown. A new set of query prompts were given to the children for S3, these were more situational and were less specific than previous sessions. At the end of the session, children were given a short survey asking about preferences on QS as well as what they would recommend changing to improve the suggestions.

Children's Surveys: Analysis and Discussion

Following the experiments conducted in S1, S2 and S3, we examined survey responses, the query prompts written by children, and the associated suggestions that were selected. As the sample is small (n=8), the analysis is not conclusive, but it is a helpful first step in further understanding how children perceive QS and in looking into future studies that can better quantify the benefits and limitations of QS technology.

At the end of S1 children were asked what differences they noticed between the two search engines. Children were not directed towards the QS; although five did not notice a difference, three did. The three that noticed differences pointed out that it was due to QS. Children provided additional information by saying things such as: "one talked about things that were inappropriate" (referring to a time when one suggestion included the term 'sex'), "one was confused, opposite day computer" (implying that one was providing bad suggestions, not in line with his intent), "I got bad questions" (meaning that the suggestions were not good—did not match her intent). Of note, these negative responses were in relation to suggestions generated by Bing. Five of the children stated that they preferred the search engine which provided suggestions using ReQuIK, whereas two preferred Bing's suggestions. One of the children would not indicate one way or the other as he was emphatic that suggestions were the same. We also asked the children how comfortable they were searching on a computer. Responses were at extremes: four indicating it was very easy, four very difficult. The youngest child (a 6-year-old girl) noted she did not search for things at home—she was the only one who indicated that.

There were insights from the survey at the end of S2 and S3, which highlighted how children utilize or would utilize suggestions. Most children indicated that it was easy to use suggestions. They stated that they would be more likely to use QS if they used bigger letters, and if there was some sort of a help to remind them to use QS. All children (besides the 6-year-old girl who indicated she wouldn't search anyway) said that with those changes they would use QS "A lot".

S1 Query Prompts

Round 1

- What is the movie "Coco" about?
- What kind of habitat does an "aardvark" live in?
- Search and learn something new about your favorite place.

Round 2

- What is the movie "Leap!" about?
- What kind of habitat does a "platypus" live in?
- Search and learn something new about your favorite holiday.

S2 Query Prompts

- Name 3 countries and their capitals other than the US.
- What animals live the longest lives? shortest lives?
- Favorite desert and ingredients for baking it.
- Going on a trip to Alabama – find something fun to do.
- Favorite superhero and a movie with them in it.
- Find something to show your friend about your favorite book.
- How many different types of potatoes are there: list some.
- Find five different types of dogs.
- How will you search for your favorite math text book
- How will you search for dolphins?
- Who were the characters in the movie frozen?
- How many centimeters are in a meter?
- What is the temperature today?
- Ingredients in a sandwich?
- How long is the giraffe's neck?
- What is the largest continent?
- What is the best show on TV?
- What time will the sun rise tomorrow?
- Why is the sky blue?
- Will skiing be fun this year?

S3 Query Prompts

- Situational, not specific questions

Process Observations

We offer observations regarding our experiments, which may be useful to researchers in this area.

Query Prompts

Initially, we gave some specific and some open-ended query prompts. We noticed particularly in S1 and S2 that children would try to use the exact phrases given in prompt as their query. Thus, in S3 we use situational prompts such as "You are at your friend's house and are talking about books and you want to show your friend some information about your favorite one. You get on a computer and search for information to show your friend." We found these situational prompts enabled children to come up with queries on their own rather than using the query prompt as their query.

Support Autonomy and Completion

The focus of our research was on QS. This motivated the setup of S2, where children would start entering a query and suggestions would pop-up to allow them to indicate which they liked and which they did not. While the focus was on QS, and this yielded information regarding their preferences with regards to the two algorithms used to retrieve suggestions, it violated some important design principles, which was noted. Specifically, this instrument violated the user-centered design principles of internal locus of control and yielding closure. Children felt forced to only interact with QS. The trigger of showing QS after the first entered term motivated children to try to write a full query without spaces, which was also problematic. Additionally, the instrument in S2 did not show children the results of their queries, which did not yield closure and children found that disconcerting. These observations prompted the changes that were made for S3, which allowed children to continue to enter more to their query even after QS, popped up requesting the user to indicate their preference. In S3, the instrument also showed search results for the first suggestion that was marked as good. The lesson learned was that even though the instrument may be focused on a specific aspect of search, autonomy needs to be respected and the full task still needs to be supported.

Limitations and Validity

Kids seemed to pick suggestions that they liked rather than accurate ones. This is challenging, as it prevents researchers from identifying suggestions that not only children respond to but that also help them, i.e., are relevant to their specific information discovery tasks. To help curb this issue, in the future, we will conduct instead more guided searches and offer search literacy directives prior to the search sessions.

Conclusion and Next Steps

For decades, QS strategies have been developed with the aim of improving search tasks. Yet, when it comes to young audiences, there are many open questions that require attention. Based on the feedback provided by 6-to-10 year olds, and as illustrated in Figure 4, young children still find the search process—formulating effective queries and identifying the right resources—very challenging. While not conclusive, outcomes from our on-going research efforts provide insights on children views on QS functionality.

In the future, we will expand the group of children surveyed and conduct new studies to answer what technologies can children turn to for help with query formulation; which currently-available QS strategies are tailored for children; what are the limitations on these strategies, and do children require the same level of help for different type of search tasks.

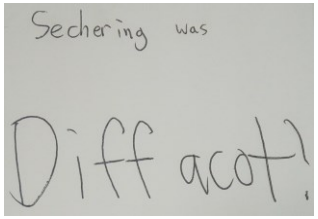

Figure 4. Journal entries reflecting on the day's exercise, indicating that search is still difficult. This illustrates the need for continued research in this area.

Researchers in information retrieval often extract children's queries from the popular AOL query log by identifying the sessions that retrieve information from web pages known to be for children [7,9]. These are considered "good children queries", however, as discussed by Gossen [12], some of these queries may have been misclassified, as some adults and children could have similar search patterns. With that in mind, we will lead further studies that can shed light on what makes a good QS from a child perspective. This will allow us to collect and directly analyze queries written or selected by children, as opposed to asking them to articulate what is required of a good suggestion.

Acknowledgements

Work partially supported by NSF Award no. 1565937.

References

1. Sumit Bhatia, Debapriyo Majumdar, and Prasenjit Mitra. 2011. Query suggestions in the absence of query logs. In *ACM SIGIR*, 795–804.
2. Dania Bilal. 2001. Children's use of the Yahooligans! Web search engine: II. Cognitive and physical behaviors on research tasks. *JASIST* 52, 2: 118–136.
3. Dania Bilal. 2002. Children's use of the Yahooligans! Web search engine. III. Cognitive and physical behaviors on fully self-generated search tasks. *JASIST* 53, 13: 1170–1183.
4. Huanhuan Cao, Daxin Jiang, Jian Pei, Qi He, and others. 2008. Context-aware query suggestion by mining click-through and session data. In *ACM SIGKDD*, 875–883.
5. Wanyu Chen, Fei Cai, Honghui Chen, and Maarten de Rijke. 2017. Personalized Query Suggestion Diversification. In *ACM SIGIR*, 817–820.
6. Allison Druin, Elizabeth Foss, Leshell Hatley, Evan Golub, and others. 2009. How children search the internet with keyword interfaces. In *IDC*, 89–96.
7. Sergio Duarte Torres, Djoerd Hiemstra, and Pavel Serdyukov. 2010. An analysis of queries intended to search information for children. In *IIiX*, 235–244.
8. Sergio Duarte Torres, Djoerd Hiemstra, Ingmar Weber, and Pavel Serdyukov. 2012. Query recommendation for children. In *ACM CIKM*, 2010–2014.
9. Sergio Duarte Torres and Ingmar Weber. 2011. What and how children search on the web. In *ACM CIKM*, 393–402.
10. Carsten Eickhoff, Tamara Polajnar, Karl Gyllstrom, Sergio Duarte Torres, and Richard Glassey. 2011. Web Search Query Assistance Functionality for Young Audiences. In *ECIR*, 776–779.
11. Elizabeth Foss, Allison Druin, Robin Brewer, Phillip Lo, and others. 2012. Children's search roles at home: Implications for designers, researchers, educators, and parents. *JASIST* 63, 3: 558–573.
12. Tatiana Gossen. 2016. *Search engines for children: search user interfaces and information-seeking behaviour*. Springer.
13. Diane Kelly, Karl Gyllstrom, and Earl W Bailey. 2009. A comparison of query and term suggestion features for interactive searching. In *ACM SIGIR*, 371–378.
14. Simon Knight. 2014. Finding knowledge–what is it to know when we search?
15. Udo Kruschwitz, Deirdre Lungley, M-Dyaa Albakour, Dawei Song, and others. 2013. Deriving query suggestions for site search. *JASIST* 64, 10: 1975–1994.
16. Ion Madrazo, Nevena Dragovic, Oghenemaro Anuyah, and Maria Pera. 2018. Looking for the movie Seven or Sven from the movie Frozen?. In *ACM CHIIR, 92-101*.
17. Janet C. Read and Stuart MacFarlane. 2006. Using the Fun Toolkit and Other Survey Methods to Gather Opinions in Child Computer Interaction. In IDC, 81–88.