Searching for spellcheckers: What kids want, what kids need

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ABSTRACT

Misspellings in queries used to initiate online searches is an everyday occurrence. When this happens, users either rely on the search engine's ability to understand their query or they turn to spellcheckers. Spellcheckers are usually based on popular dictionaries or past query logs, leading to spelling suggestions that often better resonate with adult users because that data is more readily available. Based on an educational perspective, previous research reports, and initial analyses of sample search logs, we hypothesize that existing spellcheckers are not suitable for young users who frequently encounter spelling challenges when searching for information online. We present early results of our ongoing research focused on identifying the needs and expectations children have regarding spellcheckers.

IDC '19, June 12–15, 2019, Boise, ID, USA

ACM ISBN 978-1-4503-6690-8/19/06…$15.00
https://doi.org/10.1145/3311927.3325328

CCS CONCEPTS

• **Social and professional topics** → **Children**; • **Information systems** → Web searching and information discovery; Personalization; • **Human-centered computing** → Participatory design.

KEYWORDS

spelling, children, web search, participatory design

ACM Reference Format:
Brody Downs, Tyler French, Katherine Landau Wright, Maria Soledad Pera, and Casey Kennington, Jerry Alan Fails. 2019. Searching for spellcheckers: What kids want, what kids need. In *Interaction Design and Children (IDC '19), June 12–15, 2019, Boise, ID, USA.* ACM, New York, NY, USA, 6 pages. https://doi.org/10.1145/3311927.3325328

INTRODUCTION

When you spell it wrong, it teaches you that it's wrong and not auto-correct. – Karter

The design idea above was expressed by Karter, an 11 year-old design partner (see Table 1), during a session investigating spelling supports for children. Strategies to generate query spelling corrections, along with resources suitable for development, have been extensively presented in the literature [4, 7, 10]. These resources, however, depend upon the existence of large query logs or annotated corpora. Most of the existing and available logs and corpora which capture spelling mistakes and subsequent corrections made by *adult* users. We question the effectiveness of these strategies, when it comes to identifying suitable spelling corrections for queries formulated by children. This is a problem of special importance, given reports that indicate that between 25% and 40% of queries formulated by children include at least one spelling error [5]. Furthermore, children are known to make unique spelling errors [9], which can be hard for spellcheckers and search engines to interpret.

Spellcheckers have also received mixed reviews in educational research, highlighting concerns such as not helping students catch errors in homophones, and that students who struggle with spelling are more likely to over-rely upon technological tools [12]. Part of the challenge lies in the fact that most spellcheckers attempt to fix the spelling error quickly and efficiently, rather than help students develop their spelling skills. This is in direct conflict with research-based best practice for spelling instruction [8]. While, traditionally, spelling was taught as a memorization exercise (e.g., children receive a list of words on Monday and are told to study for an assessment on Friday), this approach is based upon research from nearly 100 years ago, and more recently scholars have demonstrated its ineffective nature [8]. What children need is instruction in the patterns of spelling so they may apply knowledge gained to novel words [13]. In short, as expressed by our 11 year-old design partner, spellcheckers for children should not be spelling fixers – they should resemble spelling instructors.

Table 1: Participants names*, ages, spelling developmental levels, and approximate grade levels. The table is ordered by spelling developmental level. (*Names are pseudonyms.)

Name*	Age	Developmental Level	~Grade
Kali	7	Late Letter-Name Alphabetic	K to 3^{rd}
Karter	11	Early Within Word Pattern	1^{st} to 4^{th}
Wade	7	Early Syllables and Affixes	3^{rd} to 8^{th}
Alexis	10	Early Syllables and Affixes	3^{rd} to 8^{th}
Dana	9	Early Derivational Relations	5^{th} to 12^{th}
Mason	9	Early Derivational Relations	5^{th} to 12^{th}
Van	9	Late Derivational Relations	5^{th} to 12^{th}

Figure 1: Screenshot of prototype search mechanism (CAST) with spelling assistance.

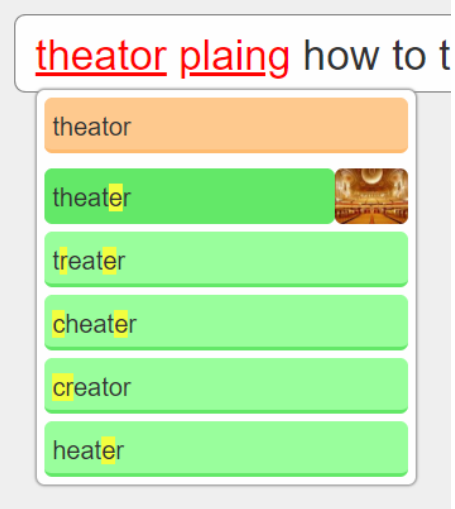

Figure 2: Sample spelling corrections suggested for the misspelled query keyword *theator*.

KIDSTEAM & SPELLING LEVELS

Children involved in our study are members of an inter-generational co-design team – where adults and children work together as design partners [2, 6]. This team, called Kidsteam, 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 both kids and their parents. Parents signed consent forms to allow participation, and children assented to participating on the team. At the time of this study there were 3 girls and 4 boys; ages 7-to-11. The children vary in computer abilities (novice to intermediate).

Since our focus in this research was on children's spelling, we administered the Words their Way Elementary Spelling Inventory [1] to the child participants. This assessment allowed us to identify our participants' developmental spelling levels and provide some insights into what spelling patterns they have mastered and which they would likely struggle with. The Kidsteam participants represented each of the four major developmental stages (See Table 1). Children in the *Letter-Name Alphabetic* stage are able to correctly represent most consonant and single-letter short vowel patterns. Children in the *Within Word Pattern* stage are learning how to represent common short and long vowel patterns (such as adding the letter "e" to "hop" to change the vowel sound and produce "hope"). In the *Syllables and Affixes* stage, children are learning how spelling changes at syllable junctures. For instance, children learn that the word "rabbit" is spelled with two b's to indicate that the "a" is making the short /a/ sound. Finally, in the *Derivational Relations* stage, children learn how spelling patterns convey meaning as well as sound, such as learning that "different" is not spelled as we often pronounce it (i.e., "diffrent") because it is derived from the word "differ" [1].

OUR PROTOTYPE SEARCH SYSTEM/INTERFACE (CAST) WITH SPELLING ASSISTANCE

In order to investigate children's interactions with existing spellcheckers, we shared an initial prototype that was a simple search mechanism with spell checking assistance. We presented children a number of prompts (see Table 2), so that they could freely formulate queries to initiate the information discovery process. For tasks 1-3 spelling suggestions were provided just as text; for tasks 4-6, an image associated with the word correction was also included (see Figure 2). The goal of our study was not to investigate a quantitative difference (across tasks), but to elicit likes, dislikes, and design ideas with a slightly modified interface using a sticky note technique [3]. In order to contextualize the feedback, we first give a brief description of the search tool then present a brief analysis of the query logs (and spelling corrections), and the formative design feedback given via the sticky notes.

The search tool is meant to mimic the interface of well-known search engines, and thus is composed of a search bar, search button, and *Child-Adaptive Search Tool* (CAST) logo (see Figure 1). Like other

Table 2: Search prompts task descriptions.

#	Task Description
1	You are making a poster about snowstorms, find some information about it
2	What movies do you want to see and why?
3	Find information about some fun summer vacation plans
4	Find information about an animal you don't know much about
5	Find information about a technology toy for parents to approve gift (max 120)
6	What superpower do you want and what characters have it?

[1]We pre-processed the query log in order to remove duplicate queries that resulted from children clicking on the "search" button twice, along with empty queries. This pre-processing did not effect generated results.

[2]Any query that included at least a term misspelled, as per Typo.js' dictionary, was treated as a potentially-misspelled query.

modern search tools, users are able to type what they want to find out about in the search bar. Pressing enter or clicking the search button will submit the query and show results. In our case, the retrieval and ranking process is carried out by Google (through its API), with safe search mode on.

As children type their query terms, each word is checked against a dictionary when a space is typed or when the user has not typed for a short period. Different spellcheckers have different strengths and weaknesses some of which we explore below. Spell checking in our prototype is done with the open source spellchecker Typo.js. While the choice of spellchecker is important and impacts the user experience, the primary focus of this initial study was to reveal patterns of usage and interactive preferences and designs. If a word is misspelled, as defined by the default dictionary, it is underlined and colored red to clearly indicate a spelling error. Hovering over an underlined word produces a localized pop-up window containing several buttons: one being the misspelled word, the rest being spelling suggestions (see a sample illustration of such an action in Figure 2). Each spelling suggestion has yellow-highlighted letters, indicating the difference between it and the misspelled word. In the case of Tasks 4-6, hovering over a suggested word displays a relevant image retrieved through the Google Search API. This feature is optional and can be enabled or disabled in a configuration file. Clicking on a spelling suggestion replaces the incorrectly spelled word with the suggestion in the search bar and closes the spellchecker window. All interaction events in the search interface are time-stamped and logged in a database. We offer insights from our collected data in the next section.

How Children Used CAST Spelling Assistance (Query Log Analysis)

A summary of our findings are presented in Table 3. We collected 147 queries (70 while completing Tasks 1-3; 77 for Tasks 4-6); approximately 16 queries per child.[1] We observed that children interacted with the spelling suggestions for 20% of the queries. This means that children took the time to explore spelling suggestions for fixing most of the queries that included a potential spelling mistake[2] – 26% of the total number of queries contained at least one mispelling. Among the 20% in which children interacted with the spellchecker, 77% children explored (i.e., hovered over) offered spelling suggestions and chose a spelling correction for 43% of them. We were particularly interested in this result, as it showcases that children were not able to find a spelling suitable to their search intent for the majority of their search tasks. Looking deeper into the interactions with the spellchecker, we see that if a proper noun was not capitalized (e.g., "*oregon*") the spellchecker would flag this query term as a mistake, yet, it would not offer a correction (e.g., "*Oregon*") as one of the offered suggestions. Another factor contributing to the low percentage or correction selection is the lack of association of misspelled terms with kid-friendly, pop-culture terms. For example, the spellchecker flagged the query term "*disne*" as a misspelling, leading the child to look into the suggestions for a correction, only to find "*dine*" but no "*Disney*". This result correlates with the findings regarding general query suggestions for

Table 3: Summary from query log generated as a result of the Session prompted by tasks in Table 2. For brevity, "SS" is short for spelling suggestion in the table below.

Action/Description	Total	Tasks 1-3	Tasks 4-6
Total # queries	147	70	77
Avg # queries per user	16.3	7.8	8.6
[standard deviation]	[10.5]	[5.6]	[6.5]
% queries ≥1 SS offered	20%	18.6%	22%
% queries where SS selected	43.3%	46.2%	41.2%
% queries where SS explored	76.6%	92.3%	64.7%
Avg pop-up SS per user	8.5	5.1	3.4
Avg hover over SS per user	21.4	14.6	6.8
Avg selected SS per user	1.5	0.7	0.8
Avg hover over misspelled term	6.9	5	1.9

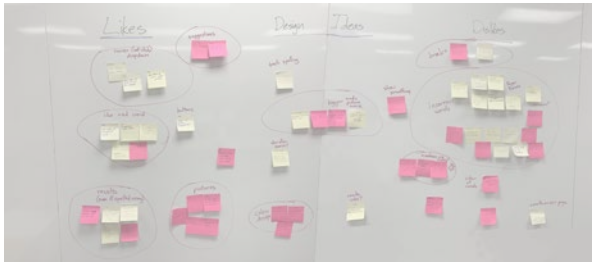

Figure 3: Sticky notes indicating likes, design ideas, and dislikes of the prototype spelling correction interface. Children utilized yellow sticky notes for Tasks 1-3, and pink for Tasks 4-6.

children [11], as they also tend to overlook terms that are of interest and popular among younger audiences and instead prioritize those appealing to general audiences.

What Children Want Spelling Suggestions to Do (Discussion of Sticky Notes)

As indicated above children were asked to complete Tasks 1-3 using textual spelling suggestions, and for Tasks 4-6 an image was added to each suggestion. While children were given a search task, the focus of the design session was explicitly identified as the spelling component and children were asked to identify what they liked, disliked, and design ideas regarding the spelling aspect of the search experience on sticky notes [3]. Adult facilitators helped children express their ideas (one per sticky note) while the children interacted with the prototype. Sticky notes were then grouped and categorized by multiple adult facilitators to distill big ideas (see Figure 3). After the clustering, the full team (children and adults) validated and refined the clustering via a full group discussion. Below we share some of the high level categories from the sticky notes.

Likes: Several children liked how potential misspellings changed color (to red). In the discussion afterwards one child specifically mentioned how they liked that it was the full word, not just an underline like they had seen elsewhere. All children noticed and liked when the images were added to the spelling suggestions. One child mentioned that they like suggestions "coz I don't know how to spell it". There was also a like regarding the size and shape of the spelling suggestion buttons – that they were easy to select. While the focus of this investigation was spelling, some mentioned that they appreciated that even if they typed something wrong, that sometimes there were related results.

Dislikes: The largest cluster was the dislike that the suggestions were not accurate enough. The off-the-shelf spellchecker we used was not adequate for children's needs. There were some other aspects that they noted very quickly, such as the incorrect handling of proper names, numbers, and not providing suggestions that matched their intent.

Design Ideas: The most pronounced grouping of design ideas was to make things bigger (e.g. the letters/text and pictures). There were also important single ideas, such as always show some suggestions even if nothing matches, and that the spellchecker should teach you how to spell words and not just fix them (i.e. the suggestion we started this paper with).

WHAT CHILDREN NEED – CONCLUSION AND NEXT STEPS

We presented in initial exploration of children's interactions with spellcheckers as they conduct online search tasks. Based on the analysis and discussion presented in previous sections of this manuscript, and anchored in Literacy Development, Human-Computer Interaction, Natural Language Processing, and Information Retrieval, it is clear the need for new spell-checking technology that explicitly respond to not only the expectations, but most importantly the educational and developmental needs, children have when it comes to formulating properly-spelled queries that in turn have the potential to initiate

a successful search process. We are particularly interested in further exploring the use of images to ease the process of identifying correct spelling solutions among suggestions that sound alike, but have different meanings; as well as the use of text-to-speech to read aloud the possible spelling suggestions.

ACKNOWLEDGMENTS

Work presented in this manuscript was supported by National Science Foundation Award #1763649.

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