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Author Note

The authors declare that they have no conflict of interest with respect to this preprint.

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Abstract

This experiment tested whether performing a pre-search task involving either the spelling or the meaning of words modified the way 11 years-old children subsequently scanned a text to find a single-word answer to a question. Compared to adults performing the same searches, eye movement recordings revealed that the induction tasks had a stronger influence on young adolescents. In particular, the semantic induction task may facilitate question-answering by adolescents when the text contains semantically-relevant distracting information.

Keywords: information search, eye-tracking, word identification, question answering, adolescent.

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Visual search through verbal information has become a critical issue because of the information boom associated with the Internet. On the Web, people must often search for what they need within pages involving both relevant and irrelevant information. Their common method of selection is to choose the sources that contain the keywords they used, or the words used in the question they were asked. At the single word level, Dampuré, Rouet, Ros, and Vibert (2014) showed that adults who must find target words within word clouds use both the orthographic and the semantic features of words to identify the target.

Studies investigating how young adolescents search from search engine result pages indicate that developing readers may be more sensitive to surface features such as typographical emphasis or the presence of particular keywords, than to the deeper meaning of the phrase under examination (Walraven, Brand-Gruwel, & Boshuizen, 2008). Using simulated search engine result pages, Rouet, Ros, Goumi, Macedo-Rouet, & Dinet (2011) found that 6th graders tended to select irrelevant phrases (e.g., The highest train in the world) in response to a search phrase (e.g., the highest mountains in the world) if the matching keywords were capitalized (e.g., the HIGHEST train in the WORLD). However, if they read a short text about the topic of the search before to perform the task, good readers were better able to select the relevant phrases. These results are in line with the Kiefer and Martens' (2010) attentional sensitization framework. This theory postulate that performing an "induction task" involving either the orthographic or the semantic features of words leads participants to use preferentially the orthographic/visual or semantic features of words, respectively, in subsequent tasks. Indeed, a study by the authors of this communication suggested that at the single word level, asking either adolescents or adults to elaborate on the meaning of target words before searching fostered access to the meaning of words during the search phase.

Hence, the present study focused on whether asking young adolescents (fifth graders) to elaborate on the meaning of a question before to search for the answer in a short text could similarly foster access to the meaning of words during text processing, and on whether this manipulation would increase question-answering efficiency. Understanding how children and teenagers visually scan verbal displays to fulfill their information needs is essential in explaining some of the challenges they face when using complex information systems such as search engines, forums, social networks, or web pages.

The fifth graders' results were compared with those of a previous study in which adult participants performed exactly the same experiment (Darles, Ros, Rouet, & Vibert, 2019).

Eleven years-old young adolescents were asked to memorize a simple, literal question after performing an induction task involving either the spelling or the meaning of the words used in the question. Then, they searched for the single-word answer to the question through short texts. The texts were manipulated to include words that were orthographically-similar (orthographic distractors), semantically-related (semantic distractors), or unrelated (neutral distractors) to the target. Predictions were that participants would pay more attention to the meaning of words and might find the answer to the question more easily after the semantic than after the perceptual induction task.

Method

Participants

The participants were 30 young adolescents (*M* age = 10.9 years, *SD* = .6, range 8.8 to 11.8, 16 girls) who were recruited from three different elementary schools. All were native French speakers and had normal or corrected-to-normal vision.

Materials

The visual search material was composed of 12 texts of 121 to 161 French words (*M* = 140.81, *SD* = 11.27) taken from a French website designed for elementary school students. A within-participant design was used to manipulate the nature of the induction task, and to investigate how the presence in texts of orthographic and semantic distractors influenced information search. More precisely, each text included three words that could be neutral distractors, orthographic distractors, or semantic distractors depending on the version of the text that was used. The location of the distractor words was the same in each text version, but the surrounding sentence had to be slightly edited to ensure that the text was still meaningful. Each participant performed 12 search trials, and the assignment of the 12 texts between the two types of induction task and the three versions of each text was counterbalanced so that the text version was crossed with six sets of texts (two texts per set) and six groups of five participants.

Participants' eye movements were recorded using a TOBII T120 eye-tracker. Error rates, response times, and several eye movement related dependent variables were used to analyze the data. Statistical analyses (except for error rates) were performed using linear mixed models.

Procedure

Participants were asked to locate as quickly as possible single-word answers to a literal question within short texts. Trials began with the presentation of the question (e.g., “What does the adventurer drink to celebrate his victory?”), on which participants had to perform either one of two induction tasks. The perceptual task involved the question’s orthographic/visual features and consisted in counting the number of times the letter “e” appeared in the words of the question. In the semantic task, participants were asked to make a sentence with one of the words used in the question. The word to use (“victory” in the above example) was given by the experimenter. Then, the question disappeared and the text in which participants had to search for the answer was presented.

Results

The overall error rate was 25.8%, and did not depend on the type of induction task that was performed. The adolescents' average response time for correct answers was 38.5 seconds (*SD* = 34.6 seconds) and, as for the adult participants tested in a previous study, did not significantly depend on either the induction task or the type of distractor words present in the text. Both the error rate and the response times were about twice greater in young adolescents than in adults. Interestingly, when semantic distractors were present, adolescents' response times tended to be shorter after the semantic induction task than after the perceptual one (37.9 versus 39 seconds, respectively).

Eye movement recordings revealed that after performing the semantic induction task rather than the perceptual one, adolescents needed to make about 20% more gazes on the text to find the correct answer when neutral or orthographic distractors were present. In contrast, when semantic distractors were present, they needed to make about 25% less gazes on the text to find the answer after performing the semantic induction task. Hence, in the latter situation, the presence of semantic distractors in the text allowed them to focus their attention more quickly on the relevant part of the text.

In addition, whatever the type of distractors present in the text, the average duration of adolescents' gazes on the text was about 5% shorter after performing the semantic induction task than after performing the perceptual one. This shows that following the semantic induction task, young adolescents needed less time to process the words they were gazing at than after the perceptual induction task.

Discussion

Contrary to what was expected, performing the semantic induction task rather than the perceptual one did not accelerate adolescents' information search within the text. However, the pre-search induction tasks did have significant effects on both the number and duration of the gazes made by adolescents on the text. Interestingly, compared to the perceptual induction task, the semantic induction task significantly reduced the average duration of adolescents' gazes, which suggests that the semantic induction task facilitated word processing. When semantic distractors were present in the text, the semantic induction task led in addition to a significant decrease of the number of gazes needed by adolescents to find the answer, and as stated above adolescents' response times tended to be shorter than after the perceptual task.

Hence, despite the absence of significant impact of the semantic induction task on response times (which may be due to the very large inter-trial and inter-individual variability), performing the semantic induction task may, as hypothesized, facilitate question-answering at least when the text contains semantically-relevant distracting information.

Altogether, the induction tasks had a stronger influence on young adolescents' eye movements than on the eye movements of adults who performed the same searches in a previous experiment. Indeed, for adult participants, the pre-search induction tasks only modified the duration of gazes made on the different types of distractor words, and eye movement recordings did not show any sign of facilitation of question-answering by the semantic induction task.

In summary, fostering the semantic processing of words may help fifth graders find the answer to a literal question in a text when the text includes semantically-relevant distracting information. In view of this encouraging result, future research may address more precisely the conditions in which using semantic induction tasks can improve information search in response to

literal questions, or whether the semantic induction task would have a stronger impact on searching for the answer to inferential or less precise questions.

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