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"If I point, do they look?": The impact of attention–orientation strategies on text exploration during shared book reading

Annie Roy-Charland[1] · Melanie Perron[1] · Jessica Boulard[1] · Justin Chamberland[1] · Nichola Hoffman[1]

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Abstract The current study examined the effect of pointing to the words and using highlighted text by examining eye movements when children in preschool, Grade 1 and 2 were read storybooks of two levels of difficulty. For all children, pointing to and highlighting the text was observed to increase the amount of time and number of fixations on the printed text than when there was no intervention. Furthermore, with difficult text, an increased amount of time and number of fixations was observed when the text was pointed to than when it was highlighted. For preschoolers, even with the increased attention on the text from pointing to and highlighting the words, the fixations did not match the narration. First and second graders, with the difficult book, made more matching fixations both when the printed text was pointed to and highlighted than when no intervention was done. Additionally, more matching fixations were made when the printed text was highlighted than when pointed to. Future research is required to examine the effects of attention-orienting strategies on reading related outcomes.

Keywords Shared book reading · Eye movements · Attention–orientation strategies

Introduction

Learning to read and write is one of the most, if not the most important set of skills, that a child needs to succeed in school (Desrochers, Carson, & Daigle, 2012). Consequently, researchers and policy makers have focused on strategies to help

✉ Annie Roy-Charland
aroycharland@laurentian.ca

Melanie Perron
mperron@laurentian.ca

[1] Department of Psychology, Laurentian University, 935 Ramsey Lake Road, Sudbury, ON P3E 2C6, Canada

prepare children for school in order to improve children's emergent literacy skills (Storch & Whitehurst, 2002; Whitehurst & Lonigan, 1998). Amongst those skills, print awareness (defined as the ability to recognize, discriminate and recall the specific components and functions of written language) is one of those prerequisite to learn to read and write (Desrochers et al., 2012; Piasta, Justice, McGinty, & Kaderavek, 2012; Roy-Charland, Saint-Aubin, & Evans, 2007). Studies have proposed that reading strategies that make print references, either verbally or nonverbally, could promote children's attention to printed text during shared reading and thus contribute to this preparation for formal reading and writing teachings (Evans, Willamson, & Pursoo, 2008; Gong & Levy, 2009; Justice, Pullen, & Pence, 2008; Piasta et al., 2012). While this may seem plausible, not only is it unknown if these strategies improve text learning, it even remains unclear if it is effective in attracting children's attention to print as a function of the narration. The current study systematically examined the effect of two strategies aiming to attract children's attention to the printed text: pointing to the words with the finger or using highlighted text. The exploration of the printed text as a function of the narration and the text-orienting strategy was observed by simultaneously recording eye movements during the shared reading.

Shared book reading

Shared book reading is defined as an activity in which a parent/caregiving adult or teacher reads aloud to a child (see e.g. Levy, Gong, Hessels, Evans, & Jared, 2006). It has been commonly asserted that shared reading makes an important contribution to the child's learning to read (see meta-analysis by Bus, van IJzendoorn, & Pellegrini, 1995; and review by Scarborough & Dobrich, 1994). Benefits that have been proposed as deriving from shared book reading include familiarizing children with the grammar and syntax of the written language register, developing print awareness, learning about word structure, and enriching their vocabulary and knowledge of literate discourse rules (e.g., Brett, Rothlein, & Hurley, 1996; Bus et al., 1995; Elley, 1989; Evans & Saint-Aubin, 2013; Mol, Bus, & de Jong, 2009; Pick, Unze, Brownell, Drozdal, & Hopmann, 1978; Scarborough & Dobrich, 1994; Senechal, 1997). In regard to oral language development stemming from shared reading, a child does not necessarily have to pay attention to the printed text; he or she may still benefit linguistically from simply listening (see e.g. Evans & Saint-Aubin, 2013). However, in order for a child to benefit in terms of print awareness and word recognition, it stands to reason that he or she must pay active attention to the printed text that is being read aloud (e.g., Evans & Saint-Aubin, 2005). Unfortunately, research suggests that this is typically not the case (Evans & Saint-Aubin, 2005; Justice, Skibbe, Canning, & Lankford, 2005; Roy-Charland et al., 2007).

Evans and Saint-Aubin (2005) tracked the eye movements of young children to determine exactly where children were looking during shared reading as well as whether the book design influenced the children's attention to the print or illustrations. Adults were asked to read five books that varied as a function of the

display of the text (i.e., illustration on a page and text on the other, speech bubbles within the illustrations, etc.) and attractiveness of the illustrations (i.e., complex colourful illustrations or simple monochromatic illustrations) to preschoolers while the latter's eye movements were recorded. Results revealed that children spent only approximately 7 % of their time looking at the printed text. Essentially, they found that during shared book reading, preschool children spend very little time looking at print and most of their time fixated on the illustrations, regardless of the spatial arrangement of the text and illustrations or of the attractiveness of the illustrations. Similar results have also been observed by Justice et al. (2005). In effect, even with print-salient materials intended to attract children's attention to the text, preschoolers still spent only 7 % of the time on the print.

Carrying this research forward into the school-age years, Roy-Charland et al. (2007) examined visual attention during shared book reading with children from kindergarten to Grade 4. One important goal was to determine if and when children shift their attention from the illustrations to the printed text, and whether that shift was related to changes in their reading ability. This study showed that the amount of time children spend focusing their attention on the printed text during shared reading increases as a function of their reading ability. When the level of reading difficulty surpasses a child's reading abilities, his or her attention reverts to being primarily focused on the illustrations, with eye movements resembling those of preschoolers who do not yet read (Roy-Charland et al., 2007). However, young readers, regardless of their reading skills, still spent the majority of their time looking at the illustrations in a shared book reading activity.

In sum, both preschoolers and school-age children spend the majority of their time looking at illustrations during shared reading as opposed to the printed text. The above studies aptly demonstrate that left to their own devices, children less frequently interact with print or even focus their attention on it for any significant amount of time during shared reading (Evans & Saint-Aubin, 2005; Justice et al., 2005; Roy-Charland et al., 2007). This implies that rather than manipulating the physical characteristics of the books, parents and educators need to make deliberate efforts and utilize styles and strategies designed to engage and support young children's visual attention to the printed text when sharing reading (Justice et al., 2005), if the goal of the activity is to promote print knowledge.

Strategies to attract attention to print

Research has explored verbal and non verbal strategies designed to attract children's attention to printed text during shared reading (Evans et al., 2008; Gong & Levy, 2009; Justice et al., 2008; Piasta et al., 2012). Piasta et al. (2012) conducted a longitudinal study of the effects of verbal and nonverbal print references on children's long-term literacy achievement. Preschool classes were randomly assigned to receive either a high frequency (four sessions per week) or low frequency (two session per week) shared reading program with many embedded verbal and non-verbal print references, or a regular classroom reading program with four sessions per week. The children were assessed four times over a three-year

period following the reading program. While they did not differentially compare verbal versus nonverbal print references, Piasta et al. (2012) found a relationship between teachers' use of print references during class shared reading and long-term increases of approximately one quarter of a standard deviation unit in the children's literacy achievement. However, such broad programs included numerous strategies and do not allow a clear understanding of the underlying mechanisms responsible (e.g. specific attention to print) or which strategy (e.g. verbal or non-verbal) was deemed effective for the observed improvements.

Evans et al. (2008) examined the single strategy of adults pointing to the words during shared book reading on children's attention to print. The experimenters read oversized books formatted with the printed text on one page and illustrations on the opposite to children aged three, four, and five years. With the experimental group, the researchers followed the text with a finger while reading aloud to the child; with the control group, the researchers simply read aloud to the child. The children's eye movements during the shared reading were recorded with a digital camera using a zoom feature. Evans et al. (2008) found that children in each of the age groups gazed more importantly in the direction of the page containing the print when the reader tracked the words with a finger than in the control condition. These results suggest that pointing to the words may be an effective strategy for increasing children's attention to print during shared reading. However, there were some important limitations in Evans et al.'s (2008) study. While results showed that children directed their attention to the page with printed text when it was tracked with the finger, the gross measure of eye movements did not allow the observation of whether or not the children's eye movements were following along with the printed text being read or moving in patterns typically associated with reading. For instance, children may have looked at the page containing the text without actually focusing on the printed text or doing so in as a function of the words being heard.

Justice et al. (2008) used eye-tracking technology to explore the effects of verbal and nonverbal print references on children's attention to print during shared book reading. Four-year-old children were read computerized versions of storybooks in one of four conditions. In one condition, the text was read word-by-word without any other intervention from the adult. The other conditions integrated direct interventions in which the adult either referred to elements of the illustrations, verbally referenced elements from the text or non-verbally referenced elements in the printed text by pointing to words or letters or following parts of the printed text while reading it. Results revealed that compared to the verbatim condition, both verbal and nonverbal print references resulted in the children displaying a significantly higher number of fixations on print zones. Additionally, nonverbal print references resulted in a significantly higher proportion of fixations on print. While informative, the scope of the above-mentioned results remains restricted. For instance, while participants spent more time and made more fixations on the printed text when non-verbal strategies orienting the child to the text were used, it remains unknown if the time spent on the text followed the narration. If children are expected to make a link between printed and verbal words, they would have to fixate the word or at least part of it as it is being read. In addition, as in other studies, in each condition, multiple strategies were used making it difficult to isolate which

individual strategy was more effective. For example, in the non-verbal condition, on some pages the words were followed with the finger systematically while single words or letters were pointed to on other occasions.

Finally, it should be mentioned that in all previously mentioned studies, including Justice et al.'s (2008) study, gains in attention to printed text were modest. Even in its most effective condition, the participants only spent 8 % of the time on the printed text, which remains comparable to other studies in which no intervention was done (e.g. 7 % in Evans & Saint-Aubin, 2005; 10 % in Roy-Charland et al., 2007). The current study will isolate the strategy of pointing to the words with the finger systematically for the whole storybook as well as examining if the words are fixated as a function of the narration using eye-tracking.

Electronic strategies to attract attention to print

Each of the above studies examined shared book reading in the traditional manner of a joint activity between an adult and a child. Yet with advances in technology, products have become available that allow children to have reading experiences without the presence of an adult reader. Educational products represent one of the largest markets for a child demographic and there is a growing variety of electronic products purportedly designed with the objective of helping children increase their vocabulary and their reading skills (Bus & Neuman, 2009). Moreover, the technology is advancing quickly and new products appear regularly, offering new research challenges and opportunities. Within the growing body of research that focuses on whether electronic shared reading experiences produce similar benefits to those provided by traditional shared reading (e.g. de Jong & Bus, 2002, 2003; Korat & Shamir, 2007, 2008; Roskos & Brueck, 2009; Segers, 2009), results about the impact of such tools on general literacy benefits remain inconsistent. For example, de Jong and Bus (2002) suggest that e-books, while possibly being a complement to traditional shared book reading, might not replace the latter activity and its benefits by creating distractions. However, others propose that interactive features provided by e-books improve word meaning skills and word recognition (see e.g., de Jong & Bus, 2004; Korat & Shamir, 2007, 2008; Verhallen, Bus, & de Jong, 2006).

Within the wide range of products, some have the same objective as pointing to the words with a finger to attract children's attention to the print. For example, e-books highlight the words read (Roskos & Brueck, 2009) and education Internet sites such as "Between the Lions" use a jumping ball to follow the narration (PBS Kids, 2012). Nevertheless, to the best of our knowledge, no previous study has directly examined the impact of electronic strategies to attract attention to print. The current experiment seeks to build on the existing shared reading literature and to fill some of the gaps therein by exploring the impact of pointing to the words with the finger and highlighting the text electronically on preschool and early school years children's attention to the printed text, and more precisely, examining the attention to text as a function of actual words read.

The goal of the current study was to determine whether pointing to or highlighting printed text leads to a greater degree of attention to said text than when

there is no intervention, where attention was measured by examining the proportion of time and proportion of fixations on the printed text. In addition, this study seeks to determine whether these differences are as a function of text difficulty and grade level. More importantly, the current study also seeks to determine if either of the manipulations leads to an increase in the proportion fixations on the print that follow the narration (i.e. matching fixations). It was hypothesized that highlighting and pointing would lead to an increase in attention and matching fixations on the print, when compared to when there is no intervention. The impact of these manipulations will also be assessed as a function of reading capability with the difficult texts, to determine if reading ability is a contributing factor.

Methods

Participants

Thirty-six francophone children in the community of Sudbury were recruited as participants for this study. The sample included 10 preschool-age children attending daycare (6 girls and 4 boys), 14 children in the Grade 1 (8 girls and 6 boys) and 12 children in Grade 2 (6 girls and 6 boys). Only 12 of the 14 Grade 1 children were used in the analysis because two children had missing data since they did not look at the printed text in one or more of the conditions. School-age children were all recruited in school, from the same school, while all preschoolers were from a single daycare. The average age of preschoolers was 36 months, 75 months for the first graders and 85 months for the second graders. All parents reported that their children had normal or corrected vision. Of the 36 participants in this study, only 24 parents agreed to complete the demographic questionnaire. Of the 24 parents, all families reported owning at least 10–20 children books, while the majority (50 %) of families had between 75 and 150 books. All families except one, since data was missing, reported reading to their children at least 3 times per week and 42 % of families read every day. It is also important to note that no parent reported having concerns about their child's development.

Materials

Questionnaire

A French translation of the *Home Literacy Experiences Questionnaire* (Levy et al., 2006) was distributed to parents a few weeks before the experimental session. This questionnaire was used to collect information concerning the child's reading activities as well as family demographic information.

Books

Six books published in French were used in this study. The qualities of the illustrations, all in colour, were similar for all six books. Two of these books were

selected from the *easy* and *difficult* books used by Roy-Charland et al. (2007). Two other *easy* books and two other *difficult* books were chosen from the same collection for a total of three books per difficulty level. All six books were modified in order to have identical difficulty levels. Book difficulty was evaluated using SATO Calibrage (Daoust, Laroche, & Ouellet, 1996). This program used properties such as word frequency, word length, sentence length, etc. to evaluate the text by indicating the corresponding school level. Difficulty levels and a short description of the books are presented subsequently.

Easy books

All three easy books were written in Times New Roman size 26 and had a SATO index level of 1.0 corresponding to the beginning of Grade 1. In addition, for all easy books, 15 pages were presented in the study. *Je veux aider!* (Wilhelm, 2003a) is a story that features a small white dog who wants to help in the house. This book has a total of 93 words and a total of 18 sentences. *Je n'ai pas peur!* (Wilhelm, 2003b) is a story featuring the same little dog who wants to dress up for Halloween. This book has a total of 92 words and 17 sentences. Finally, *J'aime la pluie!* (Wilhelm, 2011) describes the adventures of the same little dog on a rainy day. This book has a total of 75 words and 17 sentences.

Difficult books

All three difficult books were written in Times New Roman size 14 and had a SATO index of 3.7 corresponding to the second half of Grade 3. For the difficult books, eight pages were presented in the study. *Alex et son chien Touli* (Tibo & Germain, 2000) features a boy and his dog playing hockey. During a hockey game, the dog breaks its leg. This book has a total of 404 words and a total of 60 sentences. *Alex et le mystérieux Numéro Sept!* (Tibo & Germain, 2009b) is the story of the same boy trying to be the best hockey player, but he is intimidated by the number seven. This book contains a total of 550 words and a total of 60 sentences. *Alex et la grande disparition* (Tibo & Germain, 2009a) is the story of the disappearance of the same little boy's girlfriend. A total of 356 words and 46 sentences are presented.

Audio tracks

The books were accompanied by audio tracks. These were created for the purpose of the study by a professional radio personality. Tone, speed and voice expression were similar for all the books. An average of two seconds was spent per page (M = 320 ms per word; average fixation duration in reading being 250 ms, Rayner, Pollatsek, Ashby, & Clifton, 2012) for the *Je veux aider!* (Wilhelm, 2003a) book, with a total time of 26 s taken to complete the entire text. For *Je n'ai pas peur!* (Wilhelm, 2003b), an average of 2.24 s was spent per page (M = 370 ms per word) with 29 s to complete the book. With the *J'aime la pluie!* (Wilhelm, 2011) story, an average of 1.77 s was spent per page (M = 350 ms per word) and 23 s for the entire book. *Alex et son chien Touli* (Tibo & Germain, 2000) took 129 s, with an average

of 21.5 s per page (M = 430 ms per word). For *Alex et le mystérieux Numéro Sept!* (Tibo & Germain, 2009b), an average of 26 s was spent per page (M = 380 ms per word) and 156 s for the entire story. Finally, 115 s was taken to read *Alex et la grande disparition* (Tibo & Germain, 2009a), with an average of 19.17 s per page (M = 430 ms per word).

Eye movement recording apparatus

The participant's eye movements were recorded using the SR Research EyeLink 1000. This device comprises a camera and an infrared sensor. The camera is placed directly in front of the participant under the computer screen. As a default, the participant's right eye was tracked. The EyeLink 1000 system uses an Ethernet connection between the device and the computer on which the stimuli are presented to allow the transfer of information in real time (Roy-Charland et al., 2007).

Procedure

Two research assistants were present for the experimentation. The session began with a familiarization with the eye-tracking equipment. This familiarization lasted approximately 10 min and allowed the child to become familiar with the equipment used and the task. In addition, a practice for the calibration task of the apparatus was carried out by having children follow the experimenter's finger with their eyes without moving their head (Evans, Roy-Charland, & Saint-Aubin, 2009).

Following the familiarization period, the participant was seated in front of the computer screen at a distance of 60 cm and the calibration was initiated. The current study used a five-point calibration procedure. To calibrate and validate the apparatus, the participant had to fixate on the face of a famous cartoon character (*Caillou*). The character appeared in five locations on the screen (upper center, middle, lower center, middle right and middle left of the screen) and the child had to move his or her eyes to fixate the character without moving their head. This procedure was repeated twice and the average deviation between the two measurements had to be 1° in visual angle or less to be accepted.

Following calibration, the storybooks were presented on the screen one page at a time, accompanied by the corresponding audio tracks (i.e. narration). Each participant was exposed to three conditions: neutral, pointing, and highlighting. In the neutral condition, participants listened to the narration of the text without intervention. In the pointing condition, the experimenter pointed to each word as it was read by the narrator. In the highlighting condition, each word was highlighted as it was read by the narrator. For each condition, participants were exposed to one easy book and one difficult book. The three conditions, as well as the presentation of the difficulty of books (easy or difficult), were counterbalanced between participants. Furthermore, the books presented for each condition was counterbalanced between participants.

After the presentation of the books, similar to Roy-Charland et al. (2007), the children were asked to read six pages (one per book) that had previously been removed from the books. The pages were presented in paper format in ascending order of difficulty with the three pages from the easy books presented first and the three pages

from the difficult books presented last. Order within difficulty level was counterbalanced. This strategy was used to avoid discouraging younger children who might only be able to read the easy books. Children were instructed that they might not be able to read all the pages but were encouraged to try to read the pages to the best of their ability. If a child struggled significantly during the task, the experimenter discontinued presenting the pages. Each child received a sticker for his or her participation.

Data analysis

Eye movements were scored with EyeLink Dataviewer. With this program, participants' fixations were viewed superimposed on the presented stimuli. Raw averages for the number of fixations on the text and illustrations as well as the number of fixations on the text matching the narration are presented in Table 1 as a function of book difficulty and grade level. It should be noted that the raw average

Table 1 Raw averages for the number of fixations on the text matching the narration as a function of book difficulty and grade level

Grade	Area	Difficulty	Number of fixations			Matching fixations		
			Highlight	Neutral	Pointing	Highlight	Neutral	Pointing
P	Text	Easy	1.03	0.66	1.52	0	0	0
			(1.57)	(1.10)	(1.03)			
		Difficult	3.82	1.97	10.85	0.10	0	0.32
			(6.94)	(4.38)	(8.69)	(0.32)		(0.72)
	Image	Easy	12.61	11.20	10.73	–	–	–
			(2.41)	(2.76)	(3.47)			
		Difficult	52.87	50.58	44.42	–	–	–
			(10.10)	(15.74)	(9.20)			
1	Text	Easy	4.79	2.36	4.15	3.60	0.83	2.71
			(2.94)	(2.05)	(2.47)	(2.36)	(0.85)	(2.22)
		Difficult	13.72	6.50	26.88	12.36	2.47	18.57
			(12.57)	(8.91)	(13.38)	(11.24)	(6.04)	(12.03)
	Image	Easy	12.26	11.55	10.41	–	–	–
			(4.17)	(2.63)	(3.46)			
		Difficult	56.04	60.31	44.92	–	–	–
			(16.94)	(16.55)	(17.83)			
2	Text	Easy	7.97	5.38	6.02	4.94	2.95	2.90
			(2.59)	(2.53)	(1.72)	(1.93)	(1.86)	(1.18)
		Difficult	28.00	23.68	40.89	21.22	2.06	10.42
			(18.21)	(22.58)	(17.03)	(18.49)	(1.10)	(23.61)
	Image	Easy	9.88	10.60	9.41	–	–	–
			(2.13)	(2.51)	(2.55)			
		Difficult	44.61	50.33	34.50	–	–	–
			(22.74)	(27.05)	(15.78)			

for the number of fixations is based on all possible observations. The raw average for the matching fixations is only based on the cells for which fixations on the text were, in fact, observed. However, analyses were computed on proportions (see Roy-Charland et al., 2007) and results are presented in Figures. For each group (Preschool, Grade 1 and Grade 2), the proportion of time spent gazing at the printed text was computed for each condition (neutral, pointing and highlighting) and each difficulty level (easy and difficult) by dividing the amount of time on the printed text by the sum of time spent on the printed text and on the illustrations. At least one fixation had to occur in the zone for an observation to be computed, without which an empty cell was recorded. The proportion of fixations was computed by dividing the number of fixations on the printed text by the sum of fixations on the printed text and on the illustrations. Finally, proportion of matching fixations was computed by counting the number of fixations on the printed text that corresponded with the narration and dividing it by the number of fixations on the printed text. In other words, if the child fixated the word as it was being read, a matching fixation was counted. This analysis was conducted without the preschoolers because only one participant performed matching fixations in this group.

Results

Eye movement measures

Raw data for number of fixations and number of matching fixations are presented in Table 1. Inspection of this table shows that the more words there are in the text (i.e., the difficult books), the higher the raw number of fixations and matching fixations. This is expected since the narration takes more time for these longer texts allowing more fixations (see Evans & Saint-Aubin, 2005 for similar results). More importantly, these raw results show that 3–5 words maximum on average across all grade levels (as more that one fixation can be made on the same word) out of 75–93 words in the easy books were actually fixated in the pointing and highlighting conditions, and that on average only between 11 and 24 out of 356–550 words in the difficult books were fixated as a function of the narration. The remaining words were either not fixated or were mismatched, in other words, fixated but not when they were actually heard.

For proportion of time, a 2 (book difficulty: easy and difficult) × 3 (conditions: neutral, pointing and highlighting) × 3 (grade: preschool, Grade 1, and Grade 2) mixed-design ANOVA was used, with difficulty and condition as within-subject factors and grade as a between-subject factor. Results revealed a main effect of condition, $F(2,62) = 32.73$, $\eta_p^2 = .51$, and grade, $F(2,31) = 16.35$, $\eta_p^2 = .51$, and an interaction between condition and difficulty, $F(2,62) = 11.79$, $\eta_p^2 = .28$. The main effect of difficulty, $F < 1$, did not reach significance, and neither did the interactions between difficulty and grade, $F(2,31) = 1.58$, $p = .22$, condition and grade, $F(4,62) = 1.93$, $p = .12$, nor between difficulty, condition and grade, $F(4,62) = 1.07$, $p = .38$. For the effect of grade, post hoc tests (LSD) indicated that children in Grade 2 spent a greater proportion of time on the text than those in Grade

1 and preschool, while children in Grade 1 spent more time on the text than preschoolers. Simple main effect tests for the condition by difficulty interaction revealed no difference between easy and difficult books for the highlight condition, $F(1,93) = 3.95$, $p = .05$, nor the neutral condition, $F(1,93) = 1.75$, $p = .19$. However, children spent more time on the printed text for the difficult books than easy ones in the pointing condition, $F(1,93) = 10.36$, $\eta_p^2 = .10$. Simple main effect tests also revealed differences between conditions for the easy book, $F(2,124) = 8.71$, $\eta_p^2 = .12$, and for the difficult book, $F(2,124) = 37.63$, $\eta_p^2 = .38$. For the easy book, post hoc tests (LSD) indicated that children spent more time looking at the printed text in the highlighting and pointing conditions than the neutral condition. The former two did not differ significantly. Results also revealed that children spent more time on the printed text of the difficult book with the pointing condition than the other two, and more time with the highlight condition than the neutral condition. These results are displayed in Fig. 1.

Results for proportion of fixations produced a similar pattern of results as for proportion of time, as presented in Fig. 2. A 2 (book difficulty: easy and difficult) × 3 (conditions: neutral, pointing and highlighting) × 3 (grade: preschool, Grade 1, and Grade 2) mixed-design ANOVA was performed with difficulty and condition as within-subject factors and grade as a between-subject factor. Results revealed a main effect of condition, $F(2,62) = 38.46$, $\eta_p^2 = .55$, and grade, $F(2,31) = 10.98$, $\eta_p^2 = .41$, and an interaction between condition and difficulty, $F(2,62) = 12.27$, $\eta_p^2 = .28$. The main effect of difficulty, $F < 1$, did not reach significance, and neither did the interactions between difficulty and grade, $F < 1$, condition and grade, $F(4,62) = 1.88$, $p = .13$, nor between difficulty, condition and grade, $F < 1$. When simple main effect tests were conducted for the interaction between condition and difficulty, the pattern of results was the same as for proportion of time. In effect, differences were obtained between conditions for the easy book, $F(2,124) = 8.71$, $\eta_p^2 = .12$, where post hoc tests (LSD) indicated that children made more fixations on the printed text in the highlighted and pointing conditions than the neutral condition, and the former two did not differ. For the difficult book, differences were also observed between conditions, $F(2,124) = 44.87$, $\eta_p^2 = .42$. Post hoc tests (LSD) revealed that children made more fixations on the printed text with the difficult book in the pointing condition than the other two, and more with the highlighting condition than the neutral condition. Furthermore, these results indicate a difference between easy and difficult books in the pointing condition, $F(1,93) = 14.90$, $\eta_p^2 = .14$. For the highlighting and neutral conditions, no significant difference was observed between easy and difficult books, $F(1,93) = 2.06$, $p = .15$ and $F < 1$ respectively. Post hoc tests (LSD) for the effect of grade indicated that a greater proportion of the fixations was spent on the text for children in Grade 2 than those in Grade 1 and preschool, and more for children in Grade 1 than preschoolers.

For matching fixations, a 2 (book difficulty: easy and difficult) × 3 (conditions: neutral, pointing and highlighting) × 2 (grade: Grade 1, and Grade 2) mixed-design ANOVA was used, with difficulty and condition as within-subject factors and grade as a between-subject factor. Results revealed a main effect of condition, $F(2,44) = 9.43$, $\eta_p^2 = .30$, a main effect of difficulty, $F(1,22) = 27.75$, $\eta_p^2 = .56$,

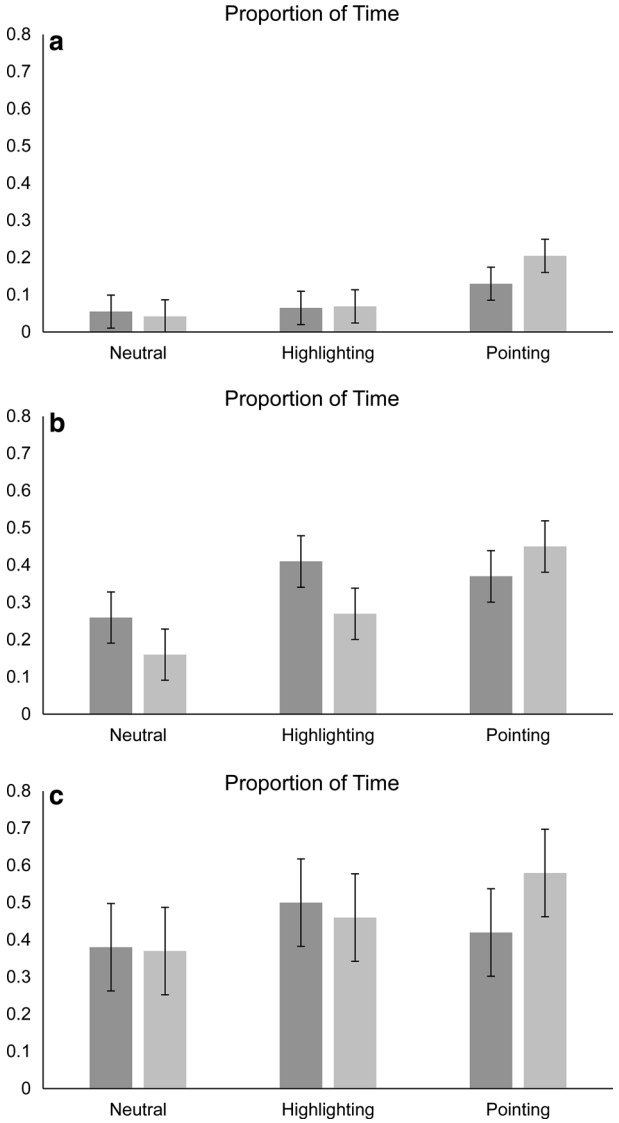

Fig. 1 The proportion of time on the printed text made by preschoolers (**a**), first graders (**b**) and second graders (**c**). This was done as a function of condition and difficulty, where the *dark* and *light grey* represent easy and difficult text, respectively. *Error bars* represent within-subject confidence intervals, at alpha level of 0.05, computed according to Loftus and Masson (1994)

and an interaction between condition and difficulty, $F(2,44) = 5.88$, $\eta_p^2 = .21$. The main effect of grade, $F < 1$, did not reach significance, and neither did the interactions between difficulty and grade, $F < 1$, condition and grade, $F(2,44) = 2.47$, $p = .10$, nor between difficulty, condition and grade, $F(2,44) = 2.06$, $p = .14$. Simple main effect tests on the condition by difficulty

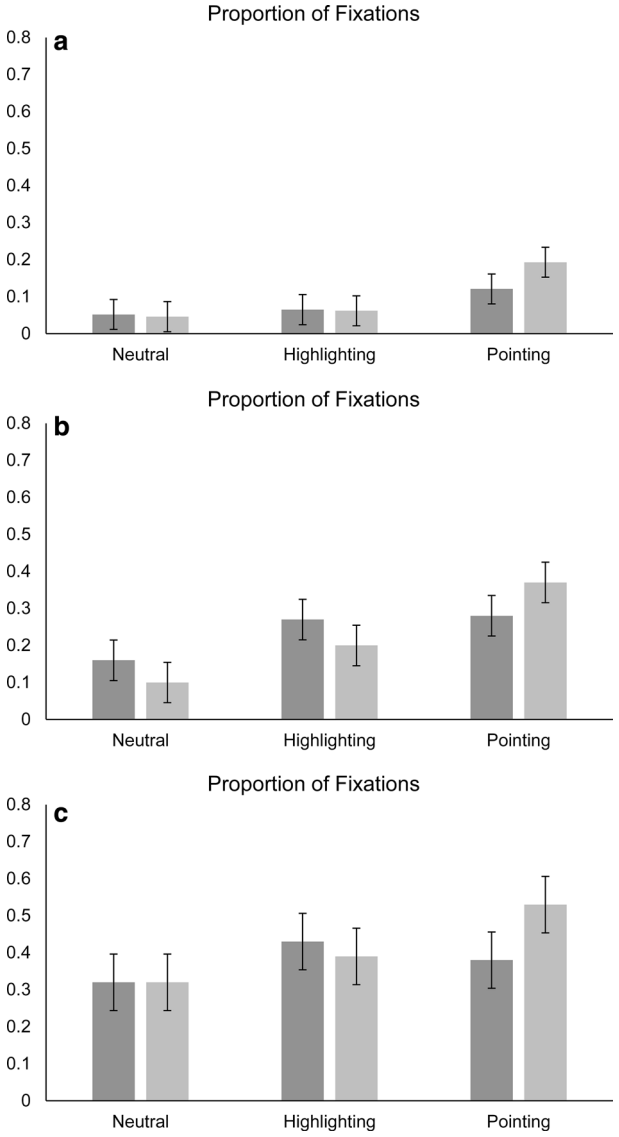

Fig. 2 The proportion of fixations on the printed text made by preschoolers (**a**), first graders (**b**) and second graders (**c**). This was done as a function of condition and difficulty, where the *dark* and *light grey* represent easy and difficult text, respectively. *Error bars* represent within-subject confidence intervals, at alpha level of 0.05, computed according to Loftus and Masson (1994)

interaction revealed differences between conditions for the difficult book, $F(2,88) = 15.07$, $\eta_p^2 = .26$, but no difference was found for the easy book, $F < 1$. Post hoc tests (LSD) revealed that children made more matching fixations with the highlighting condition than the other two, and more with the pointing condition than the neutral condition. Simple main effect tests also revealed no

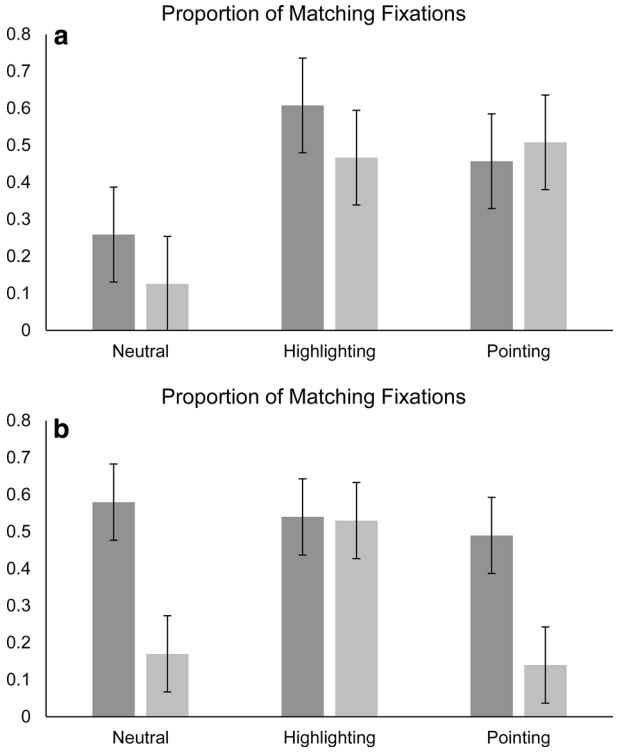

Fig. 3 The proportion of matching fixations on the printed text made by first graders (**a**) and second graders (**b**). This was done as a function of condition and difficulty, where the *dark* and *light grey* represent easy and difficult text, respectively. *Error bars* represent within-subject confidence intervals, at alpha level of 0.05, computed according to Loftus and Masson (1994)

difference between easy and difficult books for the neutral condition, $F < 1$. Alternatively, children made more matching fixations on the printed text for the difficult books than easy ones in the highlighting condition, $F(1,66) = 20.53$, $\eta_p^2 = .24$, and the pointing condition, $F(1,66) = 17.88$, $\eta_p^2 = .21$. These results are presented in Fig. 3.

Ability to read the book

The ability to read the books was measured using the same criteria as Roy-Charland et al. (2007). More precisely, a child was considered able to read the book if he or she could decode all the words from a page without assistance from the research assistant. Criteria for the categorization of the ability to read the book were simple because all children could either easily read the page presented or could not read any of the words from the page. When children were asked to read the pages from the books, none of the preschoolers were able to read any of the pages. For the first graders, five were able to read the pages from the easy books and two were able to read the pages from the difficult books. Finally, for second graders, all children were

able to read the easy books and nine were able to read the difficult books. In sum, a total of seventeen children were able to read the easy text and eleven children were able to read the difficult text. For the difficult books, since some first and second graders could read them and some in each grade could not read them, a supplementary series of analyses was computed on the measures as a function of the ability to read the difficult books. These analyses are displayed in Fig. 4. For proportion of time on the printed text, the 2 × 3 mixed-design ANOVA with condition as a within-subject factor and ability (able and unable) as a between-subject factor revealed a main effect of condition, $F(2,44) = 21.51$, $\eta_p^2 = .48$, but neither the effect of ability, $F = 2.69$, $p = .12$, nor the interaction were significant, $F = 1.70$, $p = .20$. Post hoc tests (LSD) revealed that, regardless of their reading ability, children spent more time on the printed text in the pointing condition than in the other two conditions and more time in the highlighting condition than in the neutral condition.

For proportion of fixations on the printed text, patterns of results are identical. The 2 × 3 mixed-design ANOVA revealed a main effect of condition, $F(2,44) = 23.32$, $\eta_p^2 = .52$, but the effect of ability, $F = 3.23$, $p = .09$, nor the interaction were significant, $F = 1.08$, $p = .35$. Post hoc tests (LSD) revealed that, regardless of their reading ability, children made more fixations on the printed text in the pointing condition than in the other two conditions and more fixations in the highlighting condition than in the neutral condition.

For proportions of matching fixations, the 2 × 3 mixed-design ANOVA revealed a main effect of condition, $F(2,44) = 13.69$, $\eta_p^2 = .38$, and an interaction, $F(2,44) = 3.45$, $\eta_p^2 = .14$, but the effect of ability was not significant, $F < 1$. A repeated-measures ANOVA was done on the conditions, for each ability group. For the children able to read the books, a main effect for condition was observed, $F(2,20) = 10.36$, $\eta_p^2 = .51$. Post hoc tests (LSD) indicate that more matching fixations were made for the highlighting condition than the neutral and pointing conditions. No difference was found between the latter two conditions. For the children unable of reading the books, an effect was found for condition, $F(2,24) = 5.64$, $\eta_p^2 = .32$. Post hoc tests (LSD) suggested more matching fixations for the highlighting and pointing conditions than the neutral. However, no difference was found between the former two conditions. Within each of the conditions, between-subject t-tests were used to determine if there was a difference between the children able and unable of reading the books. No difference was found within the highlighting, neutral, and pointing conditions ($p = .19$, $p = .91$, and $p = .08$, respectively).

Discussion

The current study aimed at exploring the role of two strategies proposed to attract children's attention to the printed text: pointing to the words being read or highlighting the words with the narration. More precisely, the study explored whether these strategies increased the time and the number of fixations on the printed text as well as if these fixations were produced in concert with the words being read. This was accomplished by monitoring eye movements. Previous research supports that these strategies do, in fact, increase the children's attention to

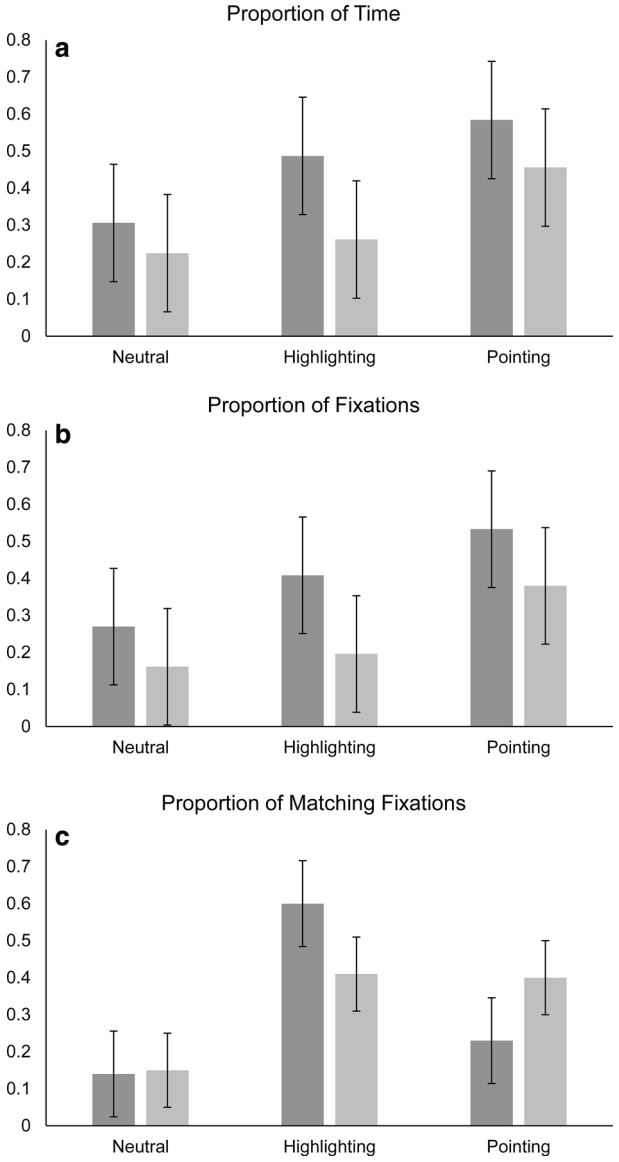

Fig. 4 The proportion of time (**a**), proportion of fixations (**b**), and proportion of matching fixations (**c**) on the printed text comparing individuals able (*dark grey*) and unable (*light grey*) to read, as a function of condition. *Error bars* represent mixed-design confidence intervals, at alpha level of 0.05, computed according to Loftus and Masson (1994)

the printed words (e.g. Evans et al., 2008). However, the question to be answered is whether these fixations correspond with the narration and whether the importance of each strategy varies as a function of the difficulty of the reading material as well as if the impact of these strategies are similar within different age groups. These specific results will be discussed individually as well as with their implications.

First, results for the neutral condition, in which no intervention was done to attract attention to the printed text reproduce those observed in the literature (Evans & Saint-Aubin, 2005; Justice et al., 2005; Roy-Charland et al., 2007). More precisely, children in preschool spent approximately 5 % of their time on the printed text. In effect, since none of these children were able to read, they resorted to exploring the illustrations. For first graders, they spent 26 % of their time on the printed text of the easy book and 16 % of their time for the difficult book when no intervention was done. These results are similar to those of Roy-Charland et al. (2007). As in the latter study, in the current study, the majority of first graders were unable to read the difficult book, thus reverting to behaviours similar to those of preschoolers of spending more time looking at the illustrations. Finally, for second graders, they spent approximately 38 % of their time on the printed text of both levels of books as most of them were able to read both the easy and difficult books. Nevertheless, for all children they spent the majority of their time looking at the illustrations rather than the text, regardless of their grade level or reading ability. As discussed by Roy-Charland et al. (2007), it seems that shared book reading, when no specific intervention is proposed, is more of an oral language activity than a print related learning experience.

However, one of the goals of the current study was to explore the effects of strategies suggested to increase attention to the printed text. Results from the current study indicate that differences between the strategies are observed as a function of the book difficulty for both the time spent on the printed text and the number of fixations on the text. For instance, in the pointing condition, children spent a greater proportion of time and made more fixations on the difficult text than the easy text. However, in the neutral and highlighting conditions, children spent an equal amount of time and made a similar number of fixations on the printed text with the easy book and the difficult book. For the easy book, children spent more time and made more fixations on the printed text both when it was pointed to and highlighted than when no intervention was done but for the difficult book, more time and more fixations were observed on the text when it was pointed to than when it was highlighted or when no intervention was done. Highlighting resulted in more time and fixations on the printed text than when there was no manipulation. While the child's grade was not found to interact with any of these effects, results indicated that second graders spent more time and made more fixations on the printed text than first graders. Preschoolers were also observed to spend less time and make fewer fixations on the printed text than first graders. These results suggest that developmental factors (e.g. introduction of formal reading teachings, cognitive development) may have been observed, but may not have modulated the effectiveness of the different strategies. Nevertheless, consistent with previous work (Evans et al., 2008; Gong & Levy, 2009; Justice et al., 2008; Piasta et al., 2012), attention-orienting strategies seem to be effective in increasing the time and the number of fixations on the printed text.

Nevertheless, the main goal was to explore if the additional fixations on the printed text, resulting from the pointing and highlighting strategies, matched the narration. In other words, do children look at the printed text in concert with the narration? In order for the link between the word pronounced and the printed word

to be created, we assume that words need to be fixated as they are being read (e.g. Evans & Saint-Aubin, 2005). Consequently, the proportion of matching fixations was examined. More specifically, the measure was obtained by counting the number of fixations on a printed word when it was read and dividing it by the total number of fixations on the text. Interestingly, while pointing to the text increased the time and the number of fixations children in preschool made on printed words, for all children, the extra attention on the text was not on the words as they were being read, except one child who made two matching fixations. For first and second graders, more matching fixations were observed when the printed text was pointed to and highlighted than when no intervention was introduced with the difficult books. However, no difference was observed between strategies with the easy books. A greater number of matching fixations were also observed with the difficult books than the easy books when the text was pointed to or highlighted. No difference was observed between the book difficulties when there was no intervention. In sum, for preschoolers, fixations on the printed text did not at all match the narration, regardless of the use of an attention-orienting strategy or not. Thus, while the strategies studied here might contribute to learning concepts related to print, it is difficult to support the idea that they would help children in associating spoken words with printed representation. For first and second graders, pointing to the words and highlighting them significantly increased the number of matching fixations. It could be proposed that with these groups, which are in their early processes of formal reading learning, these strategies might be a useful tool. However, the impact of the text-orienting strategy was restricted to difficult books.

The current study provides evidence for the role of non-verbal attention-orienting strategies in directing children's attention to print as a function of the narration. However, it is important to note that, while significant, the gains in attention were modest. In effect, for preschoolers, they spent 20 % of their time at most on the text, which means that 80 % of their time was on the illustrations and since, for most of the participants, none of the fixations on the printed text matched the narration, almost 100 % of them were mismatched fixations. For first graders, they spend 45 % of their time on the text at most, which leaves more than half of their time on the illustrations (55 %). Finally, even for second graders, who showed the most time on the text, the most was 58 % of their time on the text. Most importantly, of the small percentage of fixations on the text, only about half of them, at most, are simultaneous with the words being read. Consequently, half or more of the fixations on the text are mismatched with the narration. Actually, the inspection of raw fixations and raw matching fixations show that very few of the words are fixated (maximum of 3–5 words on average for the easy book and 11–24 for the difficult book across all grade levels) and most of the words are not fixated or fixated while they are not being read. Thus, the importance of such strategies in making a contribution to gains in print knowledge should be considered cautiously.

Limitations and future research

The current study allowed the examination of children's attention to the printed text as a function of the narration when attention-orienting strategies were used. First, it

remains unknown if the gains in attention observed in the current study would be maintained over multiple exposures. In addition, future research should explore the concentration and the location of the matching fixations to see if the there is a pattern associated with these fixations as a function of the narration (e.g. at the beginning or end of a sentence or page). More importantly, what remain unclear are the specific outcomes of this additional attention to the print. In fact, it is unknown if these strategies lead to benefits or detrimental effects on other reading related components. For instance, whether the strategies actually help children make the link between print and narration was not explored directly. Future research should examine this question by measuring if children learn to read or recognize new printed words as a function of attention-orienting interventions. Furthermore, future studies should also investigate the impact of these interventions on other reading related components such as comprehension as well as the link with reading ability. Researchers should also explore the possibility of detrimental effects of the use of these strategies. In effect, it has previously been suggested that some types of interventions might be detrimental to comprehension by creating distractions (de Jong & Bus, 2002). What is more, the introduction of interventions in the shared book reading activity might impact the intrinsic pleasure associated with this activity (see e.g. Bus et al., 1995; Scarborough & Dobrich, 1994). These aspects were not explored in the current study but should be another step in future investigations.

Conclusion

It is often suggested to point or highlight the text as you read to your child. We hypothesized that for these strategies to be effective, words need to be fixated as a function of the narration. We examined whether pointing to or highlighting printed text led to a greater degree of attention to said text than when there was no intervention by recording eye movements. Results have shown gains in the fixations matching the narration for young readers in Grades 1 and 2 but not for preschool-age children who have yet to receive formal reading teachings. Even for first and second graders, gains in matching fixations were modest and were not observed unequivocally in all circumstances. Nevertheless, future research is required to examine the effects of attention-orienting strategies on reading related outcomes.

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