Research Article

What Children Are Looking at During Shared Storybook Reading

Evidence From Eye Movement Monitoring

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ABSTRACT—*Two studies were conducted to determine the extent to which young children fixate on the print of storybooks during shared book reading. Children's books varying in the layout of the print and the richness of the illustrations were displayed on a computer monitor. Each child's mother or preschool teacher read the books while the child sat on the adult's lap wearing an EyeLink headband that recorded visual fixations. In both studies, children spent very little time examining the print regardless of the nature of the print and illustrations. Although fixations on the illustrations were highly correlated with the length of the accompanying text and could be altered by altering the content of the text, fixations to the text were uncorrelated with the length of the text. These results indicate that preschool children engage in minimal exploration of the print during shared book reading.*

In recent years, increasing attention has been given to children's preliterate knowledge and skills, environmental experiences that foster them, and how they provide a foundation for later learning to read. One component of preliterate knowledge is print awareness, which includes understanding of the conventions of book text (e.g., that it is read from left to right, that a book has a title), appreciation of written words as discrete units whose appearance follows orthographic conventions (e.g., even and linear appearance, space between words), knowledge of the alphabet (e.g., ability to distinguish letters from numbers and to recognize specific letters), and knowledge of metaliteracy terms (e.g., *spell*, *print*, *word*). Prominent among the environmental experiences that foster later literacy is the activity of reading to children, which is cited by parents as being the most common and valued home literacy activity (Fitzgerald, Spiegel, & Cunningham, 1991) and is recommended in early-childhood policy documents as a way for parents to promote their children's literacy development (Bowman, Donovan, & Burns, 2000; International Reading Association and National Association for the Education of Young Children, 1998; Snow, Griffin, & Burns, 1998). Although a few studies have attempted to investigate how reading to young children in the home relates to their emergent literacy skill (e.g., Haden, Reese, & Fivush, 1996; Pellegrini, Brody, & Sigel, 1985; Reese, Cox, Harte, & McAnally, 2003), the literatures on shared book reading and orthographic development remain largely separate, allowing for little empirical study of the relationship between the two.

Some researchers have traced the developmental course of children's orthographic understanding across the preschool and early primary grades (see, e.g., Bialystok, 1995; Landsmann & Karmiloff-Smith, 1992; Levy, Gong, Hessels, Evans, & Jared, in press; Pick, Unze, Brownell, Drozdal, & Hopman, 1978). These studies have shown that between ages 3 and 5, children increasingly recognize that configurations of letterlike forms, single letters, repeated letters, misoriented letters, and misspaced letters are not printed words. Given these increases in children's print awareness and the frequency with which children are read books within this age period, it has often been assumed that print awareness and shared book reading are causally related. For example, Pick et al., Goodman (1980, 1986), and Wells (1985) noted that reading to children helps them develop knowledge about written language symbols. However, little empirical evidence supports such assertions or

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documents that children attend to print when they are read to. Yaden and McGee (1984) observed that Yaden's two 2-year-old sons asked many questions about illustrations, but that illustrations within which print was embedded appeared to lead them to ask at least some questions about print. Subsequently, Yaden, Smolkin, and Conlon (1989) and Yaden, Smolkin, and MacGillivray (1993) found that no more than 10% of the questions 3- through 6-year-olds asked during shared book reading concerned print conventions and forms. Similarly, Phillips and McNaughton (1990) found that neither parents nor 3- and 4-year-olds made many comments pertaining to print during shared reading. Most recently Shapiro, Anderson, and Anderson (1997) videotaped twelve 4-year-olds and coded their verbal and nonverbal behaviors as attention to print, illustrations, mathematics, or knowledge development. Again, little attention to print was found, with attention to illustrations predominating by at least a 10:1 ratio.

Together, these studies suggest that the focus of young children's attention during shared reading is rarely on the text. However, the window onto children's attention in these studies was their questions and comments. Because not all items of visual attention are necessarily commented on, counting children's comments on print versus pictures may not accurately reflect where the children are looking or the extent to which they have the opportunity to attend to or process print in this context. Moreover, trade books for children are typically rich in illustrations and vary in the ways in which text and pictures are arrayed. Reports of the previous research have not described the format of the printed text and nature of the illustrations. Thus, it is unknown to what extent the design of books may influence children's attention to print. In this study, we examined directly where children were looking during shared reading by tracking their eye movements.

A second purpose was to begin to examine the influence of book design on children's attention to print. In particular, we thought that by varying the attractiveness of illustrations, we might encourage children to spend more or less time looking at the pictures and accompanying text. Similarly, we thought that text that includes illuminated uppercase letters and text that appears in speech bubbles within the illustrations might be more likely to attract children's attention than regular text is. Thus, we examined children's eye movements when they were read contemporary storybooks with colorful illustrations, simple black-and-white drawings, and varied text features.

EXPERIMENT 1

Method

Participants

Five children (1 boy and 4 girls), ages 48 to 61 months, participated. All were native French speakers. On average, they correctly named 13 of 26 randomly arranged uppercase letters (range: 0–22). No child was able to read any of nine simple words from the stories.

Materials

Five storybooks representing a variety of text-illustration arrangements were used (see Fig. 1 for examples of pages from four of the books). The first three books (two of which are represented in the figure) were abridged from the originals, to keep the experimental sessions to a reasonable length, but maintained the story lines. Otherwise, they were not altered in any way. The last two books were unaltered except for being translated into French.

In *Boule et Bill* (Roba, 1986), which we refer to here as the *text-bottom-and-top* book, each page included both text and an illustration, with a line of text at the top of the page and a second line of text at the bottom. This story concerns a boy's adventures with different vehicles, and on 8 of the 13 pages, one word, which was always the name of the vehicle shown in the illustration, appeared in uppercase. On the remaining pages, regular font was used. There was an average of 25 words per illustration (page).

Les Vaches Voyageuses (Lebel & Daigneault, 1991), referred to as the *text-left* book, tells the story of four cows on a trip. The text was always in a block on the left side, and each page began with an enlarged decorated uppercase letter. A small line drawing relevant to the text was displayed at the bottom of this page, adjacent to the right-hand page with the main illustration. Six of the nine pages were presented, with an average of 36 words per page.

Le Potiron du Jardin Potager de Madame Potier (Pommaux, 1997), referred to as the *text-bubbles* book, is the story of planting and growing a pumpkin. The text on each of the six pages appeared in speech bubbles within the illustration, with an average of 35 words per page.

These three books all had rich, colored illustrations. In addition, we used two older books with simple monocolor illustrations. *The Carrot Seed* (Krauss, 1947) referred to as the *simple-drawings A* book, had 12 pages with an average of nine words per page; the text was on the left for all but two pages. In *The Happy Egg* (Krauss, 1967), referred to as the *simple-drawings B* book, the text was on the left of all 14 pages, and there were seven words per page on average.

Apparatus

Eye movements were measured with an SR Research EyeLink II system. A light headband and three camera systems were used to simultaneously track both eye and head position (to allow compensation for head movements). The children were able to sit on their parents' laps in a natural position. This system has high spatial resolution (0.005°) and a high sampling rate (500 Hz). By default, only the pupil of each participant's dominant eye was tracked. The EyeLink system uses an Ethernet link between the eyetracker and the display computer for real-time

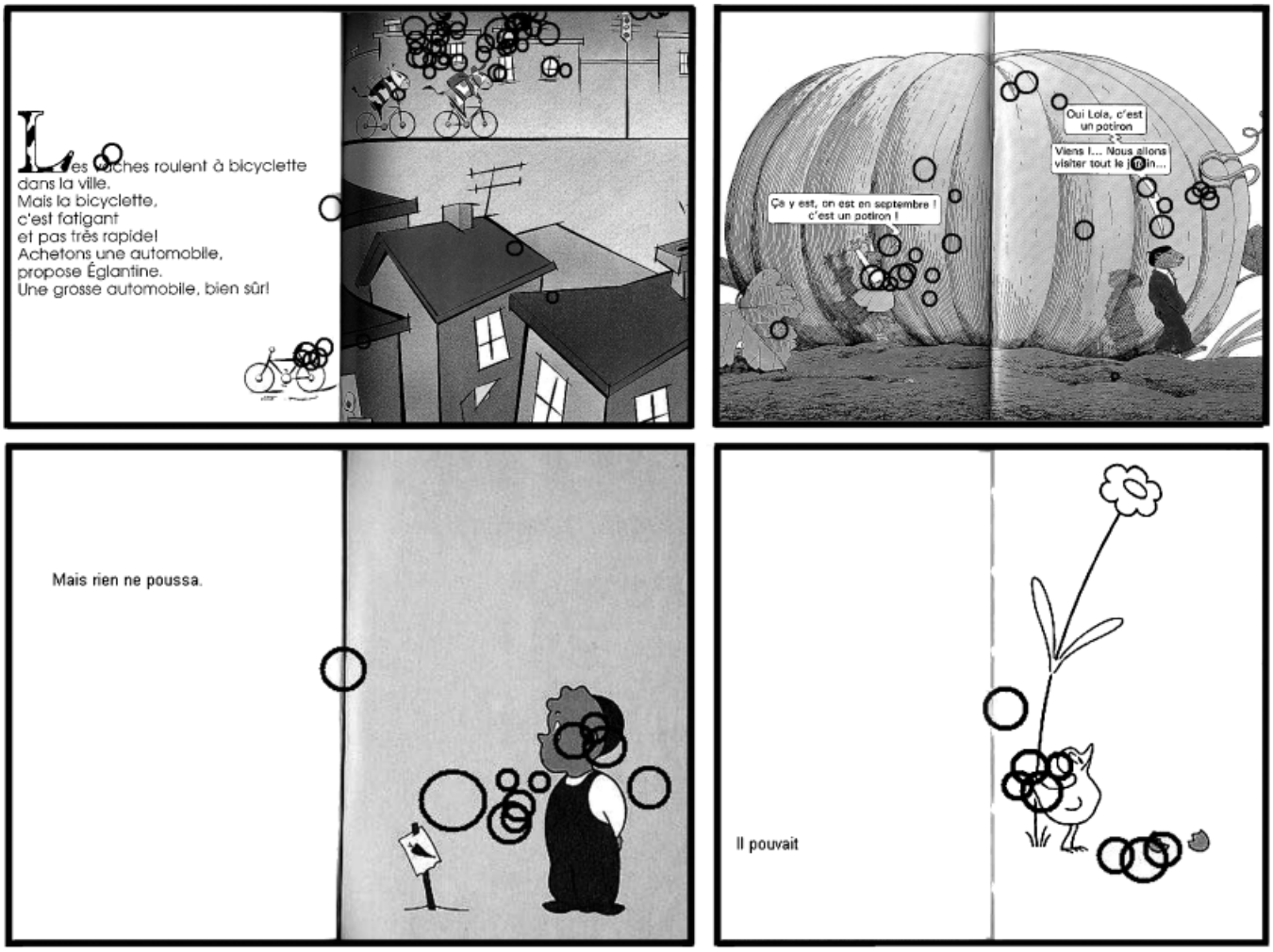

Fig. 1. Sample pages from four of the storybooks used in Experiment 1. The circles superimposed on each picture represent the fixations of a participant. The diameter of the circles is proportional to the duration of the fixations they represent. The books represented, in order from left to right and top to bottom, are *Les Vaches Voyageuses* (text left; Lebel & Daigneault, 1991), *Lola: 10 Histoires Instructives* (speech bubbles; Pommaux, 1997), *The Carrot Seed* (simple illustrations; Krauss, 1947), and *The Happy Egg* (simple illustrations; Krauss, 1967).

transfer of saccade and gaze-position data. In the present investigation, the configurable acceleration and velocity thresholds were set to detect saccades of 0.5° or greater.

Stimulus displays were presented on two monitors, one for the participant (17-in. ViewSonic 17PS monitor) and the other for the experimenter. The experimenter's monitor was used to give feedback in real time about the participant's computed gaze position. This feedback, which was given in the form of a gaze cursor measuring 1° in diameter, allowed the experimenter to evaluate the system's accuracy and to initiate a recalibration if necessary.

Procedure

Each child was tested in one session lasting approximately 1 hr. During an initial 10-min familiarization period, the child followed the experimenter's hand with his or her eyes, without moving the head, as practice for the eyetracker calibration task. After the familiarization period, the child sat on the parent's lap, the headband was installed, and calibration was initiated. For the calibration, the child had to successively fixate on three small dots appearing at the center top, bottom left, and bottom right of the screen. This procedure was followed twice, and the mean deviation between the first and second fixation on each small dot had to be smaller than 1° for calibration to be considered successful. The parent then began reading the storybook. After each story page was read, a blank screen appeared, and the child had to fixate on a dot at the center of the screen; this ensured that calibration was still accurate before the next page was presented. The experimenter checked on her screen to determine that the child's fixation of the dot was actually on it. This additional measure ensured that the eye movement recording remained accurate and was not distorted if the child moved the helmet while listening to the story. Three boys were unable to perform the calibration, leaving 5 children in the study.

Presentation order of the five texts was counterbalanced across children with a Latin square design. Parents were asked to read the text as they would usually do, but were told not to backtrack to a previous page or to skip pages. Parents made few comments on the stories or pictures and almost exclusively simply read the text appearing on the screen. Children listened relatively quietly and made few spontaneous comments.

Results

The data were scored with the EyeLink Data Viewer program, which presented the storybook pages as they were presented to the children, superimposing on the pages the children's successive landing positions. Figure 1 shows four examples, each taken from a different child. For each child and each text screen, we determined the time spent on the text (i.e., the sum of all fixation durations on the text) and the time spent on the illustration (i.e., the sum of all fixation durations on the illustration). For all five storybooks, the children almost never fixated on the text, and when they did, the isolated fixations did not follow a coherent pattern. Table 1 shows that the time spent on text was uniformly low, and that the children spent much more time looking at the illustrations. Furthermore, the time spent on the illustrations varied across the storybooks: It was longer for storybooks with richer text and illustrations and shorter for storybooks with simple drawings.

A 2 × 5 repeated measures analysis of variance (ANOVA) with target (text vs. illustration) and storybook as factors confirmed those observations. There were effects of storybook, $F(4, 16) = 42.81$, $p < .0001$, $\eta^2 = .10$, and of target, $F(1, 4) = 50.04$, $p < .01$, $\eta^2 = .69$, as well as a significant interaction, $F(4, 16) = 27.13$, $p < .0001$, $\eta^2 = .08$. Simple main-effect tests revealed that for all storybooks, children spent significantly more time on the illustrations than on the text. More important, the simple main effect of storybook was significant for illustrations, $F(4, 32) = 67.39$, $p < .0001$, $\eta^2 = .18$, but not for text, $F < 1$. Post hoc comparisons (Tukey's HSD) revealed that the time spent on illustrations was significantly different for all storybooks except the two with simple drawings, which did not differ from each other (time on illustrations was highest for the text-bubbles book, second highest for the text-left book, third highest for the text-bottom-and-top book, and lowest for the two simple-drawings books). As shown in Table 1, the time spent on illustrations mirrored the length of the text pertaining to each, as was confirmed by a significant item-based correlation between the mean number of words on each of the 51 pages and the time spent on the accompanying illustration, averaged across the 5 children, $r = .88$, $p < .0001$. However, there was no correlation between the mean number of words on each page and the time spent on that text, $r = .10$, n.s.

Finally, three of the books had particular text features that might be expected to attract children's attention. In the text-bottom-and-top book, a single word within the text was printed in uppercase font on 8 of the 13 pages. Not a single child for whom this book was unfamiliar fixated on this visually distinct word on any of the 8 pages. In the text-left book, 3 children fixated on just one or none of the enlarged decorated letters. In contrast, all of the children fixated several times on the bubbled text used in the third book. However, it seems likely that this was less a function of the way the text was printed than of the children's eye movements in exploring the illustrations and following the contours of objects such as the pumpkin (see Fig. 1). Similar contours of tree trunks, garden hoops, and other items appeared on other pages and were interrupted with parts of a text bubble, such that when the children followed the contours with their eyes, they encountered a text bubble along the way.

TABLE 1

Time Spent (in Milliseconds) on the Text and the Illustration and Number of Words per Page as a Function of Storybook in Experiment 1

	Time on text		Time on illustration		Words per page	
Storybook	*M*	*SD*	*M*	*SD*	*M*	*SD*
Text bottom and top	503	315	13,636	2,705	25.2	7.4
Text left	621	938	15,310	5,840	35.7	11.9
Text bubbles	669	324	18,065	3,715	34.7	8.2
Simple drawings A	175	164	7,458	3,683	9.2	5.5
Simple drawings B	424	338	7,235	3,721	6.6	4.6

Conclusion

The results of Experiment 1 are clear: During shared book reading, young children's fixations on text are scarce and are unaffected by the spatial arrangement of the text and the illustrations, or by the attractiveness of the illustrations. Furthermore, when extra time is spent on a given page, this time is devoted to the illustration and not the text.

EXPERIMENT 2

The second study, which used a larger number of children and a new calibration procedure, was designed to replicate the findings of Experiment 1 concerning the extent to which children attended to the text. In addition, given that the children in Experiment 1 were looking not at the text but rather at the illustrations that related to the meaning of the text, this second experiment investigated the extent to which children's fixations on the different parts of the illustrations could be manipulated by changes to the story line.

To accomplish this second goal, we took advantage of an observation in Experiment 1: All children occasionally fixated on small and incidental objects in the illustrations. In Experiment 2, we attempted to increase attention to incidental details within the illustrations of the text-left book by developing two versions

of accompanying text that highlighted different areas of the pictures. If children's eye fixations changed in response to this manipulation, this finding, in combination with a replication of the results of Experiment 1 showing that children do not look at the print, would provide evidence that during shared book reading, children follow the semantics of the text, matching the focus of their attention on the illustrations to the meaning of the text as read to them.

Method

Participants

Ten newly recruited native-French children (6 boys and 4 girls), ages 52 to 60 months, participated. On average, the children correctly named 8 (range: 0–20) of the 26 letters of the alphabet, and no child recognized any of five simple words from the story.

Materials

The original illustrations of the text-left book were presented in the original order. The text was modified to produce two versions similar to each other and to the original story in both length and difficulty. For three of the pages, a small detail of the illustration (a fish, a boat, and two stars) was highlighted by the wording of the text in one version, hereafter called Version 1. The wording of the second text version (Version 2) highlighted a portion of the illustrated page that was not around that detail. Consequently, for each of these pages, there were two zones: Zone 1, a small zone centered around the small detail, and Zone 2, the remaining part of the illustration. On the remaining six pages, there was no such detail to highlight; the illustrations on these pages were divided into two zones, arbitrarily labeled Zone 1 and Zone 2. Again, two versions of the text were written. Version 1 highlighted features of Zone 1, whereas Version 2 highlighted features of Zone 2.

Procedure

The procedure was identical to that used in Experiment 1, with a few exceptions. Only two books were used (the book with Version 1 text and the book with Version 2 text). Also, rather than a parent, a day-care teacher known to the children read the story to them. Finally, the calibration procedure was changed. During calibration, the children fixated on a tiny face of a cartoon character and were encouraged to look closely to examine its features. With this new procedure, calibration could not be completed with only 1 participant, a girl, who therefore was not included in the sample. A within-participants design was used, with both versions of the story being read, in counterbalanced order, to all children.

Results

The first series of analyses was based on all text pages read to the children. Consequently, it was based on 18 pages, across the Version 1 and Version 2 books. As shown in Table 2, the results of Experiment 2 replicated those of Experiment 1. On average, the children spent 18 times longer looking at the illustration than at the text, a pattern that was unaffected by text version. A 2 × 2 repeated measures ANOVA with target (text vs. illustration) and text version as factors revealed a main effect of target, $F(1, 9) = 288.22$, $p < .0001$, $\eta^2 = .95$, but neither the main effect of text version nor the interaction reached significance.

TABLE 2

Time Spent (in Milliseconds) on the Text and the Illustration as a Function of Text Version in Experiment 2

	Part of the page			
	Text		Illustration	
Text version	*M*	*SD*	*M*	*SD*
Version 1	603	746	13,204	1,994
Version 2	863	1,253	12,666	1,350

Because the zones were not established the same way for the pages with and without a small detail, the two groups of pages were analyzed separately. As shown in Figure 2, on the small-detail pages, the children spent more time fixating the zone with the small detail (Zone 1) when the text (Version 1) referred to this detail than when the text (Version 2) referred to another part of the illustration. Similarly, the children spent more time fixating parts of the illustration not around the small detail (i.e., Zone 2) when the text (Version 2) referred to aspects of Zone 2 than when the text (Version 1) referred to the small detail. This pattern of results was confirmed by a 2 × 2 repeated measures ANOVA with zone and text version as factors. There was an effect of zone, $F(1, 9) = 253.34$, $p < .0001$, $\eta^2 = .87$, and a significant interaction of zone with text version, $F(1, 9) = 29.83$, $p < .001$, $\eta^2 = .03$, but the effect of text version did not reach significance, $F < 1$. Simple main-effect tests revealed that the effect of text version was significant for Zone 1 (small-detail zone), $F(1, 18) = 19.25$, $p < .001$, $\eta^2 = .02$, and for Zone 2, $F(1, 18) = 17.98$, $p < .001$, $\eta^2 = .01$.

On the pages without a small detail, the children spent more time fixating Zone 2 than Zone 1, and there was no other clear trend (see Fig. 2). The 2 × 2 repeated measures ANOVA revealed a main effect of zone, $F(1, 9) = 22.78$, $p < .001$, $\eta^2 = .33$, but neither the main effect of text version nor the interaction reached significance. The zones of the illustrations were created arbitrarily, and inspection of the zones suggested that Zone 2 was generally larger and more visually complex than Zone 1. This may explain why Zone 2 elicited longer and more fixations. Thus, this result merits no further discussion.

Conclusion

The results of the second experiment clearly replicated those of the first in showing that when young children are being read to,

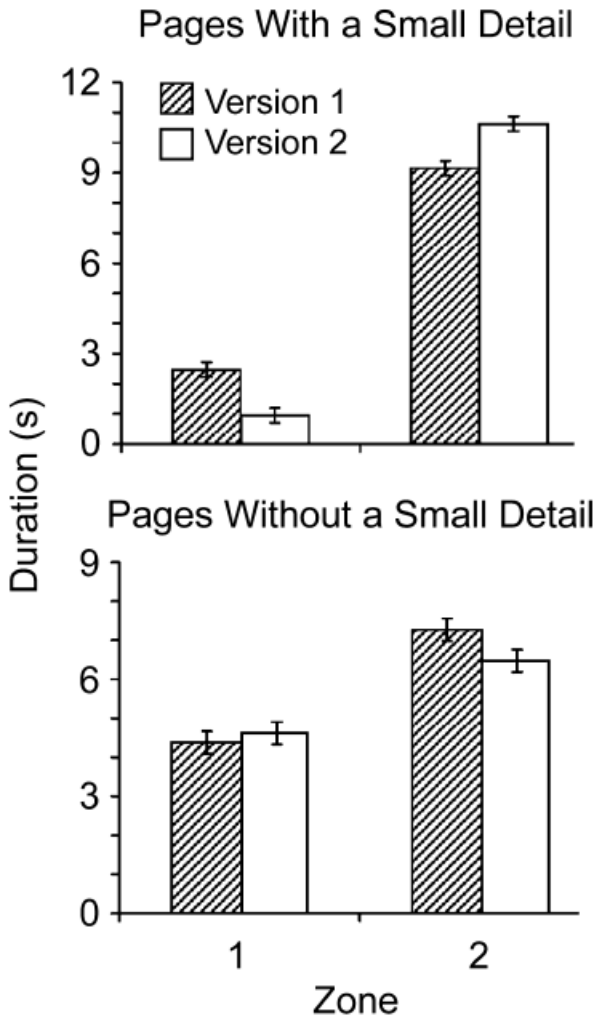

Fig. 2. Mean fixation time per page in Experiment 2 as a function of the text version and illustration zone. Results are presented separately for pages with a small visual detail (top) and pages without a small visual detail (bottom). Error bars represent within-subjects confidence intervals, at $\alpha = .05$, computed according to the method of Loftus and Masson (1994).

their visual attention is not on the printed text. The finding that visual fixations on details in the illustrations increased if the text highlighted those details shows that the children's visual attention was to some extent dependent on the accompanying text. However, when the text did not highlight a visual detail, their attention to different areas of the picture was largely unaffected by the story line.

DISCUSSION

This research was conducted to determine where children are looking when they are being read to. Experiments 1 and 2 both clearly demonstrated that 4- and 5-year-olds attended very little to the printed words on the page during shared reading. This held true regardless of the arrangement of print and illustrations. Even when the illustrations were simple monochrome line drawings, fixations on the print were minimal. These findings are in agreement with previous naturalistic research (cited in the introduction) in which children asked few questions about the print when they were read to. However, these studies were not definitive in that the children may have been looking at the print but without commenting on it.

Previous case studies have suggested that young children who are read to frequently know basic print concepts (Baghban, 1984; Sulzby, 1985). However, in light of the findings from the present study, it is difficult to see how shared reading, without additional explicit references to the print within the books, can be a major vehicle for developing children's understanding of orthography or print-specific skills. The authors of two meta-analyses of shared book reading have noted that parent-child storybook reading may have a greater impact on language skills than on emergent literacy skill in the preschool years or on school-age reading achievement (Bus, Van IJzendoorn, & Pellegrini, 1995; Scarborough & Dobrich, 1994). Our experiments provide an explanation of why this is likely to be the case—young children engage in minimal exploration of the print during shared reading.

Since these meta-analyses were published, at least three studies have directly contrasted the contribution of listening to storybooks to the development of vocabulary and to the development of reading skill. These studies found a relation between shared reading and vocabulary development, but little association between shared reading and development of reading skill (Evans, Shaw, & Bell, 2000; Frijters, Barron, & Brunello, 2000; Sénéchal, LeFevre, Thomas, & Daley, 1998). Similar results have been found within the classroom context (Meyer, Stahl, Wardrop, & Linn, 1994; Vellutino & Scanlon, 2001).

In summary, these differential effects, the findings of previous studies examining children's comments during shared reading, and the direct measurements of attention to print and pictures through the technology of eye tracking in our research reported here lead us to seriously question the effect of shared reading on print knowledge. Moreover, all these studies support Phillips and McNaughton's (1990) conclusion that the correlations between book reading and print awareness found in naturalistic studies of preschoolers are not so much a function of shared reading as of families practicing both shared reading and other literacy activities that are more closely related to print-specific knowledge. In fact, in studying 130 children in each of three grades (junior kindergarten, senior kindergarten, and first grade), Evans et al. (2004) found that the amount of time parents reported spending in shared book reading with their child correlated with how often they involved their children in activities specifically coaching print knowledge. Correlations ranged from .41 to .53 for the extent to which parents involved their child in phonics and phonological awareness activities, from .21 to .38 for the extent to which they involved their child in activities with letters, and from .21 to .44 for the extent to which they involved their child in activities practicing reading and writing.

The results of the present study should not be taken to suggest that reading to young children has little benefit to cognitive development. Rather, the focus and benefits appear to center on meaning, comprehension, and the rhythms and patterns of language. Several studies (e.g., Bus, Belsky, van IJzendoorn, & Crnic, 1997; Ninio & Bruner, 1976) have shown that from the youngest ages at which children are read to, their attention to pictures in books is elicited by their mothers. Mothers call attention to and point to the pictures, label them, ask their children to name them, and repeat and elaborate their children's responses. This interactional routine serves to teach and solidify vocabulary, and to establish a joint focus of attention between the child and the adult while reading the book. Thus, children attend to the illustrations in concert with the spoken text, as shown in our second experiment. This interactional routine also, however, may establish illustrations as the prime component of storybooks and reading in the young child's mind.

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