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Pre-schoolers, print and storybooks: an observational study using eye movement analysis

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This study used eye-gaze analysis to determine the extent to which pre-school children visually attended to print when looking at two storybooks, to contrast visual attention to print for a print-salient versus a picture-salient storybook, and to study individual differences in pre-schoolers' visual preferences. Results indicated that pre-school children infrequently attended to print: in a traditional picture-salient storybook, 2.7% of their fixations focused on print and 2.5% of their time was spent looking in regions of print. The children fixated more frequently on print and spent more time looking in print regions when reading a print-salient storybook, within which 7% of fixations focused on print and 6% of time was spent in print zones. Effect size estimates showed this difference to be consistent with a very large effect. Little variation in visual attention to print was observed across the ten children, and children's alphabet knowledge was not associated with the variance in children's visual attention to print. Educational implications are discussed.

The years preceding the transition to kindergarten are an important time in which young children develop emergent knowledge about the forms and functions of written language. This knowledge base has been described variously during the last two decades as 'print awareness', 'written language awareness' and 'concepts about print' (e.g. Goodman, 1986; Hiebert, 1981; Justice & Ezell, 2001; Lomax & McGee, 1987; Mason, 1980). In this manuscript, we adopt the term 'print awareness' to describe pre-literate children's attainments from roughly birth to the kindergarten transition that include the following understandings: (a) print is an object worthy of interest; (b) print carries meaning; (c) print is organised in specific ways; (d) print units can be differentiated and named, and (e) print units can be combined to make other print units (Justice & Ezell, 2004). Measures reflecting children's knowledge in these areas correlate, moderately to strongly, with other contemporary aspects of pre-literacy skill, such as phonological awareness and developmental writing, as well as later conventional literacy achievements, including word recognition and spelling (e.g. Bryant et al., 1990; Chaney, 1998; Lonigan et al., 1998; Stuart, 1995; Welsch, Sullivan & Justice, 2003).

Several papers have presented descriptions of major print-awareness achievements, including work completed by Hiebert (1981), Justice and Ezell (2001), Lomax and McGee (1987) and van Kleeck (1998). Along with identifying key print achievements in young children, these papers have also worked to place print awareness within a broader framework of the development of reading skill. For instance, in a paper that consolidated the place of print awareness in the framework of early reading development, Lomax and McGee (1987) showed that for 3- to 6-year-olds, print awareness, alphabet knowledge, phonemic awareness, grapheme-phoneme knowledge and word reading formed an overall sequential model of early reading development. Lomax and McGee's influential findings demonstrated the importance of print awareness as an early and necessary component of reading development. Convergent findings supporting the contribution of print awareness to early reading, and the documentation of integrative relationships between print awareness and other aspects of literacy have since been reported in numerous papers (e.g. Badian, 1998, 2001; Chaney, 1998; Justice & Ezell, 2001; Storch & Whitehurst, 2002; Welsch, Sullivan and Justice, 2003). And while the actual strength of the contribution of print awareness to the subsequent achievement of fluent, skilled word-reading ability has yet to be established (e.g. Anthony et al., 2002), it is clear that print awareness - representing a child's understanding of and interest in the forms and functions of written language - is a necessary prerequisite for the achievement of word reading.

Empirically grounded theoretical descriptions of the nature by which print awareness develops are relatively few in number, albeit of great interest in light of current research showing the importance of emergent literacy development for explaining individual differences in children's later reading achievements/ Of the few that have been presented in the literature, these have generally been derived from ethnographic and qualitative descriptions of children's interactions with, and discussions about, print during the pre-school years (e.g. Mason, 1980; Snow, 1983). These papers describe pre-school children's interactions with print within the content of scaffolded, contextualised interactions with adults in authentic literacy contexts; for instance, Snow (1983) examined a young child's explorations of print (e.g. questions concerning print) when reading favoured storybooks with his mother.' Goodman (1986) drew from a compendium of observational studies to posit that children's print awareness moves along a continuum from highly contextualised understanding of print forms and functions to de-contextualised and conventional awareness. Many of these early qualitative reports describe children's achievements of print awareness through a 'print experience model', in which children's print awareness is developed through their 'informal and naturalistic interactions with print during supportive, mediated opportunities' (Justice & Lankford, 2002, p. 11)„- This prevailing perspective is derived from emergent literacy and social constructivist perspectives that are currently the predominant theoretical frameworks used by early childhood literacy theorists (Crawford, 1995). The emergent literacy perspective views children's pre-literacy development as a developmental and dynamic process in which children are actively involve(l)As with the acquisition of oral language, children 'emerge as readers by immersion in a print-rich environment, through a series of learning experiences that encourage active engagement with both spoken and written language' (Crawford, 1995, p. 79). The social constructivist perspective extends emergent literacy theory by emphasising literacy as a social tool, whereby literacy knowledge is gradually internalised from external events by the child through mediated interactions with knowledgeable peers (see Justice & Ezell, 1999).

The literacy event viewed by the preponderance of theorists and practitioners as a particularly fertile context for the development of print awareness is adult-child shared storybook reading. The frequency of adult-child storybook reading accounts for approximately 15 to 24% of the variance in young children's print awareness (see Scarborough & Dobrich, 1994). When considering *how* children's print awareness develops in this context, emergent literacy and social constructivist accounts suggest that adult-child shared storybook reading sessions would show some evidence of (1) deliberate adult mediation of children's print awareness, and (2) children's active engagement with print. \ Empirical studies of adult-child storybook reading have nonetheless shown little evidence of either of these manifestations. For instance, in a series of descriptive studies, Justice and colleagues showed that adult facilitation of children's interactions with print was a rare occurrence in the storybook reading interactions of adults and young children (see Ezell & Justice, 2000; Justice et al., 2002; also see Phillips & McNaughton, 1990; Yaden, Smolkin & Conlon, 1989; Yaden, Smolkin & MacGillivray, 1993)^ When reading storybooks with four-year-old children, adults were found infrequently to ask questions about print, seldom to make comments about print and rarely to point to or track the print.\ While these behaviours have been recommended for use by adults to encourage children's print awareness (e.g. Snow, Burns & Griffin, 1998), there is little evidence that such behaviours are a commonplace occurrence when adults read with children^Additionally, like the adults who are reading to them, young children themselves also show little active engagement with print when looking at storybooks. Pre-literate children - even those with well-developed literacy skills - rarely talk about print (Ezell & Justice, 2000) or look at print (Justice & Lankford, 2002) whe'h reading books with adults, even when the storybook selections feature print-salient characteristics such as large print and print embedded within the illustrations (Smolkin, Conlon & Yaden, 1988). Yaden, Smolkin and MacGillivray (1993) concluded from their longitudinal book reading study of nine children that print forms and functions 'are of far less interest to the children than the meaning of the story [and] its visual impression via the illustrations' (p. 44). Such findings raise questions concerning theoretical perspectives that view storybook reading interactions as fertile contexts for print awareness development, particularly notions that young children actively internalise knowledge about print that arises from mediated interactions with their adult partners.

The research described in this manuscript was conducted to inform theory and practice in print awareness by using eye-movement analysis to characterise pre-literate children's visual attention to print when looking at storybooks. Descriptive and applied studies of the development of print awareness and its contribution to reading have primarily used three methods of inquiry: parental report (e.g. Marvin & Mirenda, 1993), behavioural testing (e.g. Justice & Ezell, 2000) and systematic observation (e.g. Martin, 1998). We recently used a fourth method of inquiry for studying print awareness in young children, namely eye-movement analysis (Justice & Lankford, 2002), a method that has been used to study story comprehension (Takahashi, 1991) and word learning (Yoshida, 1984) for pre-schooNaged children. Using technologies to monitor children's visual attention presents an ideal online means for exploring the extent to which children engage with print during literacy activities and for informing theories on print awareness. Eye-movement analysis has provided a valid and useful online measure of information processing during reading for older children, and decades of research have confirmed that an individual's sustained visual attention reflects information processing (for review, see Rayner, 1998). For these reasons, eye-movement analysis has provided a rich (albeit

occasionally controversial) source of information concerning reading development and disability.

The present work was conducted to replicate our pilot use of eye-movement analysis for studying print awareness in typically developing four- and five-year-old children. In our pilot work, four children were found to attend minimally to storybook print when being read storybooks. Although the percentage of print fixations increased from 1% for a traditional narrative storybook to nearly 6% when children were read a print-salient storybook, we concluded that young children show an overwhelming preference for anything *but* print when looking at books. We hypothesised that young children, even those with considerable pre-literacy knowledge, are unlikely to interact with print of their own accord regardless of whether print is a salient feature of the storybook. This hypothesis has important .implications for current practices in pre-school literacy interventions, by suggesting the need for explicit and deliberate scaffolding by educators and parents to support young children's visual attention to print when looking at storybooks.

Interestingly, recent findings from a laboratory independent of ours provide further support for the present hypotheses. Evans and Saint-Aubin (forthcoming) examined visual attention to print for typically developing French-speaking pre-schoolers in Canada. Their findings showed that four- and five-year-old children rarely looked at text *and* that even when looking at books with enticing print features (e.g. a single word printed in uppercase font), children's visual attention focused almost exclusively on illustrations. Importantly, a hallmark of science is the accumulation of evidence across independent laboratories using different approaches; thus it is relevant that Evans and Saint-Aubin's findings are so similar to ours.

The specific aims of the present work included: (a) to determine the extent to which pre-school children visually attended to print when looking at two storybooks, (b) to contrast visual attention to print for a print-salient versus a picture-salient storybook, and (c) to consider the extent to which individual differences are present in pre-schoolers' visual attention to print in storybooks. Respectively, it was hypothesised that children would infrequently attend to print when looking at storybooks, that visual attention would be greater for a print-salient relative to picture-salient storybook, and that there would be little individual variation in pre-school visual attention to storybook print.

Method

Participants

Participants were ten typically developing pre-school children (seven boys, three girls) and data was included from four children described in Justice and Lankford (2002). Using the means and standard deviations from pilot work (for which the effect-size estimates for the difference were consistent with a very large effect), we determined that a sample size of ten children was needed in order to detect the difference between two storybook stimuli, with power = 0.90 and a = 0.01 (for power analysis, see Sokel & Rolf, 1981).

Children were recruited through flyers dispersed at local daycare centres and pre-school programmes and through personal contacts in the community. All children were required to meet five eligibility requirements to participate, namely:

1. to pass a bilateral audiological screening at 30dB for 500, 1000, 2000 and 4000 hertz;

2. to pass binocular near-field (40 cm) vision screening (the *Massachusetts Visual Acuity Test,* Mayer & Moore, nd) at 20/50 or better;
3. to be a native English speaker;
4. to have no history of neurological, gross-motor, hearing or vision problems;
5. to exhibit typical language and literacy skills, as measured by performance on two sub-tests of the *Clinical Evaluation of Language Fundamentals-Preschool,* namely, Linguistic Concepts and Recalling Sentences in Context (CELF-P; Wiig, Secord & Semel, 1992), and three sub-tests of the *Phonological Awareness Literacy Screening-PreKindergarten,* namely, rhyme awareness, beginning sound knowledge and alphabet knowledge (PALS-PreK; Invernizzi, Sullivan & Meier, 2001).

The criteria for eligibility were standard scores of 8 or better on both of the CELF sub-tests (i.e. scores greater than — *SD* of the mean) and raw scores corresponding to 25% accuracy or higher on the three PALS sub-tests.

Table 1 provides an overview of characteristics of the participants, who ranged in age from 50 to 69 months (M = 58 months; *SD = 1* months). All ten children were Caucasian and resided in middle-class two-parent households in a small mid-Atlantic city. All parents had a high-school diploma, with the majority (80% of mothers and 70% of fathers) having a four-year college degree as well. The children were reported by their parents to enjoy reading books; specifically, parents were asked to rate their children's enjoyment of storybook reading on a scale of 1 to 5, where 1 = *not at all* and 5 = *very much;* all children received a score of 5.

Materials

Materials included two children's storybooks and eye-gaze recording technologies. Two children's books were chosen for this study and then scanned to create electronic versions. *The Very Hungry Caterpillar* (Carle, 1986) contained 9 slides and *Spot Bakes a Cake* (Hill, 1994) contained 12 slides. They are hereafter referred to as 'Caterpillar' and 'Spot', respectively. These books were selected to reflect distinct print genre, with *Spot* a *print-salient* text and *Caterpillar* a *picture-salient* text (see Justice & Lankford, 2002, for specific details about each book). Print-salient texts are those for which 'artists' illustration and design decisions result in print being displayed in a visually salient fashion which influences children's attention to print' (Smolkin et al., 1992, p. 291). Picture-salient texts are those in which illustrations are displayed in a salient fashion to

Table 1. Characteristics of child participants (n = 10).

Characteristics	*M*	*SD*	Range
Age (in months)	58	7	50–69
Linguistic concepts	12.4	1.8	10–16
Recalling sentences in context	13.4	1.3	11–15
Rhyme awareness	8.5	2.3	3–10
Beginning sound knowledge	9.0	1.1	7–10
Alphabet knowledge	20.3	5.6	7–26

Note: Scores for Linguistic Concepts and Recalling Sentences in Context (sub-tests of the CELF-P, Wiig, Secord & Semel, 1992) are standard scores, based on a mean of 10 and a standard deviation of 3. Scores for Rhyme Awareness and Beginning Sound Knowledge (sub-tests of the PALS-PreK, Invernizzi, Sullivan & Meier 2001) are percentages, based on number-correct-out-of-10 tasks. Score for Alphabet Knowledge, also from PALS-PreK, is a percentage based on number correct for naming the 26 upper-case alphabet letters.

influence children's attention to pictures. Print-salient books promote children's visual attention to print (Justice & Lankford, 2002) and their participation in print-oriented discourse (Ezell & Justice, 2000; Smolkin, Conlon & Yaden, 1988; Smolkin et al., 1992).

Apparatus

The eye-g*aze technologies used for this study were the Eye-gaze Response Interface Computer Aid (ERICA) and Gazetracker software (ERICA, Inc., 2001). The ERICA eye-tracking system was used to study children's viewing patterns when looking at storybooks. ERICA is a non-invasive, compact technology that requires no attachments to be worn by participants. The ERICA technology comprises an eye-tracking camera and a light-emitting diode (LED) that directs an infrared light to a participant's eye. ERICA tracks eye gazes at a sampling rate of 60 hertz, with an accuracy of 0.5 to 1 degree visual angle, which is roughly 0.5-1 cm accuracy on the computer monitor at a normal viewing distance. Eye-tracking data generated by ERICA were stored on a peripheral computer's hard drive (a Dell Dimension XPS T500). Gazetracker software (ERICA, Inc., 2001) was used for stimulus presentation and eye-movement analysis, specifically the generation of descriptive statistics concerning children's eye movements within identified regions of interest, or 'print zones'. Gazetracker software was also used to demarcate 'print zones' on each page of the storybooks, separating regions of print from that of other page matter (pictures and white space). The print zones comprised regions of both narrative print (the print that tells the story) and print embedded within the illustrations (see Figure 1 for an example).

Caterpillar contained 13 individual print zones marked by Gazetracker software, all of which bounded narrative text. *Spot* contained 21 individual print zones: 14 bounded narrative text, 4 bounded print embedded within the illustrations (e.g. a sign in a grocery store that said 'Special Today Chocolate') and 3 bounded speech bubbles.

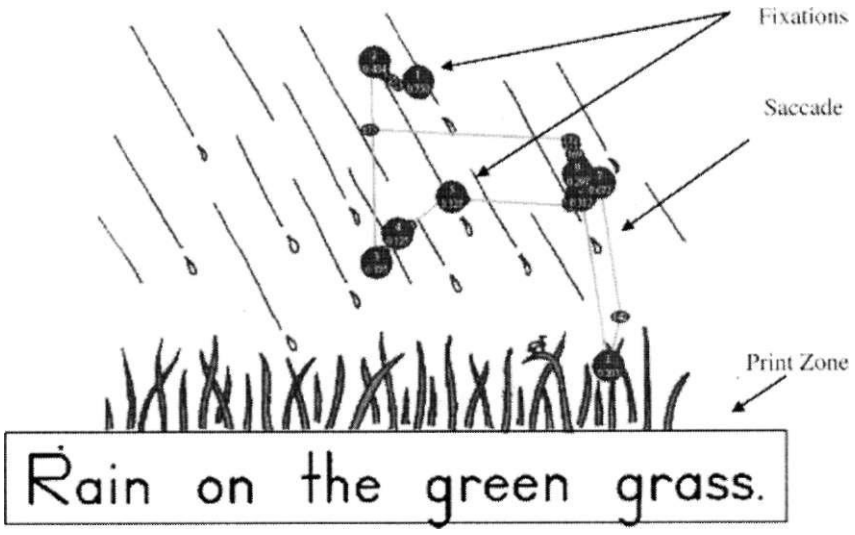

Figure **1.** Examples of eye-gaze patterns of second author for a line-drawing illustration. The black circles represent fixations, and the lines between fixations represent saccades. The print zone is bounded by a box.

General procedures

Eligibility sessions were conducted in a research laboratory on the university campus in 45-minute sessions, during which children were individually administered the eligibility protocol (i.e. hearing, vision, language and literacy testing). An individual 20-minute eye-gaze session was then scheduled for each child within a one-week period. During the eye-gaze session, children sat facing a computer monitor with their heads resting fully against the back cushion of the chair. In two instances, children sat on their mothers' laps. Children were told that they were going to look at two storybooks on the computer, and that they would need to sit very still. After practising sitting still, the ERICA system was calibrated in an approximate 10-second session during which children were asked to stare directly at.the computer screen and to look at a series of six sequential icons. (Note that once the ERICA system is calibrated, if it becomes 'uncalibrated' from the user's eyes it stops functioning, which occurred for none of the children in this study.) Then, children were read the two electronic storybooks by an adult reader (the first or third author), with the order of storybooks counterbalanced across the ten children.

Approximate viewing time for the two books together was about seven minutes, and no break was provided between the two storybooks. For each book, the adult read the text on each page verbatim and then waited approximately two seconds before turning to the next page. Children were given a set of storybooks as a gift.

Eye-gaze measures

The eye-gaze measures of specific interest in this study were (a) the number of times children fixated in print zones, and (b) the amount of time children spent in print zones. A fixation is the amount of time that children's eyes are relatively still, allowing them to attend to particular stimuli. The ERICA system coded fixations for gaze durations of 50 ms or longer, based on data showing that new information is brought into the sensory system when the eye is fixated using this parameter (Rayner, 1985). Fixations follow saccades, referring to rapid movement of the eye from one focal point to another, the purpose of which is to bring a particular visual stimulus into foveal vision for processing (Rayner, 1985).

Results

Preliminary analyses

Table 2 presents the total number of fixations and total reading time for the two storybooks. Children averaged 233.1 fixations *(SD*= 19.6) for *Caterpillar* and 229.7 fixations *(SD* = 31.0) for *Spot.* Total reading time averaged 107.5 seconds *(SD* = 7.3) for *Caterpillar* and 90.8 seconds *(SD* = 10.0) for *Spot.* The latter difference is probably attributable to the greater amount of text in *Caterpillar* that was read by the adult, averaging 19 words per page for *Caterpillar* compared to 7 words per page for *Spot.* *Caterpillar* thus took about 16 seconds longer to read. Two paired-samples *t* tests showed that the total number of fixations was similar across the books, f(9) = 0.32, *p* = 0.76 *(Caterpillar M* = 233.1, *SD* = 19.6; *Spot M* = 229.7, *SD* = 31), but that reading sessions were longer for *Caterpillar* compared to *Spot, t(9)* = 3.9, *p<0.0\ (Caterpillar* M= 107.5, *SD* = 7.3; *Spot M*= 90.8, *SD* = 10). As the sessions differed for length, the two storybooks were considered separately in all subsequent analyses or, when

Table 2. Children's visual attention to print for two storybooks: raw data.

Variables	Book					
	Caterpillar			*Spot*		
	M	*SD*	Range	*M*	*SD*	Range
Print-zone fixations	6.6	4.7	0–13	16.6	7.2	8–29
Other fixations	226.5	17.7	196–256	213.1	27.6	176–252
Total fixations	233.1	19.6	204–269	229.7	31	187–272
Print-zone time (in sec)	2.7	2.4	0.03–7.31	5.2	2.1	2.1–8.7
Other time	104.8	7.2	96.4–119.5	85.6	9.6	68.9–97
Total time	107.5	7.3	100.1–121.7	90.8	10	73–102

appropriate, raw data were divided by the length of sessions to control for reading time differences.

Main analyses

Results are presented to address the three research questions: (a) To what extent do pre-school children visually attend to print when looking at storybooks? (b) Do pre-school children show greater visual attention to print when looking at a print-salient storybook relative to a picture-salient storybook? (c) To what extent are individual differences apparent for visual attention to print? The dependent variables of interest for addressing these questions were the number of fixations in print zones and the amount of time in print zones (see Table 2).

Descriptive findings showed that children's print fixations and time spent in print zones were infrequent for both of the storybooks studied. Table 2 shows that children averaged approximately seven print-zone fixations for *Caterpillar,* and about 17 print-zone fixations for *Spot.* Proportionally, 0.03 of children's visual fixations *(SD* = 0.02) focused on print when reading *Caterpillar,* whereas 0.07 of children's fixations *(SD* = 0.03) focused on print for *Spot.* Children spent about 2.7 seconds in print zones for *Caterpillar,* and about 5.2 seconds in print zones for *Spot.* Thus, 0.03 of children's time *(SD* = 0.02) was spent in print zones for *Caterpillar,* compared to 0.06 *(SD* = 0.02) for *Spot.* Although the number of print-zone fixations and time spent in print zones showed a twofold increase when comparing *Spot* to *Caterpillar,* these data indicate that children's visual attention to print was overall quite modest for both books.

Two paired samples r-test were computed to determine the extent to which children showed greater visual attention to print for the print-salient storybook compared to the picture-salient storybook. The proportion of print-zone fixations and the proportion of time spent in print zones served as the dependent measures; the use of proportional rather than raw indices controlled for the number of print zones and the length of reading time, both of which differed across the two books. These indices were compared for *Spot* (print-salient) to *Caterpillar* (picture-salient) (see Table 3). Results showed that a greater proportion of children's fixations were focused on print for the print-salient book *(M* = 0.07, *SD* = 0.03) compared to the picture-salient book *(M* = 0.03, *SD* = 0.02), $t(9) = 6.6$, $p < 0.01$. Likewise, children spent a greater proportion of their time in print zones when reading a print-salient book *(M* = 0.06, *SD* = 0.02) compared to a picture-

Table 3. Comparison of visual attention to print to other page matter.

Dependent measures Book Category (Title)	Zones		
	Print zones	All zones	Proportion print focus
Fixations			
Picture salient (*Caterpillar*)	6.6	233.1	0.027
Print salient (*Spot*)	16.6	229.7	0.071
Duration (in sec)			
Picture salient (*Caterpillar*)	2.7	107.5	0.025
Print salient (*Spot*)	5.2	90.8	0.057

Table 4. Individual differences in print attention for *Spot Bakes a Cake*.

Child	Proportion of print-zone fixations	Proportion of time in print zones
1	0.07	0.05
2	0.07	0.06
3	0.04	0.04
4	0.07	0.06
5	0.07	0.07
6	0.04	0.02
7	0.11	0.08
8	0.12	0.10
9	0.06	0.05
10	0.06	0.04

salient book (M = 0.02, SD = 0.02), r(9) = 4.6, /?<0.01. Thus, children's visual attention to print was significantly higher for the print-salient storybook relative to the picture-salient book.

Effect size estimates for these differences were made using Cohen's *d* (Cohen, 1988) on the proportional means (see Table 3). The effect size estimate for the difference in print zone fixations was 1.93; 79.4% of observations did not overlap in the two distributions. Likewise, the effect size estimate for the difference in time spent in print zones was 1.48; 70.7% of observations did not overlap in the two distributions. These outcomes show that the magnitude of difference across the two storybook stimuli was appreciable.

For the next analyses, we considered individual differences among pre-school children's visual attention to print by creating a visual depiction of the data. Table 4 presents case-level data detailing the proportion of fixations and time spent in print zones (relative to other page matter) for *Spot.* The *Spot* data are highlighted because print attention was significantly higher for this book, and thus it may provide a more enlightening glimpse of individual differences in children's attention to print. As can be seen in Table 4, there was little variation across children in terms of print-zone fixations and print-zone duration. For visual depictions of individual differences, see Figure 2. For 80% of children, the proportion of fixations in print zones ranged only within the lowest tenth percentile; only two children appeared to be 'outliers' with higher proportions of time on print, at 0.11 and 0.12 (Children 7 and 8, respectively). Similarly, when considering the duration data, the range of scores for all children was within the lowest

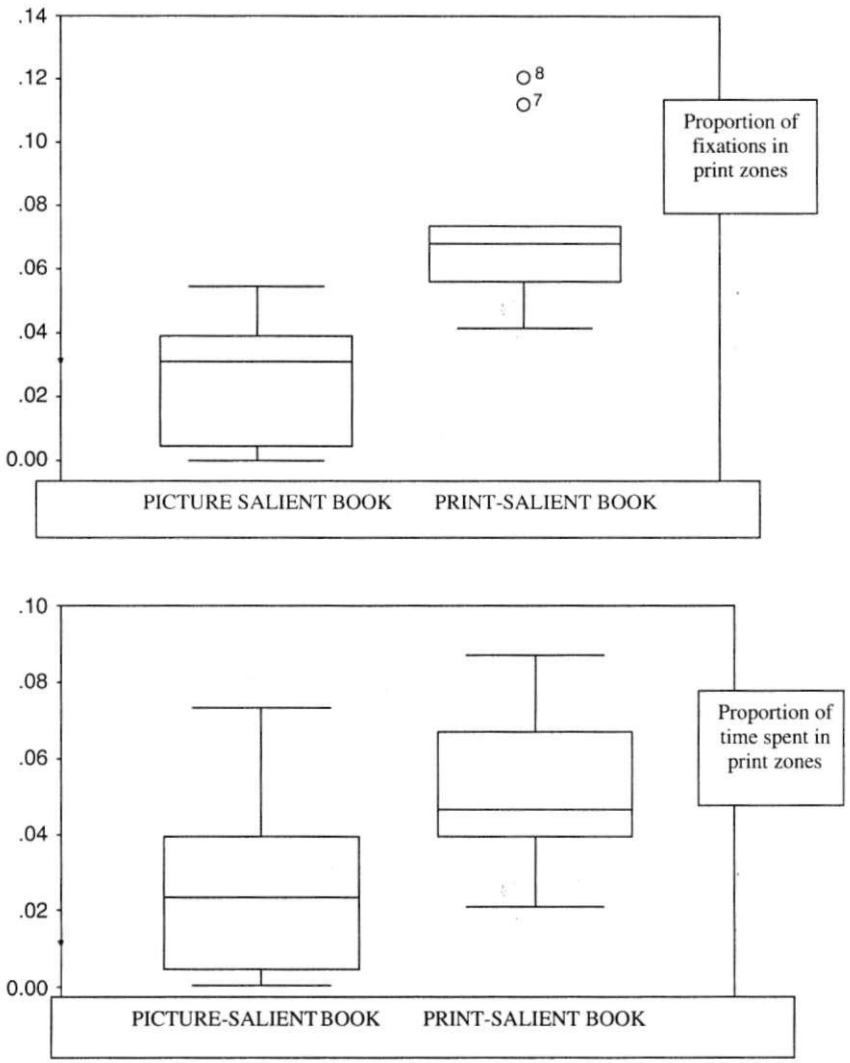

Figure2. Boxplots demonstrating individual variation in proportion of fixations in print zones and time spent in print zones (relative to other page matter) for picture- versus print-salient storybook.

tenth percentile. Seventy percent of children spent between 4% and 7% of viewing time in print zones; one child was below this range (Child 6, with 2% of time focused on print) and two children were above this range (Children 7 and 8, with 8% and 10% of time focused in print zones, respectively).

Our observation of little individual differences among children's visual attention to print suggested that children's pre-literacy knowledge had little association with their attention to print. By way of illustration, Child 5 knew all 26 letters of the alphabet and Child 4 knew only 7 letters of the alphabet. For both children, however, 7% of their fixations for *Spot* focused on print. We conducted correlational analyses between alphabet knowledge and the following variables: *Spot* print fixations ($r = 0.29$, $p = 0.42$), *Spot* time .in print ($r = 0.37$, $p = 0.29$), *Caterpillar* print fixations, ($r = 0.45$, $p = 0.19$)

and *Caterpillar* time in print, ($r = 0.44$, $p = 0.21$). As can be seen, none of these correlations were significant, suggesting that emergent literacy knowledge was not significantly associated with visual attention to print.

Discussion

Major findings of the present work were as follows. First, pre-school children spent little time attending to print when looking at a picture-salient storybook. A total of 2.7% of their fixations focused on print and 2.5% of their time was spent in regions of print. These findings left us to speculate, as did Yaden, Smolkin and MacGillivray, 'about the efficacy of this activity to generate substantial knowledge about written language symbols, despite assertions to the contrary' (1993, p. 64). Second, pre-school children fixated more frequently on print and spent more time looking at print when looking at a print-salient storybook relative to a picture-salient book. In the former context, about 7% of children's fixations focused on print and they spent nearly 6% of their time looking in print zones, compared to 2.7% and 2.5%, respectively, in the latter context. Third, little variation in visual attention to print was observed when studying individual differences across the ten children. Although both print attention variables for the two books could have ranged from 0 to 1.00, only in two instances did children's print attention extend beyond the lowest tenth percentile of this range. Correlational analyses investigating the relationship between children's alphabet knowledge and the print attention variables suggested that the emergent literacy skills of the children did not explain a meaningful level of variance in individual differences in print attention.

In sum, the pattern of results gives evidence that (a) pre-literate children spend little time attending to print during storybook reading, (b) their print attention increases when looking at a print-salient book, (c) children are generally similar in their visual preferences, and (d) emergent literacy skills have little influence on children's visual attention to print. This study replicated our previous findings from eye-gaze analyses (Justice & Lankford, 2002) and converge with those of Evans and Saint-Aubin (forthcoming), both finding that pre-school children overwhelmingly prefer looking at illustrations even when the children have well-developed emergent literacy knowledge and when the storybooks feature salient print characteristics. Research using eye-gaze analyses provide further support to observations of what children talk about when looking at storybooks, which has suggested they prefer discussing aspects of the illustrations than talking about print (e.g. Ezell & Justice, 2000; Yaden, Smolkin & MacGillivray, 1993). As Evans and Saint-Aubin note, the use of eye-gaze measurements provides yet another window through which to examine children's attention during shared storybook reading and to question prevailing theories concerning children's construction of knowledge about print within this important literacy context.

Current theories concerning the development of print awareness in pre-literate children are guided by emergent literacy and social constructivist perspectives (see Crawford, 1995). These perspectives view print awareness specifically and pre-literacy skills generally as developing through children's socially embedded mediated interactions with adults in meaningful literacy contexts. Importantly, within these interactions children are viewed as active 'meaning-making' participants and adults are viewed as dynamic facilitators of children's literacy engagement. Several studies of adult-child interactions within the literacy-rich storybook reading context have, however, raised questions about

this perspective, namely the extent to which children actively construct meaning about print and the extent to which adults actively facilitate children's engagement with print (e.g. Ezell & Justice, 2000; Justice & Ezell, 2000; Justice & Lankford, 2002; Phillips & McNaughton, 1990; Yaden, Smolkin & MacGillivray, 1993). These studies have suggested 4hat adults rarely include an explicit focus on print forms or functions within the shared-book reading context, and that children themselves rarely talk about print or look at print, even when reading storybooks in which print is a salient quality.

The present work converges with this body of empirical work by showing that pre-literate children rarely attend to print when looking at storybooks. The present findings also show that storybook stimuli are a potentially powerful force in eliciting children's attention to print. However, even when looking at print-salient books children's print attention was quite low, with less than 10% of the reading session involving print engagement by the child. The present findings substantiate Yaden, Smolkin and MacGillivray's observation that young children looking at storybooks are not interested in 'formal aspects of written letters and words, page formats and even the conventional procedures for reading a book (i.e. left-to-right sequence)' (1993, p. 44).

A number of correlational studies have consistently demonstrated moderate associations between the frequency of adult-child shared storybook reading and children's print awareness (for review, see Scarborough & Dobrich, 1994). For instance, Crain-Thoreson and Dale (1992) showed the frequency of parent-child storybook reading to explain about 8% of the variance in children's knowledge about print concepts, a moderate to large effect size in the social science disciplines. This well-documented effect provides support to emergent literacy and social interactionist theories that view children's pre-literacy skills as developing through their active engagement with print during mediated literacy-learning opportunities with adults. The present work shows, nonetheless, that the link between adult-child storybook reading and children's print awareness is not straightforward, as children are unlikely to attend to print of their own accord.

While adult use of print-referencing behaviours has been shown to be efficacious for increasing children's print awareness (Justice & Ezell, 2000, 2002), the *processes* inherent to this model - or the mechanisms by which adults scaffold children's internalisation of print knowledge - have yet to be studied. Likewise, researchers have yet to identify the factors that influence the extent to which adults use these print-referencing behaviours. Work by Bennett, Weige and Martin (2002) has suggested that adult beliefs about their role in literacy teaching may make an important contribution to how they interact with children during book-reading interactions, influencing whether this time is used to teach children explicitly about print forms and functions. Thus, it is not the storybook reading interaction *per se* that facilitates children's print awareness, but rather the adult behaviours during those interactions that manifest from their beliefs concerning their role in pre-literacy development.

The current findings have several useful implications for educators. First, findings show that young children - albeit those with considerable pre-literacy knowledge - are unlikely to attend to print when looking at storybooks. This finding suggests the need for adults deliberately and actively to encourage children's engagement with print when an awareness of print forms and functions is an educational goal. Educators (teachers and parents) are thus encouraged to use interactive techniques that explicitly focus children's attention on print forms and functions. Several evidence-based techniques include asking questions about print, commenting about print, tracking the print when reading and

pointing to print (Justice & Ezell, 2000, 2002). Educators should provide ample interactive supports to guide children's engagement with print, as the acquisition of pre-literacy is a lengthy and gradual process that involves many abstract concepts. Second, findings also show that print-salient storybooks summon children's visual attention to print at significantly greater rates than picture-salient storybooks. While many picture-salient storybooks may be useful for supporting children's linguistic achievements, these may not be particularly useful for facilitating print awareness. Smolkin, Conlon and Yade (1988) provided a useful description of five aspects of print-salient storybooks: (a) print included as part of an illustration (e.g. speech balloons, labels); (b) print displaying a change of type (e.g. changes of colour, size, style, orientation); (c) print in which the text itself forms a pattern (e.g. print arranged in a circle); (d) print where words are presented three dimensionally; and (e) print where letters appear in isolation (as in alphabet books). Educators are encouraged to use storybooks with these characteristics to encourage children's print awareness. Yaden, Smolkin and MacGillivray (1993) have also written on the importance of alphabet books for facilitating children's engagement with print; however, these researchers note that alphabet books constrain the discourse of adult-child storybook reading interactions, and thus should be used in combination with a wide variety of other genres.

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Note

1. Note that the actual reading sessions themselves were longer; the numbers here represent the actual time children's visual attention was focused on the book pages, thus eliminating periods when pages were turning or children were looking away from the pages of the book.

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