Preschool Children's Visual Attention to Print During Storybook Reading:

Pilot Findings

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Storybook reading is often credited as an important context in which children attend to and interact with print, thereby facilitating their acquisition of key emergent literacy concepts. To test the assumption that children visually attend to print in this context, this study used eye-gaze analysis to determine the extent to which four preschool children looked at print when being read two storybooks. Results showed that the children rarely attended to print; that is, they seldom fixated on print and infrequently entered "print zones" (areas on storybook pages containing print). There was, however, significant variation in children's visual attention to print when comparing the two books studied, with children attending to and fixating on print at higher rates with the storybook containing more salient print. Theoretical and practical implications of these findings, as well as future research directions, are discussed.

Children's emergent literacy knowledge is currently viewed as the first stage of reading development and the cornerstone of literacy achievement (Goodman, 1986; Snow, Burns, & Griffin, 1998; Whitehurst & Lonigan, 1998). Emergent literacy generally describes young children's knowledge concerning the forms and functions of print and the relationship between oral and written language (Teale & Sulzby, 1986). This knowledge is acquired by most children during the preschool years, prior to formal literacy instruction.

Justice and Ezell (2001) recently described emergent literacy as comprising two broad yet highly interrelated domains of knowledge: *written language awareness* and *phonological awareness.* Written language awareness, also referred to as *print awareness* or *print concepts* (Snow et al., 1998), describes children's knowledge of the forms and functions of printed language (e.g., distinctive features of alphabet letters, storybook conventions, environmental print). Phonological awareness refers to knowledge about the structure of spoken language (e.g., sound similarities among words sharing initial phonemes or rimes). Young children's performance on measures representing components for each of these broad domains has been found to be moderately to highly predictive of future reading achievement, suggesting that both are important elements of emergent literacy development (for a review, see Scarborough, 1998).

There currently exists a remarkable research base concerning preschool children's developments within the domain of phonological awareness (Bradley & Bryant, 1983; Byrne & Fielding-Barnsley, 1995; Chaney, 1992; Fernandez-Fein & Baker, 1997; Fowler, 1991; Lonigan, Burgess, Anthony, & Barker, 1998; Treiman & Zukowski, 1991; Vandervelden & Siegel, 1995; Warren-Leubecker & Carter, 1988). In contrast, considerably less is known regarding the development of written language awareness, that is, children's attainment of knowledge about the forms and functions of print.

Generally speaking, most scholars presently believe that preschool children acquire written language awareness through informal and naturalistic interactions with print during supportive, mediated opportunities (see Crawford, 1995). Adult–child shared storybook reading in particular is viewed by many researchers as one of the most potent and frequent contexts for development (Bus, 2001; Ezell & Justice, 2000; Goodman, 1986; Hayden & Fagan, 1987; Justice & Ezell, 2000; Kaderavek & Sulzby, 1998; Mason, 1980; Teale, 1986; Watkins & Bunce, 1996; Whitehurst et al., 1994; Whitehurst & Lonigan, 1998). Although the actual extent to which parent–child shared storybook reading actually supports and accelerates preschoolers' development of written language awareness has on occasion been debated (see Lonigan, 1994; Scarborough & Do brich, 1994), many emergent literacy scholars and practitioners agree that storybook reading is an important vehicle through which children attain emergent literacy knowledge. To this end, educators, parents, and other specialists (e.g., speech–language pathologists) have often been encouraged to increase the frequency with which young children in their care participate in quality shared book-reading interactions (American

Speech-Language-Hearing Association, 2001; Snow et al., 1998).

STORYBOOK READING AND WRITTEN LANGUAGE AWARENESS

Shared book reading is viewed as particularly powerful for emergent literacy development because it is a context that is meaningful, interesting, and motivating to the preschool child (Watkins & Bunce, 1996). Hypothetically, children's written language awareness is advanced within such interactions as a function of both adult and child behaviors and responsibilities (Justice & Ezell, 1999). That is, within the context of these mediated interactions with print, the adult encourages and scaffolds the child's interactions with and knowledge about written language, whereas the child, an active learner, extracts meaning and constructs knowledge about written language forms and functions (Bus, 2001; Crawford, 1995; Watkins & Bunce, 1996). Repeated engagement in such dynamic interchanges results in the successful transmission of literacy knowledge from adult to child. Support for this perspective has been obtained through studies indicating that children reared or educated in print-rich environments, in which they are provided ample opportunities to interact with print (e.g., frequent adult–child storybook reading), have more sophisticated written language awareness as compared to children with fewer print-based interactions (Bus & van IJzendoorn, 1999; Dickinson & Tabors, 1991; Purcell-Gates, 1996; Senechal, LeFevre, Thomas, & Daley, 1998; N. E. Taylor, Blum, & Logsdon, 1986). Additional support, albeit even more indirect, has been provided by intervention studies showing that children's written language awareness is promoted through participation in shared book reading employing an explicit print (Justice & Ezell, 2000, 2002) or enhanced language focus (Whitehurst et al., 1994, 1999).

Nevertheless, it is important to note that current understanding of the adult–child transmission of knowledge about written language, particularly with respect to the shared book reading context, is incomplete. Indeed, like many current emergent literacy theories, present understanding regarding such transmission is derived from a series of assumptions (Crawford, 1995). The first concerns the adult's role in encouraging and scaffolding children's knowledge, whereas the second concerns the child's extraction of meaning and construction of knowledge about written language. With respect to the first, this assumption asserts that the adult implicitly and/or explicitly encourages and scaffolds the child's interactions with written language, thereby paving the way for the child's internalization of knowledge. Recent studies of adult–child shared storybook reading have found little or no evidence of scaffolding on the adults' part for promoting preschool children's interactions with print or their development of written language concepts, however. Justice and Ezell (2000), for instance, coded 24 parents' nonverbal and verbal references to print (e.g., pointing to and commenting about print) when reading storybooks with their 4-year-old children. Parental references to print were remarkably infrequent, and this pattern of rare occurrence was found to be stable over time (i.e., a 4-week period). These recent findings of a low incidence of parental print-focussed scaffolding during shared book reading confirmed previous suggestions of this theory (Ezell & Justice, 1998; Phillips & McNaughton, 1990; van Kleeck, 1998).

The second assumption concerns the child's extraction of meaning and construction of knowledge concerning the nature of written language within the adult–child storybook reading context. The assumption is that in this highly familiar, motivating, and interesting context, children interact with print, either on their own accord as active literacy learners or via adult scaffolding (or a combination of both). Over time, these interactions with print result in increased familiarity with and knowledge about the forms and functions of written language. Nevertheless, recent studies have provided little evidence to support the perspective that preschool children interact with print within the shared book-reading context, particularly with respect to their verbal participation. Ezell and Justice (2000) found that preschool children rarely talked about print when reading storybooks with adults, even when print was a salient feature of the storybook. These researchers also found that children's verbal attention to print is highly contingent upon adults' attention to print (Ezell & Justice, 2000; Justice, Weber, Ezell, & Bakeman, 2002), such that children reading books with adults who do not reference print rarely initiate their own verbalizations about print. Given that print is a visual medium, however, it may be that preschool children reading books with adults interact with print on a visual rather than verbal basis; indeed, visual attention to print may provide the means by which children extract, internalize, and construct knowledge about written language within this literacy event. The power of shared storybook reading to promote children's written language awareness may thus be derived, at least in part, from visual attention toward print on the part of the child.

To summarize and set the stage for our description of the present study, we note two assumptions that were identified concerning the nature of emergent literacy development, and particularly written language awareness, within the context of adult–child shared storybook reading:

> **Assumption 1.** Adults reading with young children encourage and scaffold children's interactions with written language.
>
> **Assumption 2.** Children actively construct knowledge about print forms and functions during the book-reading context.

With respect to the first, little evidence exists to prove that adults reading with young children scaffold children's interactions with print (e.g., Justice & Ezell, 2000). In fact, adults reading with young children have been found to offer little explicit or implicit guidance to children concerning print's forms and

functions. With respect to the second assumption, there is presently little evidence showing that children on their own accord actively engage with print during storybook reading, at least verbally (Ezell & Justice, 2000). Nonetheless, it is possible that children extract meaning and construct knowledge about written language during book reading by visually engaging with print.

GOALS OF THE PRESENT STUDY

Objectives

To begin to explore the possibility that children extract meaning about print by visually attending to print during storybook reading, we undertook a pilot study involving eye-gaze analysis to characterize preschool children's visual attention to print when looking at storybooks. The goal was to inform current hypotheses concerning children's attainment of written language awareness within the context of adult–child storybook reading. First, we studied children's eye movements during the reading of two storybooks to calculate the frequency with which children entered regions of print and fixated on print, as well as the amount of time spent looking at print versus pictures and other page matter. Second, we also compared children's visual attention to print across two storybooks, which varied substantially in terms of quality and quantity of print. Comparisons were made to explore the association between specific storybook characteristics, such as size and type of print, and the extent to which children visually attended to print. Third, we examined individual differences in visual attention to print by comparing eye-gaze patterns across four children.

Eye-Gaze Methodology

The use of eye-gaze analyses has featured prominently in a number of empirical investigations of individuals' visual processing of print and other stimuli. Indeed, psycholinguists have long argued the validity of eye-movement measures as a means for studying online cognitive processes in linguistic tasks, such as reading (Just & Carpenter, 1980; McConkie, 1997; Pollatsek & Rayner, 1982; Rayner, 1977, 1978, 1979). In a seminal work, Rayner (1977) demonstrated that visual attention as measured through eye movement patterns provides a valid and reliable online measure of cognitive processing. Given the inherent difficulties in devising tasks that validly and reliably reflect cognitive processing, the study of eye gaze has become a prevalent methodology for many language researchers across the social science disciplines (e.g., Krappmann, 1995; McConkie, 1997).

Perhaps the most well-known application of eye-gaze analysis has occurred with respect to research on reading development and disabilities (e.g., Pavlidis, 1983; Rayner, 1985). Participants in these studies have predominantly been adolescents or young adults; however, several researchers have examined eye-gaze patterns in younger children. In an early study, for instance, S. E. Taylor (1965) used an eye-reading camera to record eye movements during picture viewing by kindergarten children. Taylor found that most kindergarteners demonstrated left-to-right directionality patterns in their visual fixations. Nodine and colleagues also conducted several important studies of visual processing patterns in kindergarteners (Nodine & Lang, 1971; Nodine & Simmons, 1974). These researchers evaluated eye movements to determine several important qualitative differences in visual processing of print between prereaders and advanced readers.

The extant literature therefore has suggested the potential viability of using eye-gaze analysis as a means for characterizing emergent literacy in young children. In other words, eye movements directly and explicitly represent an individual's visual and cognitive processing of information (e.g., Krappmann, 1995; Rayner, 1977), and measures of eye movements provide a reliable, valid, and on-line means for studying visual processing (Pavlidis, 1983; Spillane, Ross, & Vasa, 1996). To this end, eye-gaze analysis presents a potentially appealing means for characterizing children's early interactions with written language and their emergent literacy achievements.

METHOD

Participants

Four typically developing preschool children (two boys and two girls) participated in this study. The children were recruited through flyers dispersed at local daycare centers and preschool programs. To qualify for participation, children were required to meet the following criteria:

1. pass a bilateral audiological screening at 25 or 30dB (depending on level of ambient noise during screening) for 500, 1000, 2000, and 4000 Hz;
2. pass a binocular near-field (40 cm) vision screening (the *Massachusetts Visual Acuity Test,* Mayer & Moore, n. d.) at 20/50 or greater;
3. receive a passing score (i.e., -1 *SD* below the mean or higher) on two language ability subtests from the *Clinical Evaluation of Language Fundamentals–Preschool* (CELF-P; Wiig, Secord, & Semel, 1992), specifically, Linguistic Concepts and Recalling Sentences in Context;
4. receive a passing score (i.e., 25% correct or higher) on three subtests—rhyme awareness, beginning sound knowledge, and alphabet knowledge—from the *Phonological Awareness Literacy Screening–PreKindergarten* (PALS-PreK; Invernizzi, Sullivan, & Meier, 2001);
5. be native English speakers; and
6. have no history of neurological, gross-motor, hearing, or vision problems (confirmed through a parent questionnaire).

TABLE 1. Characteristics of Child Participants

Characteristic	Child A	Child B	Child C	Child D
Age (in months)	54	58	68	52
Linguistic Concepts	12	11	13	11
Recalling Sentences in Context	15	14	12	11
Rhyme Awareness (%)	100	60	90	30
Beginning Sound Knowledge (%)	100	90	90	80
Alphabet Knowledge (%)	76	76	85	26

Note. Scores for Linguistic Concepts and Recalling Sentences in Context, subtests of the *Clinical Evaluation of Language Fundamentals–Preschool* (Wiig et al., 1992), are standard scores, based on a mean of 10 and a standard deviation of 3. Scores for Rhyme Awareness and Beginning Sound Knowledge, subtests of the *Phonological Awareness Literacy Screening–Pre-Kindergarten* (PALS-PreK; Invernizzi et al., 2001), are percentages, based on the number correct out of 10 tasks. Scores for Alphabet Knowledge, also from PALS-PreK, are percentages based on the number correct for naming the 26 uppercase alphabet letters.

Table 1 provides an overview of participant characteristics. The children ranged in age from 52 to 68 months, with a mean age of 58 months (*SD* = 7 months). Each child performed above the mean on two subtests (one receptive, one expressive) of a standardized language assessment, the CELF-P. These two subtests together make up the "Quick Test" version of the CELF-P, which can serve as a preliminary step in language assessment to determine if further testing is warranted (see Wiig et al., 1992). Use of the Quick Test was viewed as appropriate for the present purposes, given that we wanted to screen children's oral language performance. In addition, the children were screened for emergent literacy skills using three subtests of an emergent literacy battery (the PALS-PreK). As a group, the children possessed fairly sophisticated emergent literacy skills; that is, they matched words on the basis of rhyme with a mean rate of 70% accuracy (*SD* = 31.6), matched words on the basis of beginning sounds with a mean rate of 90% accuracy (*SD* = 8.2), and named, on average, 66% (*SD* = 25.8) of the 26 uppercase alphabet letters. The children were all Caucasian and resided in middle-class two-parent households. All of the children's parents had a high school diploma, and the majority of the parents (88%) had attended college.

Materials

Eye-Gaze Recording and Analysis. Children's eye movements were studied using the Eye-gaze Response Interface Computer Aid (ERICA), which works in the following manner. First, an infrared light-emitting diode (LED) is emitted and directed to the eyes of the participant. Second, two features of the eye are recorded by a camera when the infrared light strikes the eye: the glint, a reflection of the LED off the cornea, and the bright eye, the absorption and remission of the LED by the retina. Third, ERICA locates and discriminates these two features at a sampling rate of 60 Hz, which thus permits the system to track where an individual is looking. Data generated by ERICA are stored on a peripheral computer's hard drive, in this case, a Dell Dimension XPS T500. Gazetracker software (ERICA, Inc., 2001) was used for stimulus presentation and eye-gaze analysis.

Storybooks. Two children's books were used, *The Very Hungry Caterpillar* (Carle, 1986) and *Spot Bakes a Cake* (Hill, 1994). (Hereafter, these books will be referred to as *Caterpillar* and *Spot*, respectively.) The two books were selected on the basis of several shared characteristics as well as several dissimilarities. With respect to similarities, both books represent popular storybook selections of preschool children. They currently are in print and are readily available in most bookstores and many classrooms. Each book is dominated by colorful illustrations and a fairly simple storyline. The first author's research and clinical experiences have suggested that both books are consistently appealing to preschool children.

The books are also dissimilar in three important ways with regard specifically to print quantity and quality. First, the amount of narrative print per page differed substantially across the two books, with *Caterpillar* averaging 19 words per page (*SD* = 11.3, range = 5–41) and *Spot* averaging 7 words per page (*SD* = 2.4, range = 3–11). Second, the size of the narrative print also differed, with *Caterpillar's* text approximately .12 inches and *Spot's* text approximately .75 inches. Third, an additional difference across the two books was the occurrence of contextualized print, that is, print embedded within the illustrations. *Caterpillar* had no occurrences of this, whereas *Spot* had 10. Based on these differences, *Spot* was viewed as containing salient print features (i.e., few words per page, large narrative print, print embedded within the pictures), in contrast to *Caterpillar*, which in all manners contained less salient print features.

For the present purposes, the entire version of each book was scanned in full color on a page-by-page basis into a com-

puter hard drive. Each page was saved as an image file using Gazetracker software. For stimulus presentation, each book was displayed on a page-by-page (i.e., slide-by-slide) basis on a 21-inch computer monitor (1280 by 1024 resolution).

General Procedures

Eligibility sessions, which were 45 minutes in length, took place in the Speech-Language-Hearing Center on a university campus. The children were individually administered the eligibility protocol (i.e., hearing, vision, language, and literacy testing) by a certified speech–language pathologist or a trained, supervised graduate assistant. After eligibility was established, an individual data collection session was scheduled for each child. For two children, data collection sessions immediately followed the eligibility session; for the other two children, the data collection followed eligibility by approximately 1 week.

Eye-gaze measures were collected in a single 20-minute data collection session in a private laboratory on the university campus. First, children were placed in a large leather chair facing a computer monitor, with their heads stabilized by resting fully against the back cushion of the chair. The children's hands were placed in their laps or to their sides. Two children chose to sit on their mothers' laps for the duration of the session; the other two children sat independently. They were told that they were going to look at two storybooks on the computer and they would need to sit very still. Second, calibration of the eye-gaze equipment was conducted by asking the children to stare directly at the computer screen and to look at each in a series of six sequential icons (i.e., "smiley" faces) that would appear. Calibration lasted appropriately 10 seconds and was successful with only one trial for all children. Third, the children were read the two computerized storybooks by an adult reader (the first author), with order of presentation counterbalanced across the four children and without a break between the two books. Approximate viewing time for the two books was 7 minutes. For each book, the adult reader changed pages (i.e., slides) using a computer mouse and read the text on each page verbatim. Following the reading of the text, the author waited for 3 seconds before turning to the next page. During this storybook reading, the reader made no extraneous comments except for feedback and prompts on an as-needed basis regarding children's attention, posture, or eye-gaze. The adult responded succinctly to extraneous comments by the child and then redirected him or her back to the storybook.

None of the children displayed any discomfort with any of the data collection activities. In fact, all four children seemed to enjoy the viewing sessions. At the end of the data collection, the children's eye-gaze patterns for the two storybooks were shown to the children and their parents, after which the children were given a set of storybooks as a gift for participating.

Eye-Gaze Measures

On each page of each storybook, regions of interest (print zones) were demarcated using the Gazetracker software. In short, a boundary was drawn around each area of print occurring in the book, with an approximate 1.5 cm space between the print and the boundary. Demarcation of print zones allowed for differentiation of regions of print from the rest of a page's visual matter (illustrations and white space). Thirteen print zones were created for *Caterpillar*, and 23 print zones were created for *Spot*. The two books were identical with respect to print zones bounding narrative print; that is, all of *Caterpillar's* and 13 of *Spot's* print zones were composed of narrative text. Ten additional print zones in *Spot* bounded contextualized print embedded within the illustrations. These latter instances included, for instance, print on a calendar, a birthday card, a sign in a grocery store, and a grocery list.

The children's visual attention to print was characterized by determining the number of times the children's eye-gazes entered and fixated in the print zones and by calculating the amount of time spent in print zones. The following ERICA-generated indices were of particular interest:

1. *Entrance into a print zone:* The child's eye-gaze enters a print zone. A print zone entrance occurs as a function of a saccade. A saccade reflects a shift in visual attention (i.e., an eye movement), which in this case enters a print zone. Saccades precede and follow fixations.
2. *Fixation in a print zone:* The child's eye-gaze fixates in a print zone. A fixation represents the processing of information (Rayner, 1985). A fixation was coded for gaze durations of 50 ms or longer.
3. *Time in a print zone:* The total amount of time the child's eye-gaze spends in a print zone, encompassing both saccades and fixations.

RESULTS

The data were analyzed descriptively and, in some cases, comparatively to examine children's visual attention to print during storybook reading in general and to compare visual attention across the two storybooks. Results are presented in the following order: (a) description of general patterns observed when considering both storybooks together, (b) comparison of patterns across the two storybooks, and (c) examination of individual differences. Descriptive indices for print zone entrances, fixations, and duration are presented in Table 2.

General Patterns in Visual Attention to Print

Print Zone Entrances. A total of 36 print zones occurred in the two storybooks studied, with 26 representing narrative text (13 *Caterpillar*, 13 *Spot*), and 10 representing contextualized print (all *Spot*). Combining raw frequencies across all four children for both books together, 37 print zones were entered out of 144 possible total entrances (i.e., 36 per child). The children averaged nearly 5 print zone entrances per book ($M = 4.6$, $SD = 1.5$, range = 2–7).

TABLE 2. Means (and Standard Deviations) for Eye-Gaze Indices

Indice	Comb.	*Caterpillar*	*Spot*
Print zone entrances	4.6 (1.5)	3.5 (1.0)	5.8 (1.3)
Print zone fixations (4.2)	7.9 (6.9)	2.3 (3.2)	13.5
Print zone duration (sec)	2.1 (1.6)	0.8 (1.0)	3.4 (0.7)

Note. Comb. = Combined—Data are combined and then averaged for both books; *Caterpillar* = *The Hungry Caterpillar* (Carle, 1986); *Spot* = *Spot Bakes a Cake* (Hill, 1994). Total print zones available for *Caterpillar* and *Spot* are 13 and 23, respectively.

Print Zone Fixations. Characterizing children's fixations in print zones offers the most enlightening glimpse of the extent to which children may acquire knowledge about print when looking at storybooks. Fixations reflect information processing (Rayner, 1985); thus, print zone fixations presumably reflect processing of written language features and functions. Considering both storybooks together, children averaged nearly 8 fixations per book in the print zones (SD = 6.9, range = 0–18). This figure is most revealing, however, when compared with the total number of fixations per storybook, which averaged 218 (SD = 18.8, range = 193–243). Fixations in print zones made up approximately 4% of all fixations per book.

Time Spent in Print Zones. Considering both books together, children averaged 2.1 seconds (SD = 1.6, range = .18–4.1) in print zones per storybook. The average time for eye-gaze analysis for each book was 83.3 seconds; time in print zones thus accounted for, on average, 2.5% of visual attention per storybook reading.

Comparison of Visual Attention Across the Two Books

Print Zone Entrances. When comparing print zone entrances across the two books (see Table 2), children entered, on average, 3.5 of *Caterpillar*'s 13 print zones (SD = 1, range = 2–4) and 5.8 of *Spot's* 23 print zones (SD = 1.3, range = 4–7). In other words, the children entered 26% of *Caterpillar's* print zones and 25% of *Spot's* print zones, indicating that they entered the same percentage of print zones when comparing the two books.

Looking specifically at print zone entrances for *Spot*, in order to compare entrances for narrative versus contextualized print, we found that entrances occurred more often for the latter: Of the 22 total print zone entrances that occurred for *Spot* (averaging 5.8 per child), 19 (85%) represented contextualized print.

Print Zone Fixations. Children fixated an average of 2.3 times within *Caterpillar's* print zones (SD = 3.2, range = 0–7), and an average of 13.5 times in *Spot*'s print zones (SD = 4.2, range = 8–18). For *Caterpillar*, children's total fixations averaged 228 (SD = 15.8, range = 208–243). Fixations in print zones thus represented 1% of all fixations (see Table 3). Children's total fixations for *Spot* averaged 208 (SD = 17.6, range = 193–229); fixations on print thus represented 6% of total fixations. The percentage of fixations occurring in print zones when comparing the two books was significantly different, based on a paired samples t test, $t(3) = 4.84$, $p = .017$. For a visual depiction of this contrast, see Figure 1.

For *Spot* specifically we also examined the number of fixations in print zones representing narrative versus contextualized print. *Spot's* print zones, as has been noted, consisted of 13 instances of narrative print and 10 instances of contexualized

TABLE 3. Comparison of Visual Attention to Print with Other Page Matter

Measure	Print zones	All zones	% Print focus
Fixations (avg.)			
Combined	7.9	218	3.6
Caterpillar	2.3	228	1.0
Spot	13.5	208	5.5
Zone durations (avg., in sec)			
Combined	2.1	83.3	2.5
Caterpillar	0.8	105.6	0.7
Spot	3.4	61.0	5.6

Note. Combined = Averages (and standard deviations) when combining both books; *Caterpillar* = *The Hungry Caterpillar* (Carle, 1986); *Spot* = *Spot Bakes a Cake* (Hill, 1994).

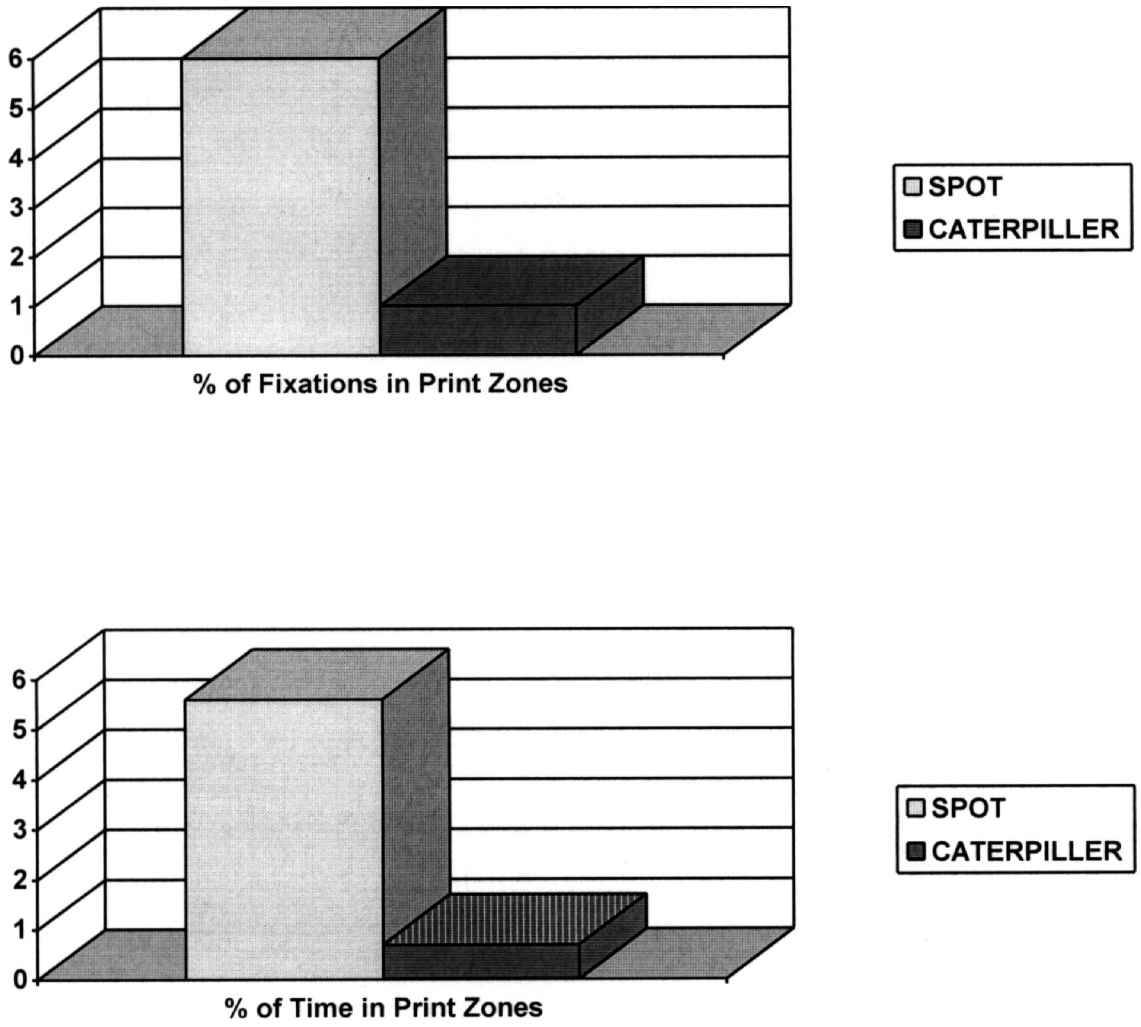

FIGURE 1. Visual comparison of percentage of print zone fixations and percentage of time spent in print zones for *Spot* (*Spot Bakes a Cake;* Hill, 1994) versus *Caterpillar* (*The Hungry Caterpillar;* Carle, 1986).

print. Ninety-three percent of the children's fixations, on average, were in contextualized print zones, whereas 7% were in narrative print zones. A paired samples *t* test indicated a significant difference in percentage of fixations for the two zone types, $t(3) = 8.98$, $p = .003$; the children fixated more often on contextualized print compared to narrative print when reading *Spot*.

Time Spent in Print Zones. The children spent an average of 0.8 seconds (*SD* = 1, range = .18–2.25) in *Caterpillar's* print zones, and 3.4 seconds (*SD* = .7, range = 2.35–4.1) in *Spot's* print zones. Time spent visually attending during storybook reading averaged 105.6 seconds for *Caterpillar* (*SD* = 12.1, range = 93.4–121.7); thus, time spent attending to print was 0.7% of total visual attention. For *Spot*, the children averaged 61 seconds visually engaged (*SD* = 32.5, range = 15.6–85.8), with 3.4 seconds occurring within the print zones; time spent attending to print thus was 5.6% of total visual attention (see Figure 1). A comparison of the percentage of time spent in print zones across the two books (paired samples *t* test) was significant, $t(3) = 7.28$, $p = .005$, with the children spending more time attending to print for *Spot* as compared to *Caterpillar*.

Considering Individual Differences in Visual Attention

Eye-movement analyses of skilled readers have indicated substantial variability across individuals (see Rayner, 1985). The small sample size of the present study readily permitted comparisons across the individual children to determine the level of variability in the dependent indices. Table 4 provides descrip-

tive indices for individual children's print zone entrances, print zone fixations, and time spent in print zones across the two storybooks. Consideration of these data suggests little variation overall across the four children for any of the three variables of interest. Specifically, for each variable, three of the four children (75%) performed similarly, with the following trends noted on the basis of these performance groupings. For *Caterpillar*, the majority of the children entered 4 of 13 print zones, fixated never or once within the print zones, and overall spent less than 0.5 second engaged with print. For *Spot*, the majority of children entered about 6 of 23 print zones, fixated approximately 15 times within the print zones, and spent about 3.5 seconds engaged with print. It does warrant mention, however, that Child B was consistently higher than the other three on several indices, despite appearing to be similar to the other participants in emergent literacy knowledge.

DISCUSSION

Summary of Key Findings

Preschool children were found to attend infrequently to print when looking at storybooks. The children's fixations in regions of print accounted for, on average, only 4% of total fixations per storybook reading, with time spent in print zones accounting for only 2.5% of total visual attention. These patterns appeared relatively uniform across the four children studied. Differences were noted, however, when comparing visual attention to print across the two storybooks studied, which varied considerably in print quantity and quality. Although the children entered the same percentage of print zones across the two books, they fixated on print less frequently and spent less time in print zones when reading a storybook with less salient print (i.e., more words per page, smaller print) as compared to a storybook with more salient print (i.e., fewer words per page, larger print, contextualized print embedded within illustrations). Nevertheless, even in the latter context, fixations on print represented only about 6% of total fixations, and time spent attending to print accounted for little more than 5% of total visual attention.

It is important to note that the study reported herein was a pilot work involving few participants; our findings should thus be viewed as strictly preliminary and warranting further investigation. Nevertheless, these findings are of interest, given the current status of knowledge concerning young children's development of written language awareness, one of the two primary emergent literacy domains (Justice & Ezell, 2001). Presently, it is generally believed that children attain written language awareness during informal, mediated interactions with print. Shared storybook reading has often been credited as a particularly important context within which such knowledge is acquired (e.g., Bus, 2001; Ezell & Justice, 2000; Lonigan, 1994; Snow et al., 1998; Teale, 1986; Whitehurst et al., 1994). Within this context, and under the guidance of their adult reading partners, children presumably interact with and attend to print to extract meaning and construct knowledge concerning the forms and function of written language.

Results of the present work, in conjunction with the results of several other recent studies (e.g., Ezell & Justice, 1998, 2000; Justice et al., 2002), challenge current assumptions concerning the way in which preschool children extract meaning about written language within the storybook reading context, and they raise questions about the extent to which children's participation in this activity contributes to growth in written language awareness. These studies have shown that (a) adults reading to young children seldom make verbal or nonverbal

TABLE 4. Individual Differences in Visual Attention to Print

	Child			
Measure	**A**	**B**	**C**	**D**
Print zone entrances				
Caterpillar	14	4	4	2
Spot	6	6	4	7
Print zone fixations				
Caterpillar	0	7	1	1
Spot	13	15	8	18
Time in print zones (sec)				
Caterpillar	0.21	2.25	0.45	0.18
Spot	2.35	4.10	3.60	3.46

Note. Caterpillar = The Hungry Caterpillar (Carle, 1986); *Spot = Spot Bakes a Cake* (Hill, 1994).

references to print (Ezell & Justice, 1998, 2000; Justice & Ezell, 2000; van Kleeck, 1998), and (b) children themselves rarely talk about print within this context (Ezell & Justice, 2000). The present findings, which suggest that preschoolers rarely look at print when being read storybooks, converges with such findings and asserts the need for future research to clarify the nature by which young children extract knowledge about print from the storybook reading context.

Clinical Suggestions

Although the results of the present study call into question contemporary perspectives concerning children's attainment of written language awareness, they offer some preliminary guidance with respect to practical applications. Shared storybook reading has been found to provide a particularly useful and robust context within which to promote at-risk preschoolers' emergent literacy knowledge (Box & Aldridge, 1993; Justice & Ezell, 2002; Lonigan, Anthony, Bloomfield, Dyer, & Samwel, 1999; Whitehurst et al., 1994, 1999). A key strategy for using shared book reading for this purpose is by encouraging an explicit yet balanced emphasis on print concepts (Snow et al., 1998), for example, by talking about print and by pointing to print. Participation in reading sessions incorporating a print focus has been found to accelerate written language awareness in both typically developing and at-risk preschoolers (Justice & Ezell, 2000, 2002).

The present findings suggest the possibility of promoting a print focus and thereby enhancing emergent literacy development through the use of storybooks containing salient print features. Children attended to print significantly more often when being read a storybook with large narrative print, relatively few words per page, and multiple instances of print embedded within the illustrations, as compared to the reading of a book with less salient print features. In the former context, print fixations composed 6% of all fixations, whereas in the latter context, print fixations represented only 1% of fixations. Rayner (1985) has argued that fixations, more than any other eye-movement index, represent the entrance of "new information into the processing system" (p. 53). Hypothetically, it could thus be argued that fixations in print zones directly correspond to children's processing of information concerning written language forms and functions. The current findings suggest, at least preliminarily, that the print features of a storybook may mediate preschool children's visual attention to print and that the use of print-salient books may be helpful for encouraging children's written language awareness.

Limitations and Future Directions

Several limitations should be noted. First, and most important, the shared storybook-reading sessions in which the children participated differed in several significant ways from more naturalistic contexts. Methodological impositions included the use of computer-presented storybooks, physical restrictions (e.g., the children were instructed to sit very still), and a verbal script in which the adult read the story without departing from the text. The extent to which the present findings can be readily generalized to account for children's eye-gaze patterns and visual attention to print in more natural interactions is not clear. Second, data were collected via analysis of a single shared-reading session using two storybooks that had many similarities (e.g., simple storyline, salient illustrations). The findings may not represent how children's visual attention to print might change over time, across various storybook genres, or with different adult readers, such as their parents. A third limitation involves our participants: not only was the sample small in size, it also was a relatively homogenous group of children in terms of socioeconomic status, literacy, language skills, and so forth. Generalizations of these results to children varying from this small cohort therefore should be made with caution.

Consideration of the present findings, as well as these limitations, suggests several important avenues for further research in this area. First, an examination of children's visual attention to print in more diverse and naturalistic environments is warranted, including the use of parents as reading partners and the employment of a variety of reading materials (e.g., children's favorite storybooks, books of different genres). The extent to which eye-gaze methodology may be used reliably with real books, rather than computerized depictions, should also be explored. Second, replication of the findings with a larger and more diverse sample is required. Of particular interest is determining the extent to which eye-gaze patterns may differ as a function of a child's emergent literacy knowledge and experiences. Third, examination of children's eye-gaze patterns with the inclusion of parental verbal and nonverbal print-referencing prompts, such as questions and comments about print, may indicate the extent to which parental scaffolds serve to promote children's visual interactions with print. This latter avenue of research may be particularly useful for designing interventions using adult–child shared storybook reading as a means for encouraging children's written language awareness.

In sum, although the results of this study appear to raise more questions than they provide answers, they unequivocally affirm the need to enhance both theoretical and practical understanding of the ways in which children acquire written language awareness, particularly within the context of adult–child shared storybook reading. Storybook reading has long been viewed as an exceptionally powerful context in which young children gain such awareness; for this reason, many practitioners use shared book reading as a means for skill development. How and to what extent children extract and attain emergent literacy knowledge within this context is not yet understood, however. Given that clinical practices should be derived from accurate representations of how children acquire literacy, future research employing a variety of methodologies clearly is warranted. Convergent findings from a variety of data sources will provide the means for proposing more accurate, research-based models of emergent literacy development and intervention.

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