The Role of Inadequate Print Exposure as a Determinant of Reading Comprehension Problems

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In the literature of cognitive developmental psychology, reading comprehension problems are typically analyzed in terms of cognitive processes operating in a suboptimal manner. In this chapter, we argue that cognitive developmental work on reading comprehension problems might benefit from searching for explanations at a more distal level than has been typical in our literature.

Researchers studying the cognitive psychology of reading comprehension have attempted to specify individual differences in the cognitive processes that support efficient reading performance (Carr & Levy, 1990; Daneman, 1991; Just & Carpenter, 1987; Perfetti, 1985; Rayner & Pollatsek, 1989; Stanovich & Cunningham, 1991). A popular research strategy has been the cognitive correlates approach (see Pellegrino & Glaser, 1979; Sternberg, 1990) in which investigators attempt to determine whether individual differences in particular cognitive processes or knowledge bases can serve as predictors of reading comprehension ability (e.g., Jackson & McClelland, 1979). The causal model implicit in such analyses locates individual differences in the cognitive subprocesses that determine comprehension ability.

In cognitive psychology, very little attention has been focused on what might be termed a form of reciprocal causation, or the possibility that individual differences in exposure to print (a side effect of differences in comprehension ability) affect both the development of cognitive processes and the declarative knowledge bases supportive of further gains in comprehension growth.

In contrast to cognitive psychologists, anthropologists and other social scientists have for decades been intensely preoccupied with speculations on how the exercise of literacy affects knowledge acquisition, belief systems, cognitive processes, and reasoning. Outside of psychology, the literature on the cognitive consequences of literacy is large and steadily growing (Akinnaso, 1981; Goody, 1977, 1987; Graff, 1986, 1987; Havelock, 1963, 1980; Kaestle, 1991; Olson, 1977, 1994; Ong, 1967, 1982; Stock, 1983).

It is not at all clear why the division of labor between cognitive psychologists and other social scientists in the domain of literacy developed in such an extreme fashion. Reading is a very special type of interface with the environment, providing unique opportunities to acquire declarative knowledge. Furthermore, the processing mechanisms exercised during reading receive an unusual amount of practice. For the avid reader, whatever cognitive processes are engaged over word or word-group units (phonological coding, semantic activation, parsing, induction of new vocabulary items) are being exercised hundreds of times a day. It might be expected that this amount of practice would have some cognitive effects. Nevertheless, the dominant framework in the cognitive psychology of reading continues to be the cognitive correlates approach, with its bias toward viewing cognitive processes as a determinant of reading ability which is almost exclusively conceived as an outcome variable.

The research we describe in this chapter challenges this causal priority by examining the extent to which differences in the exercise of reading skills may be viewed as determinants of individual differences in comprehension ability and of further growth in the cognitive abilities that underlie comprehension skill.

Reading comprehension is composed of a large number of subprocesses and component skills, and there is reason to expect that several of these processing subcomponents are enhanced by exposure to print. For example, automatic word recognition processes are known to be linked to higher levels of reading comprehension (Cunningham, Stanovich, & Wilson, 1990; Lesgold, Resnick, & Hammond, 1985; Perfetti, 1985; Stanovich, 1991), and the primary way in which word recognition becomes automatic is through extensive practice in recognizing words (LaBerge & Samuels, 1974; Perfetti, 1985; Stanovich, 1986). Similarly, levels of vocabulary knowledge are strongly correlated with reading comprehension ability (Anderson & Freebody, 1983). Later in this chapter we discuss evidence indicating that a substantial amount of vocabulary growth might occur by inferring the meaning of words from context during reading (Nagy & Anderson, 1984; Nagy & Herman, 1987). Likewise, rich bodies of declarative knowledge and large numbers of stored schemata are associated with higher levels of reading comprehension (Anderson & Pearson, 1984; Rumelhart, 1980). We argued in previous publications (Stanovich, 1993; Stanovich & Cunningham, 1993; West, Stanovich, & Mitchell, 1993) that print is a unique source of declarative knowledge, not replaceable by electronic media or oral sources.

We examine the evidence linking several of these reading subcomponents to print exposure in this chapter. However, we first address the more general question of whether individual differences in the global process of reading comprehension can be linked to individual differences in exposure to print.

DOES PRINT EXPOSURE PREDICT INDIVIDUAL DIFFERENCES IN COMPREHENSION GROWTH?

In a longitudinal investigation (Cipielewski & Stanovich, 1992), we addressed the question of whether individual differences in exposure to print can predict individual differences in the growth of reading comprehension over time. The participants were 82 children in the third grades (8- to 9-year-olds) who had been administered the comprehension subtest of the Iowa Tests of Basic Skills (ITBS). Two years later, as fifth graders, these same children were administered both the reading comprehension section of the Stanford Diagnostic Reading Test and the ITBS. Measures of exposure to print were also administered to the children in grade five.

A major part of our research program has involved the development of reliable and valid measures of individual differences in exposure to print. We have used diary methods (Allen, Cipielewski, & Stanovich, 1992), questionnaire methods (Stanovich & West, 1989), and we have developed our own unique recognition-checklist measures (Stanovich & West, 1989). Because we have described the instrument development issues extensively in many other publications (Allen et al., 1992; Stanovich, 1993; Stanovich & Cunningham, 1992, 1993; Stanovich & West, 1989), we will not dwell on this methodological issue other than to note that we used the recognition-checklist methods in most of the studies we discuss here. These measures involve having subjects recognize literacy-related items (authors of books, magazines, titles of books, newspapers, etc.) in the context of foils so that guessing can be easily detected. Scores on these instruments are then corrected for guessing (see Stanovich, 1993; Stanovich & Cunningham, 1993; Stanovich & West, 1989, for details).

Table 2.1 displays the results of a hierarchical forced-entry regression analysis in which fifth-grade reading comprehension was the criterion variable. Third-grade reading comprehension was entered first into the equation, followed by a measure of the children's exposure to print outside of school.

TABLE 2.1
Hierarchical Regressions Predicting Fifth-Grade Reading Comprehension

Step	*Variable*	*R*	*R²*	*R² Change*	*F to Enter*
Fifth-grade Stanford reading comprehension					
1.	Iowa comprehension (3rd)	.645	.416	.416	54.06*
2.	Print exposure	.725	.526	.110	17.38*
Fifth-grade Iowa reading comprehension					
1.	Iowa comprehension (3rd)	.545	.297	.297	33.78*
2.	Print exposure	.609	.371	.074	9.25*

*$p < .01$.

Thus, the analyses essentially address the question of whether exposure to print can predict individual differences in growth in reading comprehension from third grade to fifth grade. In the first analysis, with the Stanford reading comprehension test as the criterion variable, the measure of print exposure accounted for 11% unique variance after the third-grade comprehension level had been partialed. In the second analysis, with the Iowa comprehension subtest as the criterion variable, print exposure accounted for 7.4% unique variance. In both cases, the unique variance accounted for by print exposure was statistically significant. Table 2.2 displays the results of a similar analysis conducted on these children as sixth graders. For a variety of reasons, we experienced substantial attrition prior to this analysis. Nevertheless, despite the smaller sample size, in both analyses, print exposure made a significant unique contribution to the prediction of sixth-grade reading comprehension.

Note the conservatism of these analyses. If print exposure did indeed contribute to growth in comprehension ability, then some of the effects of print exposure were already in the covariate (third-grade comprehension ability) because it is highly unlikely that the effects of print exposure begin only after the third-grade year. Nevertheless, we partialed third-grade comprehension ability entirely, knowing that it carried part of the previous print exposure variance with it. Thus, our analysis was focused on growth from

TABLE 2.2
Hierarchical Regressions Predicting Sixth-Grade Reading Comprehension

Step	*Variable*	*R*	*R²*	*R² Change*	*F to Enter*
Sixth-grade Stanford reading comprehension					
1.	Iowa comprehension (3rd)	.548	.300	.300	11.13**
2.	Print exposure	.630	.396	.096	4.00*
Sixth-grade Iowa reading comprehension					
1.	Iowa comprehension (3rd)	.617	.380	.380	17.80**
2.	Print exposure	.712	.506	.126	7.15*

*$p < .05$. **$p < .01$.

third to fifth and sixth grade only. Longer time periods would probably apportion more variance to print exposure than did our analyses.

We continue to present relatively conservative analyses in the remainder of this chapter for the following reason. Levels of print exposure are correlated with many other cognitive and behavioral characteristics. Avid readers tend to be different from nonreaders on a wide variety of cognitive skills, behavioral habits, and background variables. Attributing any particular outcome solely to print exposure is extremely difficult. Thus, the explanatory ambiguities surrounding a variable such as print exposure have led us to continue to structure the analyses in a "worst case" manner as far as print exposure is concerned, because in certain analyses, we have actually partialed out variance in abilities that are likely to be developed by print exposure itself (Stanovich, 1986, 1993). It should be understood that the implied causal model in the analyses is deliberately misspecified. When the predictive power of print exposure survives such biased analyses, we begin to feel justified in advancing at least a tentative causal inference.

PRINT EXPOSURE AS A CONTRIBUTOR TO VERBAL ABILITY AND DECLARATIVE KNOWLEDGE

The results presented in Tables 2.1 and 2.2 indicate a unique contribution of print exposure to the explanation of reading comprehension differences. But reading comprehension is an extremely broad skill. A large body of research has demonstrated that reading skill is linked to a wide range of verbal abilities: Vocabulary, syntactic knowledge, metalinguistic awareness, verbal short-term memory, phonological awareness, speech production, inferential comprehension, semantic memory, and verbal fluency form only a partial list (Cunningham, Stanovich, & Wilson, 1990; Gathercole & Baddeley, 1993; Gernsbacher, 1993; Kamhi & Catts, 1989; Oakhill & Garnham, 1988; Siegel & Ryan, 1988; Stanovich & Cunningham, 1991; Stanovich, Cunningham, & Feeman, 1984; Stanovich, Nathan, & Zolman, 1988; Vellutino & Scanlon, 1987). This raises the question of whether print exposure can be linked to any of these specific subcomponents of the global comprehension process, an issue that we have addressed in our research program.

In certain domains, reading is especially likely to be a substantial contributor to cognitive growth. For example, as a mechanism for building content knowledge structures (Glaser, 1984), reading seems to be unparalleled (Goody, 1987). The world's storehouse of knowledge is readily available to those who read, and much of this information is not usually attained from other media (Comstock & Paik, 1991; Huston, Watkins, & Kunkel, 1989; Postman, 1985; West, Stanovich, & Mitchell, 1993; Zill & Winglee, 1990).

Additionally, if we consider vocabulary to be one of the primary tools of verbal intelligence (Olson, 1986), then we have another mechanism by which print exposure may influence cognition because reading appears to be a uniquely efficacious way of acquiring vocabulary (Hayes, 1988; Hayes & Ahrens, 1988; Nagy & Anderson, 1984; Nagy & Herman, 1987; Stanovich, 1986, 1993).

There are sound theoretical reasons for believing that print exposure is a particularly efficacious way of expanding a child's vocabulary. These reasons derive from the differences in the statistical distributions of words found between print and oral language. Some of these differences have been illustrated in the results of research by Hayes and Ahrens (1988) who analyzed the distributions of words used in various contexts. Three different categories of language were analyzed: written language sampled from genres as difficult as scientific articles and as simple as preschool books, words spoken on television shows of various types, and adult speech in two contexts varying in formality. The words used in the different contexts were analyzed according to a standard frequency count of English (Carroll, Davies, & Richman, 1971). This frequency count ranks the 86,741 different words in English according to their frequency of occurrence in a large corpus of written English. For example, the word "the" is ranked number 1, the 10th most frequent word is "it," the word "know" is ranked 100, the word "pass" is ranked 1,000, the word "vibrate" is 5,000th in frequency, the word "shrimp" is 9,000th in frequency, and the word "amplifier" is 16,000th in frequency.

In Hayes and Ahrens' (1988) study, the average frequency rank of the words in children's books (after a small correction) was 627 in the Carroll et al. (1971) word count and the average frequency rank of the words in popular magazines was 1,399. What is immediately apparent, upon examining Hayes and Ahrens' (1988) data, is how lexically impoverished is most speech as compared to written language. With the exception of the special situation of courtroom testimony, the average frequency rank of the words in all of the samples of oral speech was quite high, hovering in the 400–600 range of ranks. The words in children's books were, in fact, rarer than those in adult conversation, except for the situation of courtroom testimony. Indeed, the words used in most children's books were considerably rarer than those in the speech on prime-time adult television. Adult reading matter was even more disparate from speech.

These relative differences in word rarity have direct implications for vocabulary development. If most vocabulary is acquired outside of formal teaching (Miller & Gildea, 1987; Sternberg, 1985, 1987), then the only opportunities to acquire new words occur when an individual is exposed to a word in either written or oral language that is outside their current vocabulary. That this will happen vastly more often while reading than while talking or watching television is illustrated in another statistic calculated by Hayes and Ahrens (1988). They reported how often a rare word occurred in their various categories of texts. A rare word was defined as one with a rank lower than

10,000; roughly, a word that is outside the vocabulary of fourth to sixth graders. For vocabulary growth to occur after the middle grades, children must be exposed to words that are rare by this definition. Again, it is print that provides many more such word-learning opportunities. Children's books had 50% more rare words in them than did adult prime-time television and the conversation of college graduates. Popular magazines had roughly three times more opportunities for new word learning than did prime-time television and adult conversation in the Hayes and Ahrens (1988) study. Assurances that "what they read and write may make people smarter, but so will any activity that engages the mind, including interesting conversation" (Smith, 1989, p. 354) are overstated, at least when applied to the domain of vocabulary learning. The data presented by Hayes and Ahrens indicate that conversation is not a substitute for reading.

The large differences in lexical richness between speech and print are a major source of individual differences in vocabulary development. These differences are created by the large variability among children in exposure to print. This was illustrated in a study of the out-of-school time use by fifth graders conducted by Anderson, Wilson, and Fielding (1988). From diaries that the children filled out daily over several months, the investigators estimated how many minutes per day the individuals were engaged in reading and other activities when not in school. Anderson et al. found that the child at the 50th percentile in amount of book reading was reading approximately 4.6 minutes per day, over six times as much as the child at the 20th percentile in amount of reading time (less than 1 minute daily). Or, to take another example, the child at the 80th percentile in amount of book reading time (14.2 minutes) was reading over 20 times as much as the child at the 20th percentile.

Anderson et al. (1988) estimated the children's reading rates and used these, in conjunction with the amount of reading in minutes per day, to extrapolate a figure for the number of words that the children at various percentiles were reading. These figures illustrated the enormous differences in word exposure generated by children's differential proclivities toward reading. For example, the average child at the 90th percentile in print exposure read almost 2.5 million words per year outside of school, over 46 times more words than the child at the 10th percentile, who was exposed to just 51,000 words outside of school during a year. Or, to put it another way, an entire year's out-of-school exposure for the child at the 10th percentile amounted to just 8 days of reading for the child at the 90th percentile. These are the differences that, when combined with the lexical richness of print, may act to create large vocabulary differences among children.

We attempted to provide empirical evidence for such a linkage in several studies (Cunningham & Stanovich, 1991; Stanovich & Cunningham, 1992, 1993). In a study of 134 fourth, fifth, and sixth graders (9- to 13-year-olds), we examined whether print exposure accounted for differences in vocabulary development once controls for both general and specific (i.e., vocabulary relevant) abilities were invoked. The analyses displayed in Table 2.3 illustrate some of the outcomes of this study. Three different vocabulary measures were employed as dependent variables: a word checklist measure of the written vocabulary modeled on the work of Anderson and Freebody (1983), a group-administered version of the Peabody Picture Vocabulary Test (PPVT), and a verbal fluency measure where the children had to output as many words as they could that fit into a particular category (e.g., things that are red, see Sincoff & Sternberg, 1987). Age was entered first into the regression equation, followed by scores on the Raven Progressive Matrices as a control for general intelligence.

As a second ability control more closely linked to vocabulary acquisition mechanisms, we entered phonological coding ability into the equation. A variable such as phonological coding skill may mediate the relationship between print exposure and a variable like vocabulary size in numerous ways. High levels of decoding skill—certainly a contributor to greater print exposure—may provide relatively complete verbal contexts for the induction of word meanings during reading. Decoding skill may also indirectly reflect

TABLE 2.3
Unique Print Exposure Variance After Age, Raven, and Phonological Coding are Partialed

	R	*R^2 Change*	*F to Enter*
Written Vocabulary			
Age	.103	.011	1.41
Raven	.457	.198	32.57*
Phonological coding	.610	.163	33.49*
Print exposure	.683	.094	22.52*
Oral Vocabulary			
Age	.230	.053	7.29*
Raven	.393	.101	15.60*
Phonological coding	.403	.008	1.21
Print exposure	.516	.104	18.19*
Verbal Fluency			
Age	.043	.002	0.24
Raven	.231	.051	6.89*
Phonological coding	.477	.175	28.47*
Print exposure	.582	.111	21.02*

*$p < .01$.

differences in short-term phonological storage related to vocabulary learning, particularly in the preschool years (Gathercole & Baddeley, 1989, 1993). Thus, print exposure and vocabulary may be spuriously linked via their connection with decoding ability: Good decoders read a lot and have the best context available for inferring new words. This spurious linkage was controlled by entering phonological coding into the regression equation prior to print exposure. If print exposure was only an incidental correlate of vocabulary because of its linkage with phonological coding skill, then print exposure would not serve as a unique predictor of vocabulary once phonological coding was partialed out. The results of the analyses displayed in Table 2.3 indicate that for each of the vocabulary measures, print exposure accounted for a significant portion of the variance once the variance attributable to performance on the Raven and the phonological coding measure had been removed.

We conducted an even more stringent test of whether exposure to print is a unique predictor of verbal skill in a study of college students. Table 2.4 presents the results of this study. Here, two nonverbal measures of general ability, performance on a figural analogies test and on the Raven Matrices, were entered first in a hierarchical regression analysis. Next, performance on the Nelson–Denny reading comprehension test was entered subsequent to the two nonverbal ability tasks but prior to the measure of print exposure. By structuring the analyses in this way, we did not mean to imply that print exposure was not a determinant of reading comprehension ability—we showed in our longitudinal study that it is. Instead, we intended, as previously described, to separate the variance due to current level of comprehension ability from the variance due to current levels of the exercise of those abilities (i.e., self-chosen reading activities). We recognized that the reading comprehension variable carried some of the variance that should

TABLE 2.4
Unique Print Exposure Variance After Nonverbal Abilities and Reading Comprehension Ability are Partialed Out

	R^2 Change					
	Dependent Variable					
Step	*1.*	*2.*	*3.*	*4.*	*5.*	*6.*
1. Figural analogies	.100*	.077*	.079*	.073*	.057*	.042*
2. Raven	.138*	.087*	.057*	.059*	.074*	.017
3. Comprehension	.230*	.129*	.222*	.227*	.208*	.045*
4. Print exposure	.076*	.180*	.100*	.286*	.052*	.075*

Note. Dependent variables are as follows; 1 = Nelson–Denny vocabulary, 2 = PPVT, 3 = history and literature knowledge (NAEP), 4 = cultural and literacy test, 5 = spelling composite, and 6 = verbal fluency.

*$p < .001$.

rightly be apportioned to print exposure (hence our characterization of these analyses as conservative with regard to the effects of print exposure).

The results presented in Table 2.4 indicate that print exposure accounted for additional variance in two measures of vocabulary (the Nelson–Denny vocabulary subtest and the PPVT), two measures of general knowledge (a measure of history and literature knowledge taken from the National Assessment of Educational Progress and a cultural literacy test), spelling, and verbal fluency even after reading comprehension ability had been partialed along with nonverbal ability. In some cases, the unique variance explained was quite substantial.

In this study, our sample size was large enough to allow us to explore the consequences—in a correlational sense—of pitting general comprehension ability against print exposure as predictors of cognitive outcomes in the verbal domain. The next analysis took advantage of the fact that, although print exposure was positively correlated with Nelson–Denny comprehension performance, the relationship was far from perfect. There were individuals who, despite having modest comprehension skills, seemed to read avidly; and there were other individuals who, despite very good comprehension skills, seemed not to exercise their abilities—the so-called aliterates.

What are the cognitive correlates of a mismatch between comprehension abilities and the exercise of those abilities? To investigate this issue, our sample of adults was classified according to a median split in performance on both the Nelson–Denny comprehension subtest and a composite print exposure variable. The resulting 2 × 2 matrix revealed 82 subjects who were discrepant; 38 subjects who were low in print exposure but high in comprehension (LoPrint/HiComp); and 44 subjects who were high in print exposure but low in comprehension (HiPrint/LoComp). These two groups were then compared on all the variables in the study (see Table 2.5). Despite

TABLE 2.5
Differences Between Subjects High in Comprehension Ability but Low in Print Exposure ($N = 38$) and Subjects Low in Comprehension Ability but High in Print Exposure ($N = 44$)

Variable	*LoPrint/HiComp*	*HiPrint/LoComp*	*t(80)*
N–D comprehension	25.3	20.9	–11.47**
Raven matrices	10.7	9.0	–2.44*
Nelson–Denny vocabulary	15.1	14.4	–0.94
Peabody vocabulary	10.6	12.1	2.06*
History & lit (NAEP)	12.7	13.4	0.99
Cultural literacy	.396	.483	3.86**
Spelling composite	.16	–.05	–1.12
Verbal fluency	31.6	32.0	0.30

*$p < .05$. **$p < .001$.

comprehension differences favoring the LoPrint/HiComp group, as well as nonverbal cognitive abilities favoring this group (they were also higher on the Raven), LoPrint/HiComp individuals were not significantly superior on any of the other variables assessed in the study. In fact, on one measure of vocabulary (the PPVT) and one measure of general knowledge (a cultural literacy test), the HiPrint/LoComp group performed significantly better. Although inferences from these correlational analysis must be tentative, the results do suggest that low ability need not necessarily hamper the development of vocabulary and verbal knowledge as long as the individual is exposed to a lot of print.

This is the glass half full part of the story of Matthew effects in education (see Stanovich, 1986; Walberg & Tsai, 1983)—that is, the rich get richer and the poor get poorer effects. The longitudinal study previously reported was the glass half empty part. Children with higher levels of reading comprehension ability tend to read more and hence develop further their already superior comprehension skill. However, the outlier analyses presented in Table 2.5 illustrate that there may be another part of the story. These analyses show that exposure to print is efficacious regardless of one's overall level of comprehension skill. If we can break the linkage between comprehension ability and exposure, low ability individuals who do begin to read more will develop the declarative knowledge bases and lexical tools that will bootstrap further comprehension gains (see Stanovich, 1993).

In another study, we tested the idea of experiential compensation (see Stanovich, West, & Harrison, 1995) by comparing the performance of 133 college students (mean age = 19.1 years) and 49 older individuals (mean age = 79.9 years) on two general knowledge tasks, a vocabulary task, a working memory task, a syllogistic reasoning task, and several measures of exposure to print. The older individuals outperformed the college students on the measures of general knowledge and vocabulary, but did significantly poorer on the working memory and syllogistic reasoning tasks. These results were consistent with the trend in the literature for crystallized abilities (knowledge and vocabulary) to continue to grow with age and for measures of fluid ability (e.g., working memory, syllogistic reasoning) to decline with age (Baltes, 1987; Horn, 1982, 1989; Horn & Hofer, 1992). However, a series of hierarchical regression analyses indicated that when measures of exposure to print were used as control variables, the positive relationships between age and vocabulary, and age and declarative knowledge, were eliminated; in contrast, the negative relationships between age and fluid abilities were largely unattenuated. The results suggest that, in the domain of verbal abilities, print exposure helps to compensate for the normally deleterious effects of aging.

In our more recent studies, we have been examining the role of print exposure in the development of linguistic sensitivity and decontextualized thinking. The development of one of our criterion measures was motivated by the work of Olson and Astington (1990; Astington & Olson, 1990) who argued that the acquisition of certain metalinguistic and metacognitive terms is uniquely tied to literacy and experience with print. They argued that one of the ways in which literacy has an impact on thought is by offering elaborating ways for talking about talk, about thought, and about knowledge. They pointed out that the massive borrowing of vocabulary from Latin into English in the 16th and 17th centuries contained as a conspicuous part "the speech act and mental state verbs that have come to play such a large part in psychology and philosophy of mind" (Olson & Astington, 1990, p. 712).

In his recent book, *The World on Paper*, Olson (1994) illustrated how many of these mental state and speech act verbs became necessary as writers strove to represent more and more of the illocutionary force and pragmatics of oral language in text. Olson argued that "writing is largely a matter of inventing communicative devices which can be taken as explicit representations of aspects of language which are expressed non-lexically in speech and thereby bringing those aspects of linguistic structure and meaning into consciousness" (p. 110). For example, Olson argued that an orator need not say "I insist that" because he can just use an insistent tone of voice. But to make writing serve the same function that speech serves, new verbs and new concepts have to be invented—concepts such as those expressed by terms like "insist," "imply," "concede," or "infer." In short, the writer must signal intentionality and illocutionary force to the reader and the writer needs tools to do so. According to Olson, these tools are mental state and speech-act verbs (and their nominalizations) that make more fine-grained intentional distinctions. Many of these words are more complex variants of their developmentally more primitive roots "think" (e.g., infer, confirm, assume), "know" (e.g., perceive, recall, comprehend), and "say" (e.g., concede, assert, imply).

In order to investigate the link between print exposure and the acquisition of a complex mental state and speech-act lexicon, we adapted a task developed by Astington and Olson (1990) and extended by Booth and Hall (1994). The task was designed to test whether students can choose the appropriate complex variant in a particular context. In describing the task, Astington and Olson (1990) stated that "we are not interested in simply discovering whether or not a student knows a particular word—that is, in simply producing a vocabulary test. We are interested in seeing whether students can distinguish between a set of related terms, sometimes quite closely related terms, by choosing appropriate ones for appropriate contexts" (p. 79). Two examples of items from the mental state verbs task are presented in Table 2.6. Thirty percent of a college sample chose an alternative other than the correct one in both of these problems.

Astington and Olson (1990) demonstrated that there is a developmental trend in items such as those in Table 2.6—that is, high schoolers scored better than eighth graders and college students scored better than high school

TABLE 2.6
Examples of Items From the Mental State Verbs Task

It's Adam's birthday tomorrow. Barbara is just sneaking out of the house to buy a present for him when he sees her and asks her where she is going. Barbara says, "We're out of milk. I'm going to the store."
A. Barbara *means* that she is going to buy milk.
B. Barbara *concedes* that she is going to buy milk.
C. Barbara *asserts* that she's going to buy milk.
*D. Barbara *implies* that she is going to buy milk.
69.3% correct

Kate was trying to retrieve a file from her floppy disk. She was not successful. She was very upset. "Maybe there is some problem with my computer," she thought. She took the disk to her friend's place and tried it in his computer but the result was the same. She thought there must be something wrong with my floppy disk.
A. Kate *suggests* that there is something wrong with her floppy disk.
B. Kate *predicts* that there is something wrong with her floppy disk.
C. Kate *implies* that there is something wrong with her floppy disk.
*D. Kate *infers* that there is something wrong with her floppy disk.
66.4% correct

students. However, the key question raised in Olson's (1994) analysis concerned not merely the existence of developmental trends, which could arise for a variety of reasons, but whether exposure to print was specifically linked to performance on such items. Thus, we administered a set of these items to college students who also completed a battery of other tasks. Table 2.7 presents the results from two different regression analyses in which the criterion variable was the number of mental state and speech-act verb items answered correctly on a 38-item test. In the first regression analysis, performance on the Nelson–Denny comprehension subtest accounted for 18.7% of the variance in performance on the mental state verbs task. When entered

TABLE 2.7
Hierarchical Regression With Performance on the Mental State Verbs Task as the Criterion Variable

	R	R^2 *Change*	*F to Enter*	*Beta*
Nelson–Denny comp	.432	.187	31.67*	.289*
Print exposure	.532	.096	18.38*	.342*
	R	R^2 *Change*	*F to Enter*	*Beta*
Year	.333	.111	16.49*	.154
Grade point avg	.419	.065	10.28*	.160
Nelson–Denny comp	.540	.116	21.29*	.271*
Print exposure	.574	.037	7.17*	.231*

*$p < .01$.

second, print exposure accounted for a statistically significant 9.6% unique variance. In fact, print exposure was a more potent predictor of performance than was comprehension ability as can be inferred from the last column, which displays the beta weight in the final equation. The beta weight for print exposure was higher than that for comprehension. An alternative way of expressing this relationship is to note that comprehension accounted for 6.9% unique variance after print exposure was entered into the equation, compared with 9.6% unique variance for print exposure when the reverse ordering was employed.

The ability of print exposure to account for unique variance was subjected to a more stringent test in the next hierarchical regression analysis where two additional covariates were added. Unlike our earlier college subjects, who were largely at a similar point in their university careers, the subjects in this sample ranged from first-year freshmen to fifth-year students in an education program. Therefore, we entered year in college first into the regression equation, followed by the students' college grade point average. Together, these two variables achieved a multiple *R* of .419. Nelson–Denny comprehension subtest performance accounted for 11.6% additional variance when entered third. Finally, print exposure was entered and accounted for 3.7% unique variance, considerably less than that obtained when only comprehension ability was entered prior, but still statistically significant. In the final equation, only the beta weights for comprehension ability and print exposure were significant. Again we have another situation in which we may be partialing too much. Year in college is probably in part a proxy for the type of text experience that leads one to induce the subtle distinctions between the mental state verbs necessary for good performance on this task.

CONCLUSION

Many of the results in this sampling of our studies may be seen as instances of what have been termed "Matthew effects" in literacy development; educational sequences in which early and efficient acquisition of reading skill yields faster rates of growth in reading achievement and other cognitive skills—that is, rich-get-richer and poor-get-poorer effects (see Stanovich, 1986; Walberg & Tsai, 1983). For example, children who are already good comprehenders may tend to read more, thus spurring further increases in the cognitive subcomponents, vocabulary, and knowledge bases that will underlie future increases in comprehension efficiency, thus increasing the achievement differences between them and their peers who are not good comprehenders and not avid readers. Thus, free reading choices may explain part of the puzzle and the pressing social problem of widening achievement disparities between the educational haves and the have-nots (Chall, Jacobs

& Baldwin, 1990; Dreeben & Gamoran, 1986; Snow, Barnes, Chandler, Goodman, & Hemphill, 1991; Stanovich, 1993).

This, in a sense, is the glass half empty part of the story. But perhaps there is a glass half full part as well. We tested interaction terms (that is, ability by print exposure interactions) in all of our analyses and they were almost never significant. In short, exposure to print is efficacious regardless of the level of the child's cognitive and comprehension abilities. Even children with limited comprehension skills will build vocabulary and cognitive structures through immersion in literacy activities. An encouraging message for teachers of low-achieving children is implicit here. We often despair of changing "abilities", but there is at least one partially malleable habit that will itself develop "abilities"—reading.

The results summarized here suggest that, when studying comprehension deficiencies, volume of reading experience is a variable that might increase the explanatory power of our theories. Inadequate exposure to print prevents children from building important knowledge structures such as vocabulary, metalinguistic knowledge, and general world knowledge. These knowledge sources are necessary for efficient reading comprehension at the more advanced levels. Thus, early comprehension difficulties confer a twofold disadvantage. Ongoing reading is disrupted but, in addition, the child's exposure to some of the most linguistically rich stimuli—printed texts—is restricted. These potent feedback effects from self-exposure to literacy activities need to be integrated into current cognitive theories of reading comprehension difficulties.

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