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Tracking the Unique Effects of Print Exposure in Children: Associations With Vocabulary, General Knowledge, and Spelling

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This study assessed the construct validity of a recently introduced measure of children's exposure to print, the Title Recognition Test (TRT). In samples of fourth-, fifth-, and sixth-grade children, the TRT demonstrated significant correlations with spelling, vocabulary, verbal fluency, word knowledge, and general information. Most important, it accounted for variance in these criterion variables when differences in both general ability and phonological coding ability were controlled. Although correlational, the latter result suggests that print exposure is an independent contributor to the development of verbal abilities. Studies of the cognitive consequences of differing amounts of print exposure could be facilitated by the use of this easily administered indicator.

In recent years, scholars from a wide variety of social sciences and humanities disciplines have attempted to specify the effects that literacy has on cognitive functioning (e.g., Botstein, 1990; Farrell, 1977; Freedman & Calfee, 1984; Goody, 1977, 1987; Greenfield, 1972; Havelock, 1980; Olson, 1977, 1986; Ong, 1982; Scardamalia & Bereiter, 1985; Stock, 1983). This scholarly interest has coincided in an interesting way with an important educational trend in the language arts: the recent push to immerse children in real literature from their earliest encounters with print (Manning & Manning, 1989; Strickland & Morrow, 1989; Teale & Sulzby, 1986; Temple, Nathan, Burris, & Temple, 1988) and to develop positive reading habits among children (Trelease, 1989). The recent emphasis on engaging children in the world of literate culture and developing positive reading habits has precursors in earlier educational efforts (Huck, 1966; Sutherland & Arbuthnot, 1986), but its impact has never been so great. The educational community is in the middle of a perhaps unprecedented campaign to increase children's experience with literature and to increase their exposure to print.

The premises behind this trend (e.g., that reading is "good") are still, however, in need of empirical investigation, because, as some have argued (e.g., Smith, 1989), we may be in danger of overselling literacy. Researchers need to document the specific behavioral outcomes that are associated with the exercise of literacy. Arguments that educators may be overselling, when aimed at current campaigns to foster early reading habits, strike home because there is a precedent for overselling literacy. That precedent resides in the international literacy campaigns conducted in nonindustrialized countries during the last three decades. There was, in early writings, a tendency to attribute every positive outcome that was historically correlated with the rise of literacy—economic development for example—to the effects of literacy itself. However, the potential for spurious correlation in the domain of literacy is quite high. Simply put, literacy levels are correlated with too many other good things. Thus, it was a mistake to automatically attribute everything that was historically correlated with the rise of literacy to the effects of literacy itself (Fuller, Edwards, & Gorman, 1987; Gee, 1988; Graff, 1986; Wagner, 1987).

An analogous problem confronts attempts to assess the specific effects of the exercise of literacy on cognitive functioning at the level of the individual rather than society. Educators must be careful not to oversell literacy by attributing exposure to print as a cause of everything with which it is positively correlated. We have thus embarked on a research program designed to empirically isolate the unique cognitive effects of exposure to print (Cunningham & Stanovich, 1990; Stanovich & West, 1989).

Methodologies for Assessing Print Exposure

Our method of assessing the cognitive consequences of literacy exploits the fact that even within a generally literate culture there are tremendous variations in degrees of exposure to print. That is, not only is there wide variation in reading and writing skills conceived as abilities (Perfetti, 1985), but there are enormous differences in the degree to which individuals exercise their abilities (Anderson, Wilson, & Fielding, 1988; Greaney, 1980; Greaney & Hegarty, 1987; Sharon, 1973-1974). Indeed, even among a group of individuals who have the same level of reading ability, there are surprisingly large differences in their engagement in print-related activities (Stanovich & West, 1989). It is thus possible to study the correlates of this natural variation in print exposure. The strategy of looking at degrees of print exposure within a literate society obviously precludes the highly diagnostic and discrete comparisons of literate versus illiterate individuals that have dominated work in cultural anthropology (Luria, 1976; Scribner & Cole, 1981). However, our methodology has the advantage of being a research strategy of far wider applicability.

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In our methodology, we attempt to correlate differential engagement in reading activities with various cognitive outcomes that have been associated with the acquisition of literacy (Cunningham & Stanovich, 1990; Stanovich & West, 1989). However, such a logic, if not supplemented with additional methodological controls, is subject to the same problem that has plagued historical investigations of literacy's effects: spurious correlation. That is, degree of print exposure is correlated with various reading skills, such as word decoding, and with cognitive abilities generally. Simply, and obviously, individuals with superior reading skills read more. This correlation is problematic, because it raises the possibility that an association between amount of print exposure and any criterion ability, skill, or knowledge base might arise not because of the unique effects of print exposure but because of individual differences in general ability or in specific reading subskills, such as decoding.

Consider vocabulary as an example. The counterargument to the claim that print exposure is a major mechanism determining vocabulary growth (Hayes, 1988; Nagy & Anderson, 1984; Stanovich, 1986) is that superior decoding ability leads to more print exposure and that decoding abilities are themselves related to vocabulary development because better decoding insures an accurate verbal context for inducing the meanings of unknown words. Thus, according to this argument, vocabulary and print exposure are spuriously related by their connection with decoding ability: Good decoders read a lot and have the best context available for inferring new words. Decoding ability could also in part reflect the efficiency of the phonological short-term memory, which Gathercole and Baddeley (1989) have argued is critical to early oral vocabulary acquisition. Finally, vocabulary and print exposure could be spuriously linked through general cognitive abilities that are associated with both print exposure and the ability to induce meaning from context (Sternberg, 1985).

We have used a regression logic to deal with this problem. In the analyses to be reported, we first statistically control for the effects of general ability and decoding skill before examining the relationship between print exposure and criterion variables. This procedure of reducing possible spurious relationships by first partialing out relevant subskills and abilities and then looking for residual effects of print exposure was used in our earlier investigations of subword processes in reading. For example, in previous work we have demonstrated that independent of decoding ability, variation in print exposure among adults predicts spelling ability and orthographic knowledge (Stanovich & West, 1989). Similarly, in a previous study of children's performance (Cunningham & Stanovich, 1990), we found that after partialing out IQ, memory ability, and phonological processing abilities, print exposure accounted for additional variance in orthographic knowledge and word recognition. The logic of our analytic strategy has been quite conservative because we have partialed out variance in abilities that were likely to be developed by print exposure itself (Stanovich, 1986). Yet even after print exposure was robbed of some of its rightful variance, it remained a unique predictor (Stanovich & West, 1989).

In the present investigation, we extend these analyses beyond subword-level cognitive processes. Here, we examine whether a variety of declarative knowledge bases can be linked to variation in children's amount of print exposure after the effects of general ability and decoding skill have been partialed. Criterion variables in the investigation are measures of verbal fluency, word knowledge, receptive vocabulary, general knowledge, and spelling.

There are, of course, numerous difficulties encountered when attempting to measure print exposure. An important breakthrough in the study of out-of-school print exposure differences is the diary method used by Greaney (1980; Greaney & Hegarty, 1987) and Anderson et al. (1988). These studies, employing daily activity records filled out by children, attempted not only to measure relative differences in print exposure among children but also to estimate the absolute amount of time spent on literacy activities.

The measurement of absolute amounts of reading activity is a very difficult problem in general, and the diary technique requires extensive cooperation from teachers and students in order to carry out the difficult time-estimation task with any reliability. Other techniques are available if one wants only an index of relative differences in exposure to print, that is, if one gives up the quest for estimates of the absolute amount of time spent reading. Standard questionnaire techniques have been used with both children and adults to assess exposure to print outside of the classroom (Ennis, 1965; Nell, 1988; Sharon, 1973–1974; Stanovich & West, 1989; Walberg & Tsai, 1984), but these are encumbered with a number of problems. Few have shown even moderate reliabilities, and all are probably plagued with social desirability confounds: Responses are distorted because of tendencies toward reporting socially desirable behaviors (Furnham, 1986; Paulhus, 1984), in this case, to report more reading than actually takes place (Ennis, 1965; Sharon, 1973–1974).

Mindful of these problems, Stanovich and West (1989) developed two measures of relative print exposure that displayed adequate reliability and that could not be contaminated by the tendency to give socially desirable responses. In the Author Recognition Test (ART) and the Magazine Recognition Test (MRT), actual target items (real authors and real magazines) were embedded among foils (names that were not authors or magazine titles, respectively). The subject simply scans the list and checks those names known to be authors on the ART and those names known to be magazines on the MRT. The measures thus have a signal-detection logic. The number of correct items checked can be corrected for differential response biases, which are revealed by the checking of foils. Although checklist procedures have been used before to assess print exposure (Chomsky, 1972; Huck, 1966), they have not been employed in the context of a method that uses foils to control for differential response criteria.

There are several advantages to this checklist method. First, it is immune to the social desirability effects that so contaminate responses to subjective self-estimates of socially valued activities such as reading. Guessing is not an advantageous strategy, because it is easily detected and corrected for by an examination of the number of foils checked. Further, the cognitive demands of the task are quite low. The task does not necessitate complex frequency judgments that would disadvantage those who read but lack other cognitive skills. All of these advantages were empirically demonstrated in the investigation of Stanovich and West (1989), in which the recognition tests displayed correlations with reading ability that were higher than those displayed by the traditional questionnaires administered in previous research.

Cunningham and Stanovich (1990) demonstrated the utility of an analogous measure for children, the Title Recognition Test (TRT). The measure has the same signal-detection logic as the adult ART and MRT but employs children's book titles rather than authors as items. The children's measure shares the same advantages of low cognitive load, freedom from subjective judgments, and objective assessment of response bias. Thus, the TRT was employed in the present study because it circumvents most of the problems inherent in using questionnaire measures of children's print exposure, yet the logistics of its administration are considerably simpler than those of the diary technique.

Method

Subjects

The subjects were 34 fourth-grade children (16 boys and 18 girls), 33 fifth-grade children (16 boys and 17 girls), and 67 sixth-grade children (30 boys and 37 girls) recruited from a lower-middle-class school in the San Francisco Bay area. The mean age of the fourth-grade children was 10 years, 2 months (SD = 7.4 months); the mean age of the fifth-grade children was 11 years, 3 months (SD = 6.0 months); and the mean age of the sixth-grade children was 12 years, 2 months (SD = 6.1 months). The children were tested during the May–July period of a year-round school curriculum.

Measures

Raven's matrices. Subjects completed the Raven Standard Progressive Matrices (Raven, Court, & Raven, 1977), a task tapping nonverbal problem-solving skills and commonly viewed as a measure of nonverbal intelligence. The subject is required to solve problems presented in abstract figures and designs. The test consists of a booklet containing pictures of a pattern with a section missing and eight options to choose from in replacing the missing portion of the pattern. The test was administered to each class as a group. Two adults administered the test, employing the standard test directions. The children were given 45 min to complete the test, and all were able to finish within the allotted time. The split-half reliability of this measure (Spearman-Brown corrected) was .88. Raw scores were used in the analyses that follow.

Phonological coding task. This task was adapted from the work of Olson, Kliegl, Davidson, and Foltz (1985), and the stimuli were taken from Table 2 of their chapter. The children saw a list of 60 nonword strings arranged in three rows of 20 items each. Half of these stimuli were pseudowords that sounded like words when pronounced (e.g., *kake, ferst, bote, braive*), and half of the stimuli were nonwords that did not sound like words when pronounced (e.g., *dake, filst, boaf, broave*). The pseudohomophones and pure nonword foils were randomly mixed in the list. The children were instructed to look at the list of letter strings and put a check mark next to those strings that sounded like a word when they were spoken out loud and to leave blank the letter strings that would not sound like a real word. Because the stimuli in the task are all nonwords, the only way to respond correctly is to recode the stimuli phonologically. The phonological coding task took approximately 5 min to complete.

Spelling task. Twenty words were employed in the spelling task (*sugar, thumb, cloudy, dollar, towel, science, dangerous, succeed, vegetable, marriage, disease, business, excellence, committee, fudge, island, champion, cupboard, chocolate, nothing*), 14 of which were stimuli used in the Spelling subtest of the Peabody Individual Achievement Test (Dunn & Markwardt, 1970). The experimenter pronounced each word, used each word in a sentence (e.g., "We use sugar to sweeten food"), and pronounced the word again. The children were told that they could ask the experimenter to repeat the word if they did not understand what was said. The children were told that their task was to spell the word as accurately as possible, that many of the words were difficult, and that they should make their best guess if they did not know how to spell a word. The spelling task took approximately 10 min to administer. Scores on the measure were simply the number of words spelled correctly. The split-half reliability of the spelling task (Spearman-Brown corrected) was .88.

Word checklist. This task employed the checklist-with-foils format that has been shown to be a reliable measure of reading vocabulary in previous investigations (Anderson & Freebody, 1983; White, Slater, & Graves, 1989). The stimuli for this task were 27 words (*coin, ankle, swamp, wrist, argument, competition, weary, antler, snarling, grooming, composer, fragment, wedge, compass, gnawing, nuisance, bugle, scholar, musician, furious, grain, construction, funnel, cliff, secretary, shore, angle*) taken from Form M of the Peabody Picture Vocabulary Test–Revised (Dunn & Dunn, 1981) and 13 pronounceable nonwords (*arrate, disler, hould, falfold, subting, reweat, plabage, dropant, ordiful, seblement, sheal, thimmery, wiltial*) taken from a similar recognition vocabulary measure employed by Zimmerman, Broder, Shaughnessy, and Underwood (1977). The words and nonwords were randomly intermixed throughout the list. The children were told that some of the letter strings were actual words and that others were not and that their task was to read through the list of items and to put a check mark next to those that they knew were words. The children were told not to guess but only to check those strings that they knew to be words. The word checklist took approximately 5 min to administer.

Verbal fluency task. The children were administered four trials in which they had to produce as many words in a given category as they could within a 45-s time period. In the first trial the children were told that they would have 45 s to write down as many words as they could think of that began with the letter *K*. Next, the children were told that they would have 45 s to write down as many words as they could think of that rhymed with the word *cash*. Next the children were told that they would have 45 s to write down as many things as they could think of that were red. Finally, the children were told that they would have 45 s to write down as many things as they could think of that were round. On each trial the experimenter began the timing by telling the children "go" and after 45 s instructed the children to put their pencils down. The task took approximately 7 min to administer. Two fourth graders and one fifth grader did not complete the verbal fluency task; therefore, n = 131 for this measure. Accurate spelling was not required on the task.

Peabody Picture Vocabulary Test. Form L of the Peabody Picture Vocabulary Test—Revised (PPVT–R; Dunn & Dunn, 1981) was group administered to the children. The stimuli consisted of 25 of the Peabody plates ranging in number from 49 to 128. The words were *faucet, capsule, trunk, disagreement, exhausted, arid, cooperation, fatigued, mercantile, feline, tubular, barricade, tranquil, cornea, inflated, adjustable, fragile, appliance, peninsula, upholstery, arch, contemplating, dissecting, transparent,* and *pedestrian*. Each child had his or her own booklet of picture alternatives. The children were told that they would be looking at four picture alternatives while the experimenter said a word out loud. Their task was to choose one of the four pictures that best described the meaning of the word the experimenter said out loud. The experimenter said the name of each word twice. The children then wrote down the number corresponding to one of the pictures on a separate score sheet. The task took approximately 10 min. The split-half reliability of this measure (Spearman-Brown corrected) was .68.

General information. The General Information subtest of the Peabody Individual Achievement Test was employed as a probe of the children's general world knowledge. Eighteen items from the subtest were group administered to the children, ranging in difficulty from Item 19 ("What is a piece of land called that is completely surrounded by water?") to Item 64 ("What branch of our national government makes the laws?"). The remaining items administered were Items 20, 22, 24, 26, 28, 31, 35, 37, 38, 45, 49, 54, 55, 56, 59, and 62. The experimenter read each question twice out loud to the children, who were instructed to write down their best answer on the score sheet provided. The children were told that they were going to be asked many questions about the world in which they live, that many of the questions would be difficult, and that they therefore should not expect to be able to answer all of the questions. They were told to write down their best answer even if they were not sure. The task took 10–15 min to administer. One sixth grader did not complete the general information task. The split-half reliability of this measure (Spearman-Brown corrected) was .83.

Title Recognition Test. The Title Recognition Test was designed as an analog of recognition measures that had previously been used to assess amount of exposure to print in adults (Stanovich & West, 1989). The version of the TRT used in the present investigation was similar to the children's measure used in a previous research project on print exposure effects (Cunningham & Stanovich, 1990), except that the instrument had been improved on the basis of the results of the earlier investigation. Specifically, items that demonstrated poor psychometric properties in the previous investigation (e.g., those demonstrating ceiling or floor effects for children of this age) were removed and replaced by more promising candidates. The version used in this investigation consisted of a total of 39 items: 25 actual children's book titles and 14 foils for book names. The titles were selected from a sample of book titles generated by groups of children in pilot investigations. In selecting the 25 items to appear on the TRT, an attempt was made to choose titles that were not prominent parts of the classroom reading activities in the particular schools participating in this investigation. Because we wanted the TRT to probe out-of-school rather than school-directed reading, an attempt was made to avoid authors and books that were regularly studied in the school curriculum. Of course, versions of the TRT constructed for other classrooms will quite necessarily differ somewhat in item content. The foils were generated by us and randomly interspersed among the actual book titles. The list of children's titles appearing on the TRT is presented in the Appendix, along with the percentage recognition for each item. The foil titles are listed at the bottom of Appendix, but on the actual TRT forms they were interspersed with the real titles.

The TRT was group administered within each classroom. The instructions that were read to the subjects and that were printed on their response sheets were as follows: "Below you will see a list of book titles. Some of the titles are the names of actual books and some are not. You are to read the names and put a check mark next to the names of those that you know are books. Do not guess, but only check those that you know are actual books. Remember, some of the titles are not those of popular books, so guessing can easily be detected." On the response sheet that the subjects completed, this measure was labeled the "Title Recognition Questionnaire" and was referred to in this manner by the experimenter. The TRT took approximately 5 min to administer. One sixth grader did not complete the TRT. For each subject, the number of correct targets identified (sample $M = 12.6$, $SD = 4.8$) was recorded as well as the number of foils checked (sample $M = 1.7$, $SD = 2.5$). The reliability of the number of correct items checked was .82 (Cronbach's alpha).

Scoring of Measures

The raw numbers of correct items answered on the Raven, spelling, PPVT–R and general information tasks were employed in the analyses that follow. For the verbal fluency measure, the numbers of appropriate responses on each of the four trials were summed. For the three tasks that involved discriminating targets from foils (the TRT, phonological coding task, and word checklist), the performance measure was the proportion of correct targets checked minus the proportion of foils checked. This is the discrimination index from the Two-High Threshold Model of recognition performance (Snodgrass & Corwin, 1988) and was used in preference to the One-High Threshold Model correction for guessing sometimes employed in paradigms of this type (e.g., Anderson & Freebody, 1983; Graesser & Nakamura, 1982) because the latter index becomes insensitive to differential guessing rates when target detection probability nears 1.0, as was the case for some subjects on some of our tasks.

Procedure

Raven's matrices were administered in one session approximately one week prior to the administration of the other tasks. The remaining tasks were administered in one session that lasted approximately one and a half hours. Both sessions took place either in the student's classroom or in a special resource room. The majority of the children received the tasks in the following order: general information, PPVT–R, spelling, verbal fluency, TRT, word checklist, and phonological coding. Because of logistical problems, a few subjects received the TRT after the phonological coding task rather than before the word checklist. Two experimenters always administered the tasks to the students. One experimenter read the directions out loud to the students, and the second experimenter walked around the room, helping students when necessary and generally monitoring student participation.

Results

For an initial examination of the correlates of print exposure differences, performance on our recognition measure, the TRT, was classified as high or low based on a median split of the scores within each of the grades. The high- and low-scoring groups from each of the grades were then collapsed to form the high- and low-print-exposure groups. Table 1 presents a comparison of the means on the primary variables in the study for the high-TRT and low-TRT children. Performance on the TRT differentiated the subjects on each of the variables in the study. A similar pattern was obtained in each of the grades separately.

Table 1
Means for Children High and Low on the Title Recognition Test (TRT)

Variable	Low TRT	High TRT	t
TRT	.246	.524	11.03***
Raven	37.5	40.3	2.30*
Phonological coding	.445	.605	3.18**
Spelling	8.3	11.3	3.95***
Word checklist	.640	.807	4.43***
Verbal fluency	15.2	19.1	5.18***
PPVT–R	16.9	18.5	3.17**
General information	10.8	12.4	2.89**

Note. Raven = Raven Standard Progressive Matrices; PPVT–R = Peabody Picture Vocabulary Test—Revised. $df = 128$ for verbal fluency; $df = 130$ for TRT and general information; $df = 131$ for all other tasks.
* $p < .05$, two-tailed. ** $p < .01$, two-tailed. *** $p < .001$, two-tailed.

A more complete picture of all of the relationships among the variables is provided by Table 2, where performance on all of the tasks, in addition to the child's age in months, was intercorrelated. The TRT displayed significant correlations with all of the variables in the study, although the magnitude of the correlations varied somewhat. The strongest relationships were obtained with the spelling and word checklist tasks. Somewhat smaller correlations were obtained with the verbal fluency, PPVT-R, and general information measures. Low, but significant, correlations were observed with performance on the Raven and phonological coding tasks.

The results displayed in Tables 1 and 2 indicate that performance on the TRT was significantly related to measures of spelling, word knowledge, verbal fluency, vocabulary, and general knowledge. In the next series of analyses, we examined the question of whether print exposure, as measured by the TRT, is an independent predictor of these criterion variables. In all of the analyses, we employed the entire sample and partialed out age in months as the first variable. Parallel analyses conducted for each grade separately revealed identical trends.

Table 3 presents the results of a series of hierarchical regression analyses in which age was entered first, followed by performance on Raven's matrices and finally TRT performance. Thus, after partialing out age, these analyses removed the effects of general ability (as measured by the Raven) and examined whether TRT performance was related to the residual variance in each of the variables in the study. The results presented in Table 3 indicate that this question is answered in the affirmative. Table 3 presents the R, R^2, R^2 change, and F to enter at each step in the hierarchical regression. The beta weight of each variable in the final (simultaneous) regression is also presented. For each of the variables in the study, TRT predicts variance after age and Raven performance have been partialed out, and in several cases the unique variance predicted is considerable. Additionally, in all of the analyses except one (phonological coding), the beta weight for the TRT in the final regression equation was larger than that for the Raven.

Table 4 presents the results of hierarchical regression analyses that provide an even more stringent test of the ability of TRT to predict independent variance in verbal skills and general knowledge. Here, performance on the phonological coding task was entered subsequent to Raven performance but prior to the TRT in the regression equation. These analyses thus provide an even stronger guarantee against spurious relationships, because they rule out one of the most obvious third variables: decoding ability. As is clear from the table, the TRT remains a significant unique predictor of all five criterion variables.

We conducted another set of analyses in an attempt to determine how far the TRT's ability to account for unique variance could be extended. In the hierarchical regression analyses presented in Table 5, performance on the word checklist was entered into the equation after phonological coding performance but before the TRT. One way to conceive of word checklist performance in these analyses is as a control

Table 3
Unique Print Exposure Variance After Age and Raven Measure Are Partialed Out

Dependent variable	R	R^2	R^2 change	F to enter	Final β
Phonological coding					
Age	.047	.002	.002	0.30	−.135
Raven	.424	.179	.177**	28.08	.353
TRT	.474	.225	.046**	7.57	.233
Spelling					
Age	.179	.032	.032*	4.31	.045
Raven	.414	.172	.140**	21.95	.248
TRT	.570	.325	.153**	29.36	.428
Word checklist					
Age	.103	.011	.011	1.41	−.038
Raven	.457	.209	.198**	32.57	.317
TRT	.606	.368	.159**	32.45	.436
Verbal fluency					
Age	.043	.002	.002	0.24	−.071
Raven	.231	.053	.051**	6.89	.100
TRT	.471	.222	.169**	27.40	.445
PPVT-R					
Age	.230	.053	.053**	7.29	.115
Raven	.393	.154	.101**	15.60	.211
TRT	.515	.266	.112**	19.58	.365
General information					
Age	.224	.050	.050**	6.84	.122
Raven	.362	.131	.081**	12.05	.187
TRT	.476	.227	.096**	15.83	.337

Note. Raven = Raven Standard Progressive Matrices; TRT = Title Recognition Test; PPVT-R = Peabody Picture Vocabulary Test—Revised.
* $p < .05$. ** $p < .01$.

Table 2
Intercorrelations Among the Major Variables

Variable	1	2	3	4	5	6	7	8	9
1. Age	—								
2. Raven	.07	—							
3. Phonological coding	−.05	.42	—						
4. Spelling	.18	.39	.61	—					
5. Word checklist	.10	.45	.55	.68	—				
6. Verbal fluency	.04	.23	.47	.62	.50	—			
7. PPVT-R	.23	.32	.19	.32	.32	.16	—		
8. General information	.22	.29	.27	.41	.43	.44	.66	—	
9. Title Recognition Test	.27	.31	.31	.52	.53	.46	.46	.43	—

Note. Raven = Raven Standard Progressive Matrices; PPVT-R = Peabody Picture Vocabulary Test—Revised. Correlations greater than .17 are significant at the .05 level (two-tailed).

Table 4
Unique Print Exposure Variance After Age and Raven and Phonological Coding Measures Are Partialed Out

Dependent variable	R	R^2	R^2 change	F to enter	Final β
Spelling					
Age	.179	.032	.032*	4.31	.110
Raven	.414	.172	.140**	21.95	.076
Phonological coding	.656	.430	.258**	58.51	.486
TRT	.713	.509	.079**	20.42	.315
Word checklist					
Age	.103	.011	.011	1.41	.005
Raven	.457	.209	.198**	32.57	.194
Phonological coding	.610	.372	.163**	33.49	.364
TRT	.683	.466	.094**	22.52	.346
Verbal fluency					
Age	.043	.002	.002	0.24	−.039
Raven	.231	.053	.051**	6.89	−.024
Phonological coding	.477	.228	.175**	28.47	.370
TRT	.582	.339	.111**	21.02	.372
PPVT-R					
Age	.230	.053	.053**	7.29	.108
Raven	.393	.154	.101**	15.60	.211
Phonological coding	.403	.162	.008	1.21	.011
TRT	.516	.266	.104**	18.19	.364
General information					
Age	.224	.050	.050**	6.84	.140
Raven	.362	.131	.081**	12.05	.138
Phonological coding	.410	.168	.037*	5.68	.140
TRT	.492	.242	.074**	12.37	.304

Note. Raven = Raven Standard Progressive Matrices; TRT = Title Recognition Test; PPVT-R = Peabody Picture Vocabulary Test—Revised.
* $p < .05$. ** $p < .01$.

for method variance. That is, while the response and cognitive requirements of the TRT are quite low, recognition memory is still required for the items. In a previous investigation (Cunningham & Stanovich, 1990), we attempted to ensure that the predictive part of the task was not intertwined with memory ability by partialing out performance on a memory task before entering the TRT as a predictor of the criterion variables. The word checklist provides an even more stringent control, because its cognitive requirements are identical to those of the TRT: The subject must recognize familiar items in the context of unfamiliar foils. However, it is important to understand that inclusion of the word checklist in a hierarchical regression before the TRT severely biases the analyses against the latter. Print exposure is probably a major determinant of word knowledge as indexed on a task like the word checklist (see Table 4), and thus too much variance is being partialed out from the TRT in these analyses.

Nevertheless, the results presented in Table 5 indicate that the TRT remains a significant predictor of all four criterion variables even after general ability (the Raven), decoding ability (phonological coding task), and a word knowledge measure that shares method variance with the TRT (word checklist) have been entered into the equation. This is an impressive result indeed when one considers that at least two of the prior variables (phonological coding and word checklist performance) almost surely are in relationships of reciprocal causation with print exposure and thus are stealing some unknown proportion of predictive variance that might more fairly be attributed to the TRT.

The analyses displayed in Table 6 examine the robustness of the TRT as a predictor of unique variance by substituting spelling performance for word checklist performance as a memory control (in this case recall, rather than recognition, of letter strings). The TRT was a significant predictor of each criterion variable when entered last into the equation.

It should be noted that although the TRT was a robust predictor of unique variance in the verbal abilities examined in the previous analyses, it does display discriminant validity. In a hierarchical regression analysis predicting Raven matrices performance, the TRT is not a significant predictor after age, phonological coding, and spelling have been entered into the equation (R^2 change = .017, F to enter = 2.78, *ns*). Thus, print exposure, as measured by the TRT, is more tightly linked to verbal ability and knowledge measures than to nonverbal measures of general ability.

Because the TRT turned out to be such a potent predictor of word knowledge, vocabulary, and general knowledge, we conducted a further analysis that examined the consequences of a mismatch between general cognitive ability and print exposure. While not losing sight of the correlational nature of the data, we may, for example, ask whether print exposure can compensate for modest levels of general cognitive abilities, at least in a statistical sense. The comparisons presented in Table 7 address this issue. Within each grade, the sample was

Table 5
Unique Print Exposure Variance After Age and Raven, Phonological Coding, and Word Checklist Measures Are Partialed Out

Dependent variable	R	R^2	R^2 change	F to enter	Final β
Spelling					
Age	.179	.032	.032*	4.31	.106
Raven	.414	.172	.140**	21.95	.003
Phonological coding	.656	.430	.258**	58.51	.346
Word checklist	.753	.566	.136**	40.18	.386
TRT	.767	.588	.022*	6.60	.179
Verbal fluency					
Age	.043	.002	.002	0.24	−.033
Raven	.231	.053	.051**	6.89	−.056
Phonological coding	.477	.228	.175**	28.47	.284
Word checklist	.556	.309	.081**	14.73	.224
TRT	.606	.367	.058**	11.32	.292
PPVT-R					
Age	.230	.053	.053**	7.29	.108
Raven	.393	.154	.101**	15.60	.201
Phonological coding	.403	.162	.008	1.21	−.007
Word checklist	.433	.187	.025*	3.94	.049
TRT	.517	.268	.081**	13.96	.347
General information					
Age	.224	.050	.050**	6.84	.137
Raven	.362	.131	.081**	12.05	.096
Phonological coding	.410	.168	.037*	5.68	.061
Word checklist	.482	.232	.064**	10.62	.218
TRT	.517	.267	.035*	5.93	.227

Note. Raven = Raven Standard Progressive Matrices; TRT = Title Recognition Test; PPVT-R = Peabody Picture Vocabulary Test—Revised.
*$p < .05$. **$p < .01$.

classified according to a median split of performance on the TRT and on the Raven. The resulting 2 × 2 matrix revealed 58 children who were discrepant: 28 children were low on the Raven but high on the TRT (low-ability/high-print group; scoring 34.7 and 0.476, respectively), and 30 children were high on the Raven but low in print exposure (high-ability/low-print group; scoring 43.8 and 0.271, respectively). These two groups were then compared on all of the variables in the study. What is interesting is that the low-ability/high-print group was not significantly worse on any other variable in the study. Indeed, these children scored significantly higher on the verbal fluency measure.

Table 8 displays a similar analysis pitting print exposure against decoding ability, as measured by the phonological coding task. Within each grade, the sample was classified according to a median split of performance on the TRT and on the phonological coding task. The resulting 2 × 2 matrix revealed 51 children who were discrepant: 25 children were low in decoding ability but high on the TRT (low-decoding/high-print group; scoring 0.309 and 0.511, respectively), and 26 children were high in decoding ability but low in print exposure (high-decoding/low-print group; scoring 0.777 and 0.269, respectively). These two groups were then compared on all of the variables in the study. Not surprisingly, the high-decoding/low-print group was superior on the spelling task. Interestingly, however, there were no significant differences in favor of the high-decoding/low-print group on any other task. In fact, the low-decoding/high-print group displayed PPVT-R scores that were almost significantly superior ($p <$ .07, two-tailed). Although inferences from these correlational analysis must be tentative, the results do suggest that print exposure can bolster certain knowledge bases, even in children with low decoding or low general ability, and that low ability need not necessarily hamper the development of vocabulary and verbal knowledge as long as the children are exposed to a lot of print. Finally, the results of these analyses also serve to reaffirm the construct validity of the TRT as a measure of print exposure.

Discussion

A variety of these analyses indicated that print exposure is a significant unique predictor of spelling, several measures of word and vocabulary knowledge, and general world knowledge. General ability does not account for the link between print exposure and verbal skill, nor does general ability in combination with phonological coding ability.

The latter is a particularly important outcome, because there are numerous ways in which a variable like phonological coding skill might mediate a relationship between print exposure and a variable like vocabulary size. High levels of decoding skill—certainly a contributor to greater print exposure—might provide relatively complete verbal contexts for the induction of word meanings during reading, or alternatively, decoding skill might indirectly reflect differences in short-term phonological storage that are related to oral vocabulary learning, particularly in the preschool years (Gathercole & Baddeley, 1989). If print exposure were only an incidental

Table 6
Unique Print Exposure Variance After Age and Raven, Phonological Coding, and Spelling Measures Are Partialed Out

Dependent variable	R	R^2	R^2 change	F to enter	Final β
Word checklist					
Age	.103	.011	.011	0.23	−.035
Raven	.457	.209	.198**	32.57	.157
Phonological coding	.610	.372	.163**	33.49	.159
Spelling	.722	.522	.150**	40.18	.417
TRT	.745	.555	.033**	9.42	.220
Verbal fluency					
Age	.043	.002	.002	0.24	−.066
Raven	.231	.053	.051**	6.89	−.044
Phonological coding	.477	.228	.175**	28.47	.155
Spelling	.629	.395	.167**	34.59	.436
TRT	.655	.428	.033**	7.24	.219
PPVT–R					
Age	.230	.053	.053**	7.29	.110
Raven	.393	.154	.101**	15.60	.202
Phonological coding	.403	.162	.008	1.21	−.021
Spelling	.434	.189	.027*	4.20	.067
TRT	.518	.268	.079**	13.76	.341
General information					
Age	.224	.050	.050**	6.84	.120
Raven	.362	.131	.081**	12.05	.124
Phonological coding	.410	.168	.037*	5.68	.054
Spelling	.464	.215	.047**	7.57	.176
TRT	.507	.257	.042**	7.12	.248

Note. Raven = Raven Standard Progressive Matrices; TRT = Title Recognition Test; PPVT-R = Peabody Picture Vocabulary Test—Revised.
* $p < .05$. ** $p < .01$.

correlate of vocabulary because of its link with phonological coding skill, then the TRT could not serve as a unique predictor of vocabulary once phonological coding was partialed out. This prediction was repeatedly falsified in our data. The most stringent analysis (see Table 5) indicated that the TRT was a unique predictor of performance on the PPVT–R after not only phonological coding but also general ability and an analogously structured recognition measure had been partialed out. Print exposure was similarly a unique predictor of spelling ability, verbal fluency, and general knowledge.

These analyses suggest that print exposure, although clearly a consequence of developed reading ability, is probably a significant contributor to the development of other aspects of verbal intelligence. Such rich-get-richer (and their converse, poor-get-poorer) effects are becoming of increasing concern to educational practitioners (Adams, 1990; Chall, 1989) and are playing an increasingly prominent role in theories of individual differences (Anderson et al., 1988; Chall, Jacobs, & Baldwin, 1990; Hayes, 1988; Hayes & Ahrens, 1988; Juel, 1988; Nagy & Anderson, 1984; Siegel, 1989; Stanovich, 1986, 1988, 1989; van den Bos, 1989). Nevertheless, the analyses of ability–exposure discrepancies (Tables 7 and 8) seem to indicate that even the child with limited reading skills will build vocabulary and knowledge structures through reading.

Table 7
Differences Between Children With Low Ability but High Print Exposure (LA/HPE) and Children With High Ability but Low Print Exposure (HA/LPE)

Variable	LA/HPE (n = 28)	HA/LPE (n = 30)	t (df = 56)
Phonological coding	.518	.560	−0.56
Spelling	10.0	9.4	0.54
Word checklist	.744	.743	0.01
Verbal fluency	19.2	16.0	3.11[a]
PPVT–R	17.3	17.3	0.03
General information	11.2	11.0	0.22

Note. PPVT–R = Peabody Picture Vocabulary Test—Revised.
[a] Significant difference favoring LA/HPE group.

Future research will further refine the TRT as a measure of print exposure and examine its relationship to other indexes, including activity diaries. We may admit the drawbacks of our measure and at the same time recognize its potential to serve as a quick probe of individual differences in print exposure. For example, it is clear that the TRT will not measure absolute levels of print exposure in terms of time spent reading or number of words read. Instead, the TRT was designed as a measure reflecting relative individual differences in exposure to print. Additional drawbacks are also apparent. For example, it is clear that to get credit for a correct item on the TRT, one need only have some familiarity with the title. However, this seemingly problematic feature—that responses can be based on general familiarity rather than on a more complete reading of the book—may not be quite the drawback it seems. Drawing attention to the possibility of responding on the basis of a shallow familiarity serves to emphasize the fact that the TRT is not cognitively demanding and that it does not load on memory as much as do some other tasks in

Table 8
Differences Between Children With Low Decoding Ability but High Print Exposure (LD/HPE) and Children With High Decoding Ability but Low Print Exposure (HD/LPE)

Variable	LD/HPE (n = 25)	HD/LPE (n = 26)	t (df = 49)
Raven	38.5	41.0	−1.48
Spelling	9.0	11.7	−2.57[a]
Word checklist	.739	.796	−1.17
Verbal fluency	17.0	17.3	−0.25
PPVT–R	18.1	16.7	1.90
General information	11.6	10.9	0.71

Note. Raven = Raven Standard Progressive Matrices; PPVT–R = Peabody Picture Vocabulary Test—Revised.
[a] Significant difference favoring HD/LPE group.

which children might be asked to volunteer titles or information about plot and/or characters. Requiring this sort of recall may cause children to fail to index books read so long ago that they have been partially forgotten. Title recognition appropriately allows such imperfectly recalled items to influence the obtained print exposure score.

Finally, we of course admit that some of our conclusions represent a leap to causal inferences from correlational data, and there may well be additional third variables that we have not considered here. However, the third-variable problem is endemic to all correlational research on the cognitive correlates of reading; this literature continues to be dominated by correlational rather than experimental studies. Our conservative regression strategy goes further than most investigations to stack the deck against our favored variable. In future investigations, we will put our conjectures about the effects of print exposure to even more stringent tests.

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(Appendix follows on next page)

Appendix

Title Recognition Test Items

Item	% recognition	Item	% recognition
Titles		Titles *(continued)*	
A Light in the Attic	75.2	*Misty of Chincoteague*	6.0
How to Eat Fried Worms	64.7	*Henry and the Clubhouse*	22.6
Call of the Wild	51.9	*Dear Mr. Henshaw*	69.9
The Chosen	17.3	*Harriet the Spy*	42.9
Tales of a Fourth Grade Nothing	88.7	*The Lion, the Witch and the Wardrobe*	68.4
The Polar Express	32.3		
The Indian in the Cupboard	73.7	Foils	
The Cybil War	24.8	*Joanne*	4.5
Homer Price	26.3	*It's My Room*	11.3
Heidi	56.4	*Hot Top*	5.3
Freedom Train	49.6	*Don't Go Away*	10.5
James and the Giant Peach	85.7	*The Hideaway*	16.5
By the Shores of Silver Lake	32.3	*The Missing Letter*	15.8
Superfudge	67.7	*The Rollaway*	7.5
Dr. Dolittle	58.6	*Sadie Goes to Hollywood*	19.5
From the Mixed-Up Files of Mrs. Basil E. Frankweiler	45.9	*The Schoolhouse*	17.3
		He's Your Little Brother!	19.5
Island of the Blue Dolphins	80.5	*Ethan Allen*	3.0
Ramona the Pest	75.2	*The Lost Shoe*	19.5
Iggie's House	21.1	*Skateboard*	12.0
The Great Brain	25.6	*Curious Jim*	10.5

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