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Print Exposure as a Predictor of Word Reading and Reading Comprehension in Disabled and Nondisabled Readers

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The relation of print exposure, measured by a revised version of Cunningham and Stanovich's (1990) Title Recognition Test (TRT), to word reading and reading comprehension was examined in disabled and nondisabled readers, Grades 5–9. In disabled readers, the TRT was a significant predictor of word reading when phonological skill was accounted for but not when orthographic ability was added to the regression equation, suggesting that the TRT overlaps considerably with orthographic skill. The TRT significantly predicted nondisabled readers' word reading after both phonological and orthographic skills were accounted for. The TRT contributed significantly to reading comprehension once variance was partialed from higher order reading processes for disabled readers only. The TRT's power to predict comprehension may be ascribed to the effects of print exposure on automaticity of word recognition, knowledge, or familiarization with text structure.

There is growing evidence for and interest in print exposure as a predictor of skills involved in reading. Many studies have tried to measure exposure to print outside of the classroom. Perhaps the most common method of measuring print exposure until recently has been through the use of questionnaires, in which children and adults are asked to estimate the amount of time they spend reading. Questionnaires are easy to administer and appear to be a straightforward way to gather data. However, the questionnaire technique has been found to be unreliable (Cunningham & Stanovich, 1990) and probably encourages the tendency to respond in a socially desirable way, rather than in a truthful one, so that subjects may report reading more than they do in reality (Sharon, 1973–1974). However, Stanovich and his colleagues (Cunningham & Stanovich, 1990, 1991; Stanovich & Cunningham, 1992; Stanovich & West, 1989) have developed measures of exposure to print that are both reliable and less subject to social desirability effects.

These measures have been successful on divergent samples. Stanovich and West (1989) began the development of a unique print exposure measure, the Author Recognition Test (ART), with adults. They found that this measure accounted for variance in word reading skills after both phonological and orthographic abilities were entered into a regression equation as predictors of word recognition. Stanovich and West further noted that the ART was highly correlated with word recognition skills when the words were irregular, so that orthographic skills were presumably emphasized in reading them. The authors concluded that the ART was particularly useful in accounting for variability in orthographic skills.

Cunningham and Stanovich (1990) applied the same technique used in constructing the ART to create the Title Recognition Test (TRT), which was also designed to measure print exposure. The original TRT was given to third- and fourth-grade children. The TRT also proved to be a reliable and predictive measure. It accounted for additional variance in word recognition skill after the researchers controlled for phonological processing, memory, age, and nonverbal intelligence. The TRT, like the ART in adults, appeared to be particularly sensitive to variability in orthographic processing. In a follow-up study (Cunningham & Stanovich, 1991), the TRT was found to be predictive of children's spelling, vocabulary, verbal fluency, and word knowledge after phonological skills and differences in nonverbal intelligence were accounted for. The TRT even predicted additional variance in general information as measured by the Peabody Individual Achievement Test. The authors suggested that print exposure, as measured by the TRT, makes a unique contribution to verbal skills related to reading.

Clearly, the TRT accounts for unique variance at the word level and is important in predicting spelling, understanding, generating, and reading of words. The TRT has also been shown to be uniquely associated with general knowledge. All of these skills contribute to reading performance. What is lacking in the TRT literature at this point is an assessment of this instrument as a predictor of reading comprehension. Furthermore, the utility of the TRT in predicting reading skills among reading disabled subjects has not been investigated. Although the TRT has been found to make an independent contribution to vocabulary knowledge, verbal fluency, and general knowledge (Cunningham & Stanovich, 1991)—all meaningful skills related to reading comprehension—it has not, with the exception of one recent study (Cipielewski & Stanovich, 1992), been used as a predictor of reading comprehension itself. Cipielewski and Stanovich

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found that even when both decoding skill and third-grade reading comprehension ability were used to predict reading comprehension in fifth grade, tests of print exposure (both the TRT and the ART) accounted for unique fifth-grade reading comprehension variance. However, reading-disabled subjects were not assessed as a group in that study.

In the present study, we sought to investigate the unique contribution of the TRT to reading comprehension after partialing out the effects of word recognition. We recognize that there are several higher order processes that may contribute to reading comprehension. These processes might be significant in mediating the effects of the TRT on reading comprehension. In the present study, three of these variables, tapping theoretically very different kinds of skills, were measured, along with the TRT and word-level measures, to predict reading comprehension. These three variables—vocabulary knowledge, metacognitive understanding, and memory ability—are detailed below.

Vocabulary is an influential contributor to reading comprehension. Knowledge of the meanings and connotations of individual words making up the text help the reader to understand the ideas being communicated in a book or an article. Vocabulary instruction has been shown to improve reading comprehension (Beck, Perfetti, & McKeown, 1982). Several investigators have asserted that vocabulary knowledge and reading comprehension have a reciprocal relationship (see Stanovich, 1988, for a review). Thus, whereas vocabulary knowledge aids the reader in understanding a text, frequency of reading likewise improves one's vocabulary.

A second potentially significant factor in reading comprehension is metacognition about reading. Metacognition is thinking about thinking. In reference to reading comprehension, metacognition is important because it focuses on strategies that readers use to comprehend and on the ways in which they plan, monitor, and repair their comprehension (Jacobs & Paris, 1987). Skilled readers are facile at a number of reading strategies, such as predicting what comes next in a story, checking to make sure they understand what they read, and looking forward and backward in a story (Baker & Brown, 1984; Ryan, 1981). In contrast, younger and poorer readers are not as good as older, more skilled readers at knowing or applying metacognitive strategies to aid them in reading comprehension. Poor readers tend to equate reading with decoding, whereas good readers focus more on the metacognitive processes involved (Wong, 1987). The focus placed on metacognitive strategies by good readers suggests that a developed sense of metacognition about reading may contribute to good reading comprehension.

A third process that has been found to contribute to reading comprehension variation is memory ability (e.g., Saarnio, Oka, & Paris, 1990). Whether memory ability affects one's reading ability or reading ability influences one's memory capacity is unclear (Bryant & Bradley, 1985). It is clear, however, that in general poor readers perform word- and sentence-level recall tasks at a lower level than do good readers (Mann & Liberman, 1984). An inability to hold information in one's awareness may cause individuals with poor memories to forget previous information as they are concentrating on gaining new information. Furthermore, such memory difficulties have also been found to be associated with phonological problems in poor readers (Crain & Shankweiler, 1990; Mann & Liberman, 1984).

In the present study, the contribution of the TRT to two aspects of reading was measured. First, this study attempted to replicate work relating the TRT and components of word identification conducted with a random sample of children (Cunningham & Stanovich, 1990, 1991) and extend it to the population of children with a reading disability. Second, the TRT was used to predict reading disabled and normally achieving students' reading comprehension. We hypothesized that additional variance in reading comprehension can be predicted by the TRT, even after partialing out the variance due to cognitive ability, phonological and orthographic skills, vocabulary, metacognitive understanding, and memory.

Because reading comprehension seems to involve many important skills, not all of which have been investigated to the same extent, any ordering of such skills is necessarily somewhat arbitrary. In the present study, for the purpose of conducting hierarchical regression analyses with several variables to predict reading comprehension, we hypothesized the variables' rankings to be as follows. Word identification was considered, by definition, first and most necessary for reading comprehension. Cognitive ability, broadly defined, was ranked second in significance, because of its wide applicability in the processing of various phenomena, from understanding a chain of events in a story to grasping causality in a history or science text. Two of the other specific higher order variables, vocabulary and memory, were then ranked, respectively, as third and fourth. This decision was arbitrary. Metacognition was considered least important because it has thus far been given relatively sparse attention in experiments predicting reading comprehension from other higher order variables.

Method

Subjects

Eighty-five subjects were tested for this study. The reading-disabled group (n = 36) was defined as fifth-grade through ninth-grade students who scored at the 25th percentile and below on the Woodcock Reading Mastery Tests—Word Identification test (Woodcock, 1987). Thirty-two of these students came from a school for students with learning disabilities, and 4 were from public schools. Breakdowns of the groups by grade, sex, and ethnicity are presented in Table 1.

All reading-disabled subjects qualified for learning disability classes on the basis of a discrepancy between IQ and reading achievement, but the original scores used to classify the subjects were not available. These reading-disabled students had a mean percentile rank of 10.4 (range = 0.1% to 25.0%) on the Woodcock Word Identification test. The nondisabled readers (n = 49) were defined as 5th- through 8th-graders who scored above the 25th percentile on the Woodcock Word Identification test. The subjects were obtained from four public schools in middle to upper middle class neighborhoods. The nondisabled readers' mean percentile

Table 1
Numbers of Subjects by Grade, Sex, and Ethnic Identity for Disabled and Nondisabled Readers

Variable	Disabled readers	Nondisabled readers
Grade		
Fifth	5	15
Sixth	11	12
Seventh	9	10
Eighth	6	12
Ninth	5	0
Sex		
Male	25	24
Female	11	25
Ethnicity		
White	29	39
Hispanic	1	1
Black	4	0
Asian	1	7
East Indian	1	2

rank on the Woodcock Word Identification test was 62.9 (range = 28.0% to 97.0%). All testing took place between April and June of 1991.

Procedure

Subjects were tested in three sessions during school hours. Session 1 consisted only of the group administration of the Stanford Reading Comprehension test and the Stanford Reading Vocabulary test, subtests of the Stanford Achievement Test (SAT), the forms of which varied depending on subjects' age. This test was administered by individual classroom teachers in February (public schools, eighth edition of the SAT) or March (private school, seventh edition of the SAT) of 1991. During the second session, several tests were administered to each subject individually by Catherine McBride-Chang, Franklin R. Manis, or Rebecca G. Custodio. The Test of Nonverbal Intelligence (Brown, Sherbenou, & Johnsen, 1982), the Woodcock Word Identification test (Woodcock, 1987), the Peabody Picture Vocabulary Test (Dunn & Dunn, 1981; the results of which are not included in the present study), the Memory for Words test of the Woodcock-Johnson Tests of Cognitive Ability—Revised (Woodcock & Johnson, 1989), and the Memory for Sentences test of the Woodcock-Johnson Tests of Cognitive Ability—Revised (Woodcock & Johnson, 1989) were given to all subjects during this session. The nonstandardized Metacognitive Questionnaire (Jacobs & Paris, 1987) and an expanded version of the TRT for older children were also administered during this session. In Session 3, the two computer-based measures (nonword pronunciation and orthographic choice) were administered along with several other experimental tasks not analyzed in the present study.

Measures

Stanford Reading Comprehension Test. For the Stanford Reading Comprehension test, which is group administered, respondents read various story passages. They are then given questions to answer in a multiple-choice format. The reliability of this test (Form E) is .95 for Grade 5, .94 for Grade 6, and .95 for Grade 7; reliabilities for Grades 8 and 9 are of similar magnitudes.

Stanford Reading Vocabulary Test. The Stanford Reading Vocabulary test is also group administered. The tester reads the sentences and the four multiple-choice options to the respondents. Respondents select the word from the four choices that is the best answer to the question. The reliabilities of this test (Form E) range from .86 to .89 for Grades 5–7; reliabilities for Grades 8 and 9 are of similar magnitude.

Test of Nonverbal Intelligence. The Test of Nonverbal Intelligence is administered to subjects nonverbally. The format is similar to that used in the Raven's (1960) Standard Progressive Matrices. The examiner points to a blank square on a page with a pattern, indicating that this blank should be filled with the appropriate pattern selection. The examiner then points to each of four choices for the appropriate pattern at the bottom of the page and then again to the blank square. Respondents are required to figure out the task on their own and to select the appropriate answer by pointing. Patterns become increasingly difficult as the test progresses. This test has an internal consistency reliability ranging from .80 to .90 for ages 9 to 18 years.

Woodcock Word Identification test. The Woodcock Word Identification test, a subtest of the Woodcock Reading Mastery Tests (Woodcock, 1987) requires respondents to read a list of individual words aloud. These words become more difficult as the test proceeds. Standard scores were obtained from tables normed for subjects' grades (Woodcock, 1987). For students in Grades 1–9, the split-half reliability coefficient for this test ranges from .91 to .98.

Memory for Words test of the Woodcock-Johnson Tests of Cognitive Ability—Revised. The Memory for Words test, a subtest of the Woodcock-Johnson Tests of Cognitive Ability—Revised (Woodcock & Johnson, 1989), requires respondents to recall lists of words. These lists are presented by the examiner and orally repeated by the subject after the whole list has been given. For ages 6–18 years, the internal consistency reliability on this test ranges from .69 to .83.

Memory for Sentences test of the Woodcock-Johnson Tests of Cognitive Ability—Revised. In the Memory for Sentences test, which is a subtest of the Woodcock-Johnson Tests of Cognitive Ability—Revised (Woodcock & Johnson, 1989), respondents listen to sentences played on a tape recorder and are instructed to repeat each sentence after it has been heard in its entirety. Sentences increase in length as the task proceeds. The internal consistency reliability for this test for children ages 6–18 years ranges from .80 to .90.

Metacognitive Questionnaire. Created by Jacobs and Paris (1987), the 20-item Metacognitive Questionnaire gives respondents three choices for each answer, weighted 0, 1, and 2, respectively. Each question is designed to assess the subject's metacognitive awareness about reading. Four areas of metacognitive awareness are measured: evaluation, planning, regulation, and conditional knowledge. The entire survey and each of the three answers for each question were tape recorded in the present study, and subjects read along with the tape and circled the appropriate answer. Evaluation items include "How are the last sentences of a story special?" with the following responses: "a. They are the exciting, action sentences. b. They tell you what happened. c. They are harder to read." Regulation items include such questions as, "What do you do if you don't know what a whole sentence means?" The following response options were given: "a. Read it again. b. Sound out all of the words. c. Think about the other sentences in the paragraph." The questionnaire was tape recorded to ensure that the disabled readers could complete it with the least amount of frustration possible. For this questionnaire, respondents are told to "pick the best answer for you" for each question, so that they are not biased toward orienting their answers metacognitively. Scores are derived by adding each answer's weighted score (possible scores range from 1 to 40). Among fifth graders, an 8-month span between testing and retesting of the instrument yielded a Pearson product–moment correlation of .55. Our measure of internal consistency reliability for this questionnaire was consistent with this figure: .56.

Title Recognition Test. The TRT is a list of titles of real and false books. Children are instructed to check off each title on the list that they know to be an actual book. They are told that the list contains some false titles as well so that they should not guess. Reliability for the original measure (Cunningham & Stanovich, 1991), for third and fourth graders, was .81. Our revised measure contains all of Cunningham and Stanovich's items and an additional 13 targets chosen from lists of books nominated as favorites by 6th through 8th graders in a pilot study, as well as national lists of students' favorites at each grade level. (See Appendix for a list of all of the titles included in the revised TRT.) Scoring of this measure consists of the percentage of correct titles selected minus the percentage of foils selected. Therefore, it is theoretically possible for scores to range from −100 to 100. The reliability for the revised TRT is .84.

Nonword naming. We designed the nonword naming test as a measure of phonological ability. Nonwords, which are spelled with the same sequences of letters as are English words (e.g., barp, fant), were displayed on a computer screen. The students read these nonwords aloud as quickly and as accurately as they could. The possible scores for nonword naming ranged from 1 to 100. The measure used in the present analyses, accuracy, had an internal consistency reliability of .72.

Orthographic choice. Adapted from the work of previous researchers (Cunningham & Stanovich, 1990; Olson, Kliegl, Davidson, & Foltz, 1985), the orthographic choice task required subjects to discriminate between two alternative spellings of a word that sound alike. The pairs (e.g., turn–tirn) were presented on a computer screen, and subjects were required to press as quickly as possible a button corresponding to the location of the real word (to the left or the right of the display). Scores on this measure could range from 1 to 32. Accuracy was the measure of interest for this task. Its internal consistency reliability was .76.

Results

The means and standard deviations of the two groups on each measure used in the present study, along with *t* tests for the differences between them, are given in Table 2. A few of the subjects had missing data on one or more of the tests, resulting in small variations in sample sizes for the different analyses. As can be seen from Table 2, the reading-disabled students were significantly lower on the Test of Nonverbal Intelligence. In fact, the normal readers scored significantly higher than did the reading-disabled subjects on every measure except the Metacognitive Questionnaire.

The intercorrelations of all of the measures used as predictors or as criterion variables in the present study are given in Table 3 for the reading-disabled subjects and in Table 4 for the nondisabled readers. The variable, Memory, is a composite variable made up of the two subtests of short-term memory from the Woodcock-Johnson Tests of Cognitive Ability—Revised. For the nondisabled readers, the orthographic processing variable did not correlate significantly with the word recognition variable (r = .24). In fact, neither the phonological nor the orthographic variables correlated significantly with the revised TRT for the nondisabled readers (respective *r*s = .20 and .19), whereas each was significantly associated with the revised TRT for the reading-disabled group (respective *r*s = .36 and .54). Interestingly, the phonological and orthographic measures were not significantly correlated with each other for either group (*r*s = .12 and .08 for disabled and nondisabled readers, respectively). This lack of association for the nondisabled readers was due, in large part, to a ceiling effect for these readers on the orthographic choice measure. The range of correct responses for this group on this measure was 27 to 32 (maximum possible = 32), whereas for the reading-disabled group, the scores spanned 18 to 32 correct.

Table 2
Means and Standard Deviations on All Measures for Reading Disabled and Nondisabled Subjects

	Disabled readers			Nondisabled readers			t test	
Variable	*M*	*SD*	*n*	*M*	*SD*	*n*	*t*	*df*
Age (years)	12.9	1.3	36	12.4	1.2	49	1.78	84
Test of Nonverbal Intelligence (percentile)	36.3	23.9	35	53.2	28.3	49	−2.89**	83
Word Identification (percentile)	10.4	8.6	36	62.9	17.7	49	−18.08**	84
Reading Vocabulary (percentile)	47.9	24.8	36	71.3	26.4	49	−4.14**	84
Reading Comprehension (percentile)	28.2	20.2	36	73.3	23.5	49	−9.28**	84
Memory for Sentences (percentile)	47.8	28.5	36	65.5	29.2	48	−2.79**	83
Memory for Words (percentile)	51.0	29.9	36	67.7	29.7	49	−2.55*	84
Metacognitive Questionnaire (% correct)	72.3	8.3	36	75.8	8.8	49	−1.89	84
Nonword naming (% correct)	64.0	13.2	36	88.2	7.0	48	−9.36**	83
Orthographic choice (% correct)	81.9	13.4	36	94.4	4.3	48	−5.29**	83
Revised title recognition test	27.6	17.1	34	45.5	17.6	48	−4.57**	81

Note. Word Identification = Word Identification test of the Woodcock Reading Mastery Tests; Reading Vocabulary = Stanford Reading Vocabulary Test; Reading Comprehension = Stanford Reading Comprehension Test; Memory for Sentences = Memory for Sentences test of the Woodcock-Johnson Tests of Cognitive Ability; Memory for Words = Memory for Words test of the Woodcock-Johnson Tests of Cognitive Ability. Percent correct is given for the nonstandardized tests. The Title Recognition Test score is the percent of correct titles selected minus the proportion of foils selected.
* $p < .05$. ** $p < .01$.

Table 3
Intercorrelations Among Variables for Disabled Readers

Variable	1	2	3	4	5	6	7	8	9	10
1. Age	—									
2. Test of Nonverbal Intelligence	−.06	—								
3. Memory	−.03	.26	—							
4. Reading Vocabulary	.38	−.00	.36	—						
5. Metacognitive Questionnaire	.41	−.06	.15	.30	—					
6. Nonword naming	−.05	.10	.08	−.01	−.01	—				
7. Orthographic choice	.31	−.20	.19	.12	.38	.12	—			
8. Revised title recognition test	.14	.26	.35	.21	.15	.36	.54	—		
9. Word Identification	.49	−.03	.30	.38	.43	.37	.51	.49	—	
10. Reading Comprehension	.36	−.15	.19	.37	.35	.18	.55	.64	.63	—

Note. Memory = Memory for Sentences and Memory for Words tests of the Woodcock-Johnson Tests of Cognitive Ability; Reading Vocabulary = Stanford Reading Vocabulary Test; Word Identification = Word Identification test of the Woodcock Reading Mastery Tests; Reading Comprehension = Stanford Reading Comprehension Test. For correlations of .33 and higher, $p < .05$; for correlations of .43 and higher, $p < .01$.

We obtained separate regression equations for each group to answer two questions. First, it was important to determine whether the TRT predicts word identification before and after phonological and orthographic skills are taken into account. Second, we wanted to find out whether the revised TRT uniquely predicts orthographic skill after age and phonological skill are partialed out of the equation. Age was included because the age range in the present study was wider than those of previous studies, so it was important to control for effects of age in all regression equations. Results of the regression analyses for the reading-disabled students are given in Table 5.

As can be seen from Table 5, the measure of orthographic processing used in the present study and the revised TRT overlapped a great deal in the contribution of each to the prediction of word recognition. The two correlated .54, and once the orthographic choice variable was entered into the equation to predict word recognition, the revised TRT failed to account for additional variance in word reading. However, the revised TRT did account for substantial extra variance when only phonological ability and age were used to predict word recognition. Finally, the revised TRT accounted for significant variance in predicting orthographic processing ability.

As shown in Table 6, the orthographic choice variable was much less important for the nondisabled subjects. This variable was not significant when age, phonological ability, orthographic ability, and the revised TRT were used in combination to predict word recognition. In fact, orthographic choice failed to correlate significantly with either the revised TRT or word recognition. For the nondisabled readers, the revised TRT accounted for additional variance in word recognition not captured by phonological and orthographic ability. The R^2 change from the three- to the four-predictor model was statistically significant. The revised TRT did not, however, predict orthographic ability for these nondisabled readers, again most probably because of ceiling effects on the orthographic measure.

The prespecified order of variables entered to predict reading comprehension was as follows: age, word identification, the Test of Nonverbal Intelligence, reading vocabulary, composite measure of short-term memory, metacognition, and, finally, the revised TRT. According to the correlations among the predictor variables, as well as the correlations of these predictors with reading comprehension, we used regression equations with different predictors for the nondisabled and the disabled readers. When a potential predictor did not correlate significantly with reading

Table 4
Intercorrelations Among Variables for Nondisabled Readers

Variable	1	2	3	4	5	6	7	8	9	10
1. Age	—									
2. Test of Nonverbal Intelligence	.12	—								
3. Memory	.38	.28	—							
4. Reading Vocabulary	.38	.38	.73	—						
5. Metacognitive Questionnaire	.16	.27	.42	.48	—					
6. Nonword naming	.01	.33	.40	.22	.07	—				
7. Orthographic choice	.18	.42	−.10	−.04	−.09	.08	—			
8. Revised title recognition test	.19	.37	.35	.46	.05	.20	.19	—		
9. Word Identification	.51	.48	.61	.62	.19	.57	.24	.47	—	
10. Reading Comprehension	.22	.39	.49	.59	.40	.05	.15	.32	.41	—

Note. Memory = Memory for Sentences and Memory for Words tests of the Woodcock-Johnson Tests of Cognitive Ability; Reading Vocabulary = Stanford Reading Vocabulary Test; Word Identification = Word Identification test of the Woodcock Reading Mastery Tests; Reading Comprehension = Stanford Reading Comprehension Test. For correlations of .29 and higher, $p < .05$; for correlations of .38 and higher, $p < .01$.

Table 5
Regression Analyses Predicting Word Recognition for Disabled Readers

Dependent variable/predictor	R^2	R^2 change
Word Identification		
Age	.157	.157*
Nonword naming	.284	.127*
Revised title recognition test	.395	.111*
Word Identification		
Age	.157	.157*
Nonword naming	.284	.127*
Orthographic choice	.372	.088*
Revised title recognition test	.414	.042
Orthographic choice		
Age	.044	.044
Nonword naming	.048	.008
Revised title recognition test	.329	.281**

Note. Word Identification = Word Identification test of the Woodcock Reading Mastery Tests. n = 34.
* $p < .05$. ** $p < .01$.

comprehension for one group, it was excluded from further analyses for that group. For the reading-disabled subjects, the memory composite factor and the Test of Nonverbal Intelligence, both of which correlated nonsignificantly with reading comprehension (respective *r*s = .19 and −.15), were omitted from a regression equation predicting reading comprehension. As each new predictor was added to the equation, the revised TRT was included as well, to determine at which point in the hierarchical regression equation the revised TRT ceased to be a unique significant predictor of reading comprehension. The revised TRT was a unique significant predictor of reading comprehension for the reading-disabled subjects at every step. Therefore, only the final regression equation—with age, word identification, reading vocabulary, metacognitive understanding, and the revised TRT used to predict reading comprehension—is shown in Table 7.

As can be seen from Table 7, the revised TRT is a powerful contributor to reading comprehension, accounting for 17% of the variance in reading comprehension by itself. Because orthographic choice correlated significantly (.55) with reading comprehension (see Table 3), it was substituted for word identification in an additional equation predicting reading comprehension. With age, orthographic choice, reading vocabulary, metacognition, and the revised TRT used to predict reading comprehension, the equation was again significant, $F(5, 28) = 5.46$, $p = .001$; $R^2 = .49$, adjusted $R^2 = .40$. In this equation, age and reading vocabulary each captured 7% of the variance, orthographic choice captured 19%, and the revised TRT was responsible for 16% of the variance in reading comprehension.

For the nondisabled subjects, the revised TRT ceased to be a significant predictor of reading comprehension as soon as word identification was added to the regression equation, as shown in Table 8. Therefore, as a predictor of reading comprehension in these children, who were reading at or above the 25th percentile, the revised TRT accounted for very little unique variance.

Given that reading comprehension could not be predicted independently by the TRT in nondisabled readers, we wanted to determine whether the TRT would predict reading vocabulary performance for this group. We entered predictor variables in hierarchical regression analyses in the same order used to predict reading comprehension. The results of these analyses are shown in Table 9. The revised TRT was not a significant predictor of vocabulary knowledge once word identification ability was entered into the equation. We did not carry out a similar regression sequence for the reading-disabled subjects because the revised TRT failed to correlate significantly with vocabulary knowledge. In fact, the only significant correlates of vocabulary for disabled readers were the Woodcock Word Identification test and the Stanford Reading Comprehension test.

Discussion

A central goal of the study was to replicate and extend previous studies investigating relationships among word reading, print exposure, and orthographic processing. For the nondisabled readers, the R^2 increase of 7.7%, with the inclusion of the revised TRT to predict word recognition, was significant, replicating previous findings (Cunningham & Stanovich, 1990). Even after phonological and orthographic processing were taken into account, the revised TRT still contributed significantly to the prediction of word recognition skills. The revised TRT was not highly correlated with either phonological or orthographic ability for this group. The former result corroborates the findings of Cunningham and Stanovich (1990), and the latter may be due to a ceiling effect associated with the orthographic variable.

For disabled readers, the revised TRT contributed significantly to predicting word reading skill when it was entered after phonological skill and age. However, once orthographic processing was introduced as an additional variable to be partialed out in the regression equation, the unique variance contributed by the revised TRT diminished greatly. This was most likely attributable to the moderate correlation

Table 6
Regression Analyses Predicting Word Recognition for Nondisabled Readers

Dependent variable/predictor	R^2	R^2 change
Word Identification		
Age	.265	.265*
Nonword naming	.582	.317*
Revised title recognition test	.666	.084*
Word Identification		
Age	.265	.265*
Nonword naming	.582	.317*
Orthographic choice	.594	.012
Revised title recognition test	.671	.077*
Orthographic choice		
Age	.032	.032
Nonword naming	.036	.004
Revised title recognition test	.059	.023

Note. Word Identification = Word Identification test of the Woodcock Reading Mastery Tests. n = 47.
* $p < .01$.

Table 7
Regression Analyses Predicting Reading Comprehension for Disabled Readers

Variable	t	Semipartial r^2
Age	0.29	.07
Word Identification	1.30	.24
Reading Vocabulary	0.75	.02
Metacognitive Questionnaire	0.65	.00
Revised title recognition test	3.14*	.17

Note. Word Identification = Word Identification test of the Woodcock Reading Mastery Tests; Reading Vocabulary = Stanford Reading Vocabulary Test. For this equation, overall $F(5, 28) = 5.79$, $p < .001$, $R^2 = .51$, adjusted $R^2 = .42$. For t tests, $df = 33$.
* $p < .01$.

(.54) between the revised TRT and orthographic processing for this group.

Taken together, the data from nondisabled and disabled readers corroborate Cunningham and Stanovich's findings. The revised TRT accounts for a significant amount of word identification variance, independent of phonological decoding skill.

The second part of our study focused on how well print exposure, as measured by the revised TRT, predicted reading comprehension. Although the variables used were not exhaustive, they represent a fairly thorough cross-section of factors previously shown to predict reading comprehension. Included in the study were measures of nonverbal intelligence, vocabulary knowledge, short-term memory, metacognitive understanding, and word recognition, as well as print exposure. Our focus was not on the unique contribution of each variable but rather on whether print exposure by itself would be an important unique contributor to reading comprehension.

For the disabled readers, the revised TRT and word identification equally were the two variables most strongly related to reading comprehension (rs = .64 and .63, respectively). The only other variables that correlated with reading comprehension were vocabulary and metacognition. When the revised TRT was entered after the other variables (word identification, vocabulary, and metacognition), it explained an additional 17% of the variance.

The reading comprehension measure used in the present study, the Stanford Reading Comprehension test, consists of passages requiring both literal and inferential processing. It is timed, probably taxing the word identification abilities of disabled readers. In addition, this test contains vocabulary that is likely to be challenging, particularly for disabled readers. Metacognitive understanding may also be important to readers in deciding how to deploy reading and comprehension skills adequately. Nevertheless, the TRT captures significant variance in reading comprehension beyond that explained by these other variables. Why does the TRT seem to make such a strong contribution to reading comprehension for disabled readers?

It appears from past studies that exposure to print contributes to word identification, verbal intelligence, vocabulary ability, general comprehension, and reading comprehension (Cipielewski & Stanovich, 1992; Cunningham & Stanovich, 1991; Share & Silva, 1987; Stanovich & Cunningham, 1992). For disabled readers, who tend to read less than do nondisabled readers, in part because of poor word decoding skills, the resulting lack of exposure to print can cause further cognitive deficits. These deficits have been attributed in part to Matthew effects, (Stanovich, 1986) from a Biblical reference to the rich (in this case, those who are rich in reading-related skills) getting richer. One interpretation of the present results is that print exposure mediates these effects for disabled readers. Part of the benefit of greater experience with print for poor readers might be increased practice with orthographic processing, which is particularly helpful for word reading.

However, an additional possibility is that, insofar as the TRT measures exposure to print, it contributes to increased automaticity in word identification that is not measured by an untimed test such as the Woodcock Word Identification test. Perfetti and Hogaboam (1975) argued that fast and efficient word reading is an important factor in reading with comprehension. Good reading comprehension probably comes about only when there is facility, not just minimal ability, with word reading. A brisk reading rate may optimize the intake of ideas presented in a text. The question of TRT contribution to speed of word reading is one path to pursue in future research.

Another possible benefit of print exposure may occur at a higher level. Increased exposure to the written word may encourage greater interest and persistence in reading challenging text, as well as enhanced general knowledge, vocabulary knowledge, and familiarity with different types of text structure (expository, narrative, etc.). Relative differences in amount of reading, as indexed by TRT scores, may promote increased world knowledge, in both breadth and depth (Stanovich & Cunningham, 1992). Understanding of complex syntactic constructions, which are much more likely to be encountered in written text than in daily conversation or on television, is also likely to be influenced by exposure to print (Stanovich & Cunningham, 1992).

Table 8
Regression Analyses Predicting Reading Comprehension for Nondisabled Readers

Equation/variable	t	Semipartial r^2
Equation 1		
Age	1.13	.05
Revised title recognition test	2.35*	.11
Equation 2		
Age	0.35	.05
Word Identification	1.31	.10
Revised title recognition test	1.50	.04

Note. Word Identification = Word Identification test of the Woodcock Reading Mastery Tests. $n = 47$. For Equation 1, overall $F(2, 44) = 4.07$, $p < .025$, $R^2 = .16$, adjusted $R^2 = .12$. For Equation 2, overall $F(3, 43) = 3.33$, $p < .05$, $R^2 = .19$, adjusted $R^2 = .13$. For t tests, $df = 46$.
* $p < .05$.

Table 9
Regression Analyses Predicting Vocabulary Knowledge for Nondisabled Readers

Equation/variable	*t*	Semipartial r^2
Equation 1		
Age	2.19	.12
Revised title recognition test	3.05*	.15
Equation 2		
Age	0.64	.12
Word Identification	3.17*	.25
Revised title recognition test	1.62	.04

Note. Word Identification = Word Identification test of the Woodcock Reading Mastery Tests. $n = 47$. For Equation 1, overall $F(2, 44) = 8.35, p < .001, R^2 = .28$, adjusted $R^2 = .24$. For Equation 2, overall $F(3, 43) = 10.06, p < .001, R^2 = .41$; adjusted $R^2 = .37$. For *t* tests, $df = 46$.
$^* p < .01$.

The TRT by itself was a significant predictor of reading comprehension for the nondisabled readers as well as the reading-disabled students. However, when age, word identification, and the revised TRT were used to predict reading comprehension, the revised TRT failed to account for unique variance. Word reading, therefore, appears to capture most of the variance contributed to reading comprehension by print exposure in the present study. Whether this is due to the more advanced level of development of word identification and reading comprehension in this group, as compared with disabled readers, or to differences in the ways in which nondisabled and disabled readers develop reading comprehension is unclear at present.

The most significant factor explaining the lack of a unique TRT–reading comprehension link in the present sample of nondisabled readers may be that these children tended to score quite high in reading comprehension. Of these 49 readers, 33 ranked above the 70th percentile on this measure. Thus, there was some restriction of range on the reading comprehension measure. As a result, the relationship between the revised TRT and reading comprehension in the full range of normal reading ability could not be tested in the present study. Disabled readers, on the other hand, exhibited much more variability in their reading comprehension skills. Given a random sample of readers, that included the full range of reading comprehension abilities, it seems likely that the TRT would contribute to reading comprehension, as it has in previous studies (e.g., Cipielewski & Stanovich, 1992).

The TRT, in its current form, may also be influenced by other factors, such as knowledge of vocabulary and cultural norms, which in some subcultures might not be appropriate. Nevertheless, in the present study as well as in several others (Cunningham & Stanovich, 1990, 1991; Stanovich & West, 1989), the finding that the TRT accounted for additional variance in a variety of reading and language skills beyond phonological decoding ability suggests that it does tap into a unique domain most appropriately referred to as exposure to print. These results, coupled with the high reliability of this measure in the present study, as well as in previous studies, suggest that the TRT is among the purest and best measures of print exposure devised to date.

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Appendix

Book Titles Included in the Revised Title Recognition Test

Real Book Titles

By the Shores of Silver Lake
Call of the Wild
The Cat Ate My Gymsuit
The Chosen
The Cybil War
Dear Mr. Henshaw
The Diary of Anne Frank
Dr. Doolittle
Flowers in the Attic
Freedom Train
From the Mixed-up Files of Mrs. Basil E. Frankweiler
The Great Brain
Harriet the Spy
Heidi
Henry and the Clubhouse
Homer Price
How to Eat Fried Worms
Iggie's House
The Indian in the Cupboard
Island of the Blue Dolphins
James and the Giant Peach
A Light in the Attic
The Lion, the Witch and the Wardrobe
Little Women
Lord of the Flies
Misty of Chincoteague
Mrs. Frisby and the Rats of NIMH
My Brother Sam is Dead
The Pinballs
The Polar Express

Real Book Titles *(cont'd)*

Ramona the Pest
The Secret Garden
Superfudge
Tales of a Fourth Grade Nothing
Ten Little Indians
Tiger Eyes
A Tree Grows in Brooklyn
Where the Red Fern Grows
The Witch of Blackbird Pond

Book Title Foils

Curious Jim
Don't Go Away
Ethan Allen
He's Your Little Brother
The Hideaway
Hot Top
It's My Room
Joanne
The Missing Letter
The Rollaway
Sadie Goes to Hollywood
The Schoolhouse
Skateboard

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