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Using Children's Literacy Activities to Predict Growth in Verbal Cognitive Skills: A Longitudinal Investigation

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Fourth-, fifth-, and sixth-grade children participated in a 2-year longitudinal study to determine the predictive validity of the Title Recognition Test (TRT) and the Author Recognition Test (ART), 2 checklist measures of individual differences in exposure to print. Multiple regression analyses confirmed the ability of the TRT to predict growth in receptive vocabulary, general information, spelling, sight vocabulary, verbal fluency, and reading comprehension even after controlling for age, recognition memory, and previous performance in the same cognitive competency area. The ART was found to be a less robust predictor. Although correlational, our results suggest that print exposure may be an independent contributor to cognitive growth in the verbal domain.

The ability to read and write has long been recognized as critical for the transmission of culture (Kaestle, 1991; Olson, 1994; Olson & Astington, 1990; Ong, 1982; Sticht & Armstrong, 1994). Under the assumption that exposure to print and engagement in reading activities contribute to the development of vocabulary, cultural knowledge, and general verbal facility, educators have long endeavored to foster more positive reading habits (Anderson, Heibert, Scott, & Wilkinson, 1985; Cline & Kretke, 1980; Collins, 1980; Fielding, Wilson, & Anderson, 1986; Gambrell, 1984; Hong, 1981; Manning & Manning, 1984).

The tacit model of skill acquisition underlying the assumptions of most educators is that skill development is accelerated through practice or, more explicitly, that more exposure to print through home reading will lead to further growth in reading comprehension and related cognitive skills. This model of skill acquisition is consistent with Stanovich's (1986) notion that print exposure and reading comprehension (as well as other verbal skills) are in a relationship of reciprocal causation. Exposure to print is theorized to lead to an expansion and enrichment of the semantic lexicon that then leads to the development of many language/cognitive skills and increases in general information and knowledge (Booth & Hall, 1994; Mann, 1986; Nagy & Anderson, 1984; Nagy, Herman, & Anderson, 1985; Olson, 1994; Perfetti, 1985; Stanovich, 1986). However, much of the research supporting this contention is ambiguous because it consists largely of contemporaneous zero-order correlations (see Guthrie & Greaney, 1991). In contrast, the present investigation is longitudinal in nature and allows the examination of whether measures of exposure to print can predict individual differences in *growth* in verbal abilities over time because the earlier level of verbal ability can serve as an autoregressor.

Many theorists (e.g., Nagy & Anderson, 1984; Stanovich, 1986, 1993) posit that vocabulary and cognitive growth are in part determined by engagement in free reading. However, obtaining an accurate assessment of exposure to print is extremely difficult (Allen, Cipielewski, & Stanovich, 1992; Anderson, Wilson, & Fielding, 1988; Cipielewski & Stanovich, 1992; Echols, 1994). Recognizing that self-report inventories and questionnaire techniques were plagued with social desirability problems and that diary techniques required huge investments in time and other resources, Stanovich and West (1989) developed two measures of relative print exposure that were easy to administer, that displayed adequate reliability, and that could not be contaminated by the tendency to give socially desirable responses. Stanovich and West's Author Recognition Test (ART) and Magazine Recognition Test (MRT) both included actual target items (real authors or real magazines, respectively) that were embedded among foils (names that were not authors or magazine titles, respectively). The participant chooses the names of those he or she recognizes as true authors or known magazines. The measures have a signal-detection logic in that the number of correct items checked can be corrected for differential response biases

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that are revealed by the checking of foils. Both measures have very few extraneous cognitive demands. They do not necessitate complex frequency judgments that might disadvantage those who read but lack other cognitive skills. The recognition memory that is required can be controlled for by including a parallel measure of that skill as a covariate in the study (a procedure used in the present investigation). In addition, the measures can be quickly and easily administered. Indeed, Sticht, Hofstetter, and Hofstetter (1994) have shown that they can be reliably administered from the telephone.

It is clear that these checklist measures are very indirect proxy measures of reading activity and that they reflect only *relative* individual differences in exposure to print. They obviously do not measure absolute levels of print exposure in terms of time spent reading or number of words read. To obtain such estimates, it is necessary to use other methods such as the collection of activity diaries (e.g., Allen et al., 1992; Anderson et al., 1988; Echols, 1994; Guthrie & Greaney, 1991). The fact that the measures are indirect proxy indicators is, of course, problematic in some contexts. Clearly, hearing about an author on television without having been exposed to the actual written work is problematic. However, other situations in which an individual is familiar with an author's name but has not actually read the author's work do not reduce the validity of the measures. In many cases, knowledge of an author's name is still a proxy for reading activities, even though that particular author has not actually been read. This is because many behaviors leading to familiarity with the author names (whether or not the particular authors have been read) are themselves indicators of immersion in a literate environment (e.g., seeing an author's books in a bookstore, reading a review of the author's work in *Newsweek,* seeing an author's book in the "new fiction" section at the library, seeing an advertisement for the latest Danielle Steel book in the newspaper).

Cunningham and Stanovich (1990, 1991) demonstrated the utility of an analogous measure for children, the Title Recognition Test (TRT). This instrument is similar to the adult ART and MRT but uses the titles of popular children's books rather than authors and magazines. A children's version of the ART has also been tested (Cipielewski & Stanovich, 1992). Allen et al. (1992) and Echols (1994) found that the checklist recognition technique appeared to measure the construct of non-school print exposure at least as well as the resource-demanding diary strategy that has better reliability than interview or questionnaire instruments (Anderson et al., 1988).

Previous studies (e.g., Anderson et al., 1988; Cipielewski & Stanovich, 1992) have focused on the relationship between print exposure and growth in reading comprehension skill. In the present study we examined a variety of different reading subskills and also assessed print exposure during several different periods throughout the longitudinal investigation (unlike the Cipielewski & Stanovich study in which print exposure was assessed only at the end of the testing period). We also sought to determine the ability of the children's TRT and ART to predict growth in measures of verbal cognitive abilities over a 2-school-year developmental period. The analyses to be reported specifically examine whether exposure to print can account for variance in verbal abilities not accounted for by level of verbal ability at the time of the first testing. That is, they examine whether individual differences in print exposure can explain individual differences in growth in verbal abilities during 2 school years.

Method

Participants

In fall 1989, 157 students from the fourth (n = 50), fifth (n = 59), and sixth grades (n = 48) from an elementary school and a middle school in a medium-sized school district in a rural county in western Virginia were recruited to participate in the study. The students were predominantly Caucasian and native to the area. Students came from a wide range of socioeconomic levels. Children who were identified as having emotional disturbance, specific learning disabilities, or intellectual impairment were not included in the sample. At the conclusion of the study, in April and May 1991, complete data had been collected for 123 (78%) of the children who participated in the 1989–1990 phase of the study. Initial test performance on all measures did not differ statistically between those who completed the study and those who did not.

In the first year of the study, the fourth-grade sample was composed of 31 boys and 19 girls (M age = 9 years, 8 months; SD = 5.7 months). The fifth-grade sample was composed of 29 boys and 30 girls (M age = 10 years, 6 months; SD = 5.1 months). The sixth-grade sample was composed of 24 boys and 24 girls (M age = 11 years, 7 months; SD = 4.9 months). At the conclusion of the second year of the longitudinal study, 40 fifth graders (26 boys and 14 girls; M age = 11 years, 2 months), 45 sixth graders (23 boys and 22 girls; M age = 12 years, 0 months), and 38 seventh graders (19 boys and 19 girls; M age = 13 years, 0 months) remained in the sample. There were few significant sex differences on any of the variables in the study; therefore, sex is not examined further. The assessment battery was administered to the children in fall 1989, spring 1990, and spring 1991. The tasks were group administered in two 1-hour sessions.

Measures of Verbal Cognitive Skills

Peabody Picture Vocabulary Test. An adaptation of the revised Peabody Picture Vocabulary Test, Form L (PPVT; Dunn & Dunn, 1981) was used as a measure of receptive vocabulary (see Cunningham & Stanovich, 1991). The test was group administered and consisted of 25 of the PPVT plates ranging from Item 49 to Item 128. Stimuli were projected onto a screen to provide adequate visibility during the group presentation. The specific 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.* A standard administration procedure was used in which the children were told they would be looking at four numbered-picture alternatives while the experimenter said a word aloud. The experimenter said the name of each word twice. The children then wrote down the number of their selected pictures on a separate score sheet. Descriptive data, including Cronbach's alpha reliability estimate, are presented in Table 1.

General Information subtest. The General Information subtest of the Peabody Individual Achievement Test (PIAT; Dunn & Markwardt, 1970) was used as an indicator of the children's

general knowledge. The condensed 18-item test used by Cunningham and Stanovich (1991) was utilized in the present investigation so that it could be group administered. The items ranged 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 that were administered were Items 20, 22, 24, 26, 28, 31, 35, 38, 45, 49, 54, 55, 56, 59, 60, and 62. The experimenter read each question aloud twice to the children, who were instructed to write down their best answer on a score sheet provided. They were told that they were going to be asked questions about the world in which we live and that many questions were very difficult but to make their best guess if they were not sure. The task took 10 to 15 minutes to administer. Descriptive data, including a Cronbach's alpha reliability estimate, are presented in Table 1.

Spelling 1. This 20-word spelling task was identical to that used in the Cunningham and Stanovich (1991) study. Fourteen words were selected from the PIAT, and six other words were selected for their utilization of specific phonological and orthographic structures. The words were *sugar, thumb, cloudy, dollar, towel, science, dangerous, succeed, vegetable, marriage, disease, business, excellence, committee, fudge, island, champion, cupboard, chocolate,* and *nothing.* 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 they could ask the experimenter to repeat the word if they did not understand what was said. The children were told that some of the words were very difficult and that they were not expected to be able to spell them all, but that they should try to spell as much of each word as they could. The spelling task took approximately 10 minutes to administer. Scores on the measure were simply the number of words spelled correctly. Descriptive data, including a Cronbach's alpha reliability estimate, are presented in Table 1.

Spelling 2. An additional 20-word spelling measure was added to the battery in the spring of 1991. These words were selected from the Developmental Stage Spelling List developed by Bear and Barone (1989) to provide an additional spelling measure. The words were *bed, ship, drive, bump, when, train, closet, chase, float, beaches, preparing, popping, cattle, caught, inspection, puncture, cellar, pleasure, squirrel,* and *fortunate.* As with the previous spelling task, the experimenter pronounced each word, used each word in a standardized sentence (e.g., "I sleep in a *bed* at night"), and pronounced the word again. The children were told they could ask the experimenter to repeat the word if they did not understand what was said. Descriptive data are presented in Table 1.

Vocabulary Checklist. This task used a checklist-with-foils format used by several previous investigators (e.g., Anderson & Freebody, 1983; Cunningham & Stanovich, 1991; West & Stanovich, 1991; White, Slater, & Graves, 1989) to provide a reliable measure of reading vocabulary. The stimuli for this task were 27 words taken from Form M of the PPVT-R and 13 pronounceable nonwords taken from a similar recognition vocabulary measure used by Zimmerman, Broder, Shaughnessy, and Underwood (1977). The specific words used were *solar, ankle, swamp, wrist, argument, competition, judicial, antler, snarling, grooming, composer, fragment, wedge, compass, gnawing, nuisance, bugle, scholar, musician, parallel, portable, construction, funnel, cliff, secretary, shore* and *angle.* The nonwords were *arrate, disler, hould, falfold, subting, reweat, plabage, dropant, ordiful, seblement, sheal, thimmery,* and *wiltial.* The words and nonwords were randomly intermixed throughout the list presented to the children. The children were told that the list contained 40 letter strings and that some strings were actual words and some were not. They were instructed to read through the list and to put a checkmark by those they knew were words and not to guess if they were not sure. The checklist took about 5 minutes to administer. For each participant, the number of correct targets identified was recorded as was the number of foils checked. Scoring on the task was determined by taking the proportion of the correct items that were checked and subtracting the proportion of foils checked. This is the discrimination index from the two-high threshold model of recognition performance (Snodgrass & Corwin, 1988). Other corrections for guessing and differential criterion effects (see Snodgrass & Corwin, 1988) produced virtually identical correlational results. The derived scores for all other checklist-with-foils measures used in this study were calculated in this way. Descriptive data on the vocabulary checklist task are presented in Table 1.

Virginia Literacy Passport Test. Scores from the Reading Comprehension subtest of the Virginia Literacy Passport Test (Virginia Department of Education, 1993) was administered to 104 children who had been tested in 1989. This test, which is admin-

Table 1
Mean Scores, Standard Deviations, Cronbach's Alphas, and Number of Students for Measures for Fall 1989 (n = 157), Spring 1990 (n = 148), and Spring 1991 (n = 123) Test Administrations

	Fall 1989			Spring 1990			Spring 1991		
Variable	*M*	*SD*	α	*M*	*SD*	α	*M*	*SD*	α
PPVT	17.4	3.5	.72	17.9	3.8	.75	20.0	3.7	.73
PIAT Gen Info	11.8	3.6	.81	13.3	3.1	.79	14.4	2.9	.77
Spelling set 1	9.6	4.5	.88	11.4	4.5	.88	13.3	4.1	.85
Spelling set 2[a]	—	—	—	—	—	—	15.6	3.4	.83
Vocab Checklist	.66	.27	.91	.75	.23	.88	.81	.21	.91
TRT	.31	.20	.85	.39	.23	.83	.48	.20	.82
ART	.13	.10	.87	.19	.19	.82	.25	.14	.80
TVRT	.65	.21	.75	.71	.18	.69	.57	.12	.82

Note. PPVT = Peabody Picture Vocabulary Test; PIAT Gen Info = General Information Subtest of the Peabody Individual Achievement Test; Spelling set 1 = first set of spelling words; Spelling set 2 = second set of spelling words; Vocab Checklist = Vocabulary Checklist; TRT = Title Recognition Test; ART = Author Recognition Test; TVRT = Television Show Recognition Checklist.

[a] Measure administered only in spring 1991.

istered in the spring of a student's sixth-grade year, is part of a legislatively mandated testing program of the Virginia Department of Education. The reading section of this test includes 11 nonfiction passages, ranging from 300 to 350 words in length, that are read by the students, who then answer 77 multiple-choice comprehension questions. The mean score on this measure was 272.1 (SD = 14.5; range = 239–300).

Measures of Print Exposure

TRT. This checklist-with-foils task consisted of 40 items adapted from the 39-item test developed by Cunningham and Stanovich (1990, 1991). The version of the TRT used in this investigation included only items that were not titles commonly part of the school curriculum (N = 25), based on the rationale that the TRT was designed to measure relative differences in exposure to print that children might experience outside of the context of school. The remaining 15 titles were foils for book names. The children were group administered the list and told that some of the titles were the names of actual books and some were not. They were instructed to put a check in the space after each that they knew were actual book titles. They were told not to guess and that guessing could be detected. This task took about 5 min to administer. Scoring was the same as in the vocabulary checklist measure (proportion correct minus proportion of foils checked). Descriptive data on the task are presented in Table 1. Further reliability and validity data on this recognition checklist measure of print exposure are provided in Allen et al. (1992), Cunningham and Stanovich, and West, Stanovich, and Mitchell (1993).

ART. This checklist-with-foils task consisted of 40 items adapted from the test developed by Allen et al. (1992). Twenty-five items were the names of actual authors of children's books. The remaining 15 names were foils composed of names of individuals drawn from the bibliography of Arthur Heilman's *Principles and Practices of Teaching Reading* (third edition). The children were group administered the list and told that some of the names were the names of actual authors of children's books and some were not. They were instructed to circle the number next to each name they know to be an actual author of children's books. Descriptive data are presented in Table 1.

Television Show Recognition Checklist. The Television Show Recognition Checklist (TVRT), expanded from a measure developed by West, Stanovich, and Mitchell (1993), was included. This checklist was analogous to the TRT and ART and was included as a control measure of title recall for use as a covariate in regression analyses. The task is used to partial method variance that is shared with the TRT and ART, perhaps because of extraneous cognitive requirements. Forty names of network television programs that had aired shortly before the task were mixed among 20 foils, which were not titles of real programs. Instructions, administration, and scoring were analogous to the other checklist measures. Descriptive data are presented in Table 1. Although the increase in mean TVRT score from the fall of 1989 to the spring of 1990 was expected, the subsequent decrease in this score was unanticipated. The TVRT was not revised to reflect changes in the 1990–1991 television season, and, perhaps, such changes were responsible for the decline.

Results

As the zero-order correlations displayed in Tables 2 to 6 indicate, the two measures of print exposure (TRT and ART) were significantly associated with the criterion measures in the study in every case. This finding replicates the results of previous studies and indicates that there is a significant association between exposure to print and verbal

Table 2
Hierarchical Regression Analysis Predicting Spring 1991 and Spring 1990 PPVT Scores (Zero-Order Correlations in First Data Column)

Variable	r	R	ΔR^2	ΔF	Final β
Predicting Spring 1991 PPVT Score (n = 123)					
Steps 1–3 PPVT (F89), age, TVRT (F89)		.664	.440	31.21**	
Step 4					
TRT (F89)	.62**	.720	.078	19.03**	.355
TRT (S90)	.66**	.737	.103	26.65**	.408
TRT (S91)	.55**	.739	.106	27.53**	.384
ART (F89)	.33**	.665	.002	0.37	.047
ART (S90)	.37**	.677	.018	3.89	.146
ART (S91)	.36**	.712	.067	15.93**	.302
Predicting Spring 1990 PPVT Score (n = 148)					
Steps 1–3 PPVT (F89), age, TVRT (F89)		.690	.476	43.58**	
Step 4					
TRT (F89)	.56**	.722	.046	13.80**	.265
TRT (S90)	.55**	.721	.044	13.17**	.254
ART (F89)	.27**	.690	.000	0.16	.026
ART (S90)	.24*	.693	.004	1.14	.069

Note. F89 = fall 1989; S90 = spring 1990; S91 = spring 1991; PPVT = Peabody Picture Vocabulary Test; TVRT = Television Show Recognition Checklist; TRT = Title Recognition Test; ART = Author Recognition Test.
* $p < .01$. ** $p < .001$.

Table 3
Hierarchical Regression Analysis Predicting Spring 1991 and Spring 1990 PIAT General Information Score (Zero-Order Correlations in First Data Column)

Variable	r	R	ΔR^2	ΔF	Final β
Predicting Spring 1991 PIAT General Information Score (n = 123)					
Steps 1–3					
PIAT Gen Info (F89), age, TVRT (F89)		.698	.487	37.72***	
Step 4					
TRT (F89)	.55***	.718	.029	6.93**	.219
TRT (S90)	.56***	.726	.041	10.04**	.250
TRT (S91)	.47***	.724	.038	9.21**	.223
ART (F89)	.29**	.698	.001	0.04	.014
ART (S90)	.23*	.698	.001	0.05	.016
ART (S91)	.36***	.732	.048	12.14***	.249
Predicting Spring 1990 PIAT General Information Score (n = 148)					
Steps 1–3					
PIAT Gen Info (F89), age, TVRT (F89)		.816	.665	95.33***	
Step 4					
TRT (F89)	.60***	.826	.018	7.92**	.169
TRT (S90)	.62***	.839	.039	18.80***	.239
ART (F89)	.33***	.816	.002	0.62	.041
ART (S90)	.28***	.817	.002	0.94	.050

Note. F89 = fall 1989; S90 = spring 1990; S91 = spring 1991; PIAT Gen Info = General Information subtest of the Peabody Individual Achievement Test; TVRT = Television Show Recognition Checklist; TRT = Title Recognition Test; ART = Author Recognition Test.
* $p < .05$. ** $p < .01$. *** $p < .001$.

ability, vocabulary, and declarative knowledge (e.g., Cunningham & Stanovich, 1991; Lewellen, Goldinger, Pisoni, & Greene, 1993; McBride-Chang, Manis, Seidenberg, Custodio, & Doi, 1993; Stanovich & Cunningham, 1992, 1993; Stanovich, West, & Harrison, 1995; West & Stanovich, 1991). However, a more stringent test of the association between print exposure and verbal ability is provided by analyses that control for the autoregressive effects of the previous level of the criterion variable (see Anderson et al., 1988; Cipielewski & Stanovich, 1992). Such an analysis focuses on the issue of whether exposure to print can account for variance in the *growth* in the criterion variable from Time 1 to Time 2. The hierarchical regression analyses displayed in Table 2 illustrate this logic. The criterion variable analyzed in the first set of analyses is the 1991 performance on the PPVT. Entered as an autoregressor is the 1989 performance on the same test. (We have chosen not to include all previous administrations of the criterion measures as a more stringent control of autoregressive effects because of high multicollinearity. Many of the zero-order correlations between measures are extremely high, e.g., fall 1989 and spring 1990: spelling r = .9). Also entered as covariates are the children's ages and their performance on the 1989 administration of the TVRT. Performance on the latter task was used as a covariate because this task's cognitive (e.g., verbal recognition memory) and response requirements are very similar to those of the print exposure checklist measures. The task thus provides a very good control for method variance that is shared with the TRT and ART. Forcing this variable into the regression equation removed not only variance in the criterion scores specifically linked to television exposure but also variance associated with the checklist methodology.

The first analysis displayed in Table 2 indicates that, together, the children's ages, 1989 PPVT performance, and 1989 TVRT performance account for 44.0% of the variance in 1991 PPVT performance. The print exposure measures at various points in time are next presented as each is entered as the fourth step in the regression equation. For example, the 1989 administration of the TRT accounts for a statistically significant 7.8% of the variance ($p < .001$) in 1991 PPVT scores after 1989 PPVT and 1989 TVRT scores, and age are entered into the regression equation. Similarly, the 1990 administration of the TRT accounted for 10.3% of the variance ($p < .001$) in 1991 PPVT when entered as the fourth step, and the contemporaneous 1991 administration of the TRT accounted for 10.6% of the variance when entered as the fourth step ($p < .001$). The ART was not as strong a predictor of 1991 PPVT scores. The 1989 administration of the ART, although it did display a significant zero-order correlation at the .001 level, did not predict 1991 PPVT scores once the autoregressor and other covariates were in the equation. The 1990 administration of the ART accounted for a small (1.8%) proportion of the variance, but this unique variance was not statistically significant at a conventional level (p = .051). The contemporaneous 1991 administration of the ART accounted for 6.7% of the variance when entered as the fourth step ($p < .001$). The bottom half of Table 1 indicates that similar patterns were apparent when the criterion variable was the 1990 performance on

Table 4
Hierarchical Regression Analysis Predicting Spring 1991 Spelling Set 2 and Spring 1990 Spelling Set 1 Score (Zero-Order Correlations in First Data Column)

Variable	r	R	ΔR^2	ΔF	Final β
Predicting Spring 1991 Spelling Set 2 (n = 123)					
Steps 1–3					
Spelling Set 1 (F89), age, TVRT (F89)		.846	.716	100.13**	
Step 4					
TRT (F89)	.58**	.856	.017	7.61*	.171
TRT (S90)	.56**	.858	.020	8.78*	.173
TRT (S91)	.49**	.858	.020	8.83*	.159
ART (F89)	.40**	.846	.000	0.00	.001
ART (S90)	.44**	.848	.003	1.30	.063
ART (S91)	.41**	.856	.017	7.49*	.152
Predicting Spring 1990 Spelling Set 1 Score (n = 148)					
Steps 1–3					
Spelling Set 1 (F89), age, TVRT (F89)		.906	.821	219.98***	
Step 4					
TRT (F89)	.53**	.911	.009	7.63*	.125
TRT (S90)	.60**	.913	.013	11.12*	.139
ART (F89)	.45**	.907	.002	1.59	.050
ART (S90)	.45**	.907	.002	1.61	.050

Note. F89 = fall 1989; S90 = spring 1990; S91 = spring 1991; Spelling Set 1 = first set of spelling words; Spelling Set 2 = second set of spelling words (administered only in spring 1991); TVRT = Television Show Recognition Checklist; TRT = Title Recognition Test; ART = Author Recognition Test.
* $p < .01$. ** $p < .001$.

the PPVT (analyses of 1 school year's growth). The TRT, but not the ART, was a significant predictor ($p < .001$) of 1990 PPVT performance once the autoregressor and other covariates were in the equation.

The pattern of results revealed by the regression analyses presented in Table 2 indicates that print exposure (at least as measured by the TRT) proved to be a significant and enduring predictor of growth in PPVT across the 2 school years of the study. Although the findings with respect to the ART were less consistent when entered into the regression equation as the fourth step, it was a significant unique predictor in one of the analyses of the 1991 PPVT and displayed consistently significant zero-order correlations with the 1990 and 1991 administrations of the PPVT.

Table 3 presents the results of a similar set of regression analyses conducted with performance on the 1991 administration of the PIAT General Information subtest as the criterion variable. The results were remarkably similar to those obtained with PPVT. Specifically, the TRT consistently predicted variance in the 1991 PIAT after the autoregressive effects of 1989 PIAT performance and the other covariates were partialed out. The ART, although it had significant zero-order correlations in all the analyses, was only a significant unique predictor when administered contemporaneously in 1991.

The pattern of results for spelling performance (see Table 4) was structurally very similar to that obtained for the PPVT and PIAT General Information tasks except that the unique variance explained by print exposure (TRT, in particular) was lower in the case of spelling. This was because the autoregressive effects of previous spelling ability were large. The zero-order correlations between the TRT scores and spelling performance ranged from .49 to .60, and the zero-order correlations between the ART scores and spelling performance ranged from .40 to .45.

Table 5 presents the results of the hierarchical regression analyses conducted on vocabulary checklist performance. Because the autoregressive effects of previous vocabulary checklist performance left little reliable variance to explain (for 1989–1991, r = .70; for 1989–1990, r = .83), 1989 PPVT vocabulary performance served as the autoregressor in these analyses.[1] The TRT was a significant unique predictor in all three analyses, accounting for a substantial percentage of additional variance (8.4%–10.2%). The ART was a significant predictor in two of three cases and had significant zero-order correlations ($p < .01$) in all three comparisons. The 1990 results mirrored those from 1991.

Table 6 shows the relationship between the print exposure measures and scores on Reading Comprehension subtest of the Virginia Literacy Passport Test. The print exposure measures analyzed for these children were administered the year before the students were administered the comprehension test. The covariates, PPVT and TVRT, were adminis-

[1] When the 1989 vocabulary checklist score served in place of the 1989 PPVT as an autoregressor, only the fall 1989 and spring 1990 TRT remained significant predictors of the spring 1990 vocabulary checklist score.

Table 5
Hierarchical Regression Analysis Predicting Spring 1991 and Spring 1990 Vocabulary Checklist Score (Zero-Order Correlations in First Data Column)

Variable	r	R	ΔR^2	ΔF	Final β
Predicting Spring 1991 Vocabulary Checklist Score (n = 123)					
Steps 1–3					
PPVT (F89), age, TVRT (F89)		.560	.313	18.09***	
Step 4					
TRT (F89)	.54***	.630	.084	16.43***	.369
TRT (S90)	.55***	.644	.102	20.62***	.406
TRT (S91)	.44***	.631	.086	16.76***	.345
ART (F89)	.26**	.562	.003	0.40	.054
ART (S90)	.36***	.588	.033	5.82*	.197
ART (S91)	.30***	.611	.061	11.41***	.288
Predicting Spring 1990 Vocabulary Checklist Score (n = 148)					
Steps 1–3					
PPVT (F89), age, TVRT (F89)		.641	.411	33.44***	
Step 4					
TRT (F89)	.65***	.736	.131	42.88***	.447
TRT (S90)	.63***	.740	.136	43.21***	.446
ART (F89)	.30***	.647	.007	1.93	.096
ART (S90)	.39***	.676	.045	12.05***	.228

Note. F89 = fall 1989; S90 = spring 1990; S91 = spring 1991; PPVT = Peabody Picture Vocabulary Test; TVRT = Television Show Recognition Checklist; TRT = Title Recognition Test; ART = Author Recognition Test.
* $p < .05$. ** $p < .01$. *** $p < .001$.

tered from 1 to 2 years before the administration of the comprehension test. (This period varies because the different cohorts in the study were amalgamated for this analysis and because the Virginia Literacy Passport Test is administered to all children in a fixed grade [sixth]). Age of the children at the time of administration of the Virginia Literacy Passport Test was also used as a covariate. The analysis displayed in Table 6 indicates that the covariates attain a multiple correlation of .625 with the criterion variable and that both the TRT and the ART accounted for significant additional variance in comprehension ability, although the percentage of unique variance explained by the TRT was descriptively larger (7.6% vs. 4.6%).

Discussion

Several studies have used the TRT and other similar checklist recognition measures to assess relative individual differences in print exposure (e.g., Cunningham & Stanovich, 1991; Lewellen et al., 1993; McBride-Chang et al., 1993; Stanovich, 1993; Stanovich & Cunningham, 1992, 1993), and several of these studies have examined the construct validity of the measures (Allen et al., 1992; West & Stanovich, 1991; West et al., 1993). The present study demonstrates that at least some measures of exposure to print can predict individual differences in the growth of verbal cognitive abilities through the middle-school years. The TRT was a robust predictor of individual differences in every one of the longitudinal analyses conducted. The ART was not always a consistent predictor and never accounted for more unique variance than did the TRT. As is clear from Table 1, the reliabilities of the two measures were similar, but scores on the ART were considerably lower than those on the TRT. Perhaps the difficulty of the ART for children hinders the ability of this measure to serve as a sensitive index of individual differences.

In any case, the results reported here for the TRT seem to have several practical and theoretical implications. Researchers and practitioners in the reading education community are nearly unanimous in recommending that children be encouraged to spend more time engaged in literacy activities outside of school (e.g., Adams, 1990; Anderson, Hiebert, Scott, & Wilkinson, 1985; Strickland & Morrow, 1989). From a cultural standpoint, this recommendation is virtually unassailable. What is less clear, however, is the empirical status of the tacit model of skill acquisition that often underlies the recommendation to increase children's free reading. The tacit model is basically one of accelerating skill development through practice. It is thought that more exposure to print through home reading will lead to further growth in reading comprehension and related cognitive skills. As plausible as this tacit model sounds, there is actually very little evidence supporting it. Most of the available evidence is correlational—for example, research demonstrating that avid readers tend to be good comprehenders (see Guthrie & Greaney, 1991, for a review). These zero-order correlations are ambiguous because they are open to the interpretation that better readers simply choose to read more—an interpretation at odds with the tacit model

Table 6
Hierarchical Regression Analysis Predicting Future Sixth Grade Virginia Literacy Passport Test Reading Score (Zero-Order Correlations in First Data Column) (n = 104)

Variable	*r*	*R*	ΔR^2	ΔF	Final β
Steps 1–3					
PPVT (F89), age, TVRT (F89)		.625	.391	21.42**	
Step 4					
TRT	.54**	.683	.076	14.08**	.312
ART	.33**	.661	.046	8.07*	.219

Note. Virginia Literacy Passport Test was administered in the spring of students' sixth grade year; F89 = fall 1989; PPVT = Peabody Picture Vocabulary Test; Age = age at time of Virginia Literacy Passport Test; TVRT = Television Show Recognition Checklist; TRT = Title Recognition Test; ART = Author Recognition Test.
* $p < .01$. ** $p < .001$.

of skill development through practice that underlies efforts to increase children's free reading.

One reason to be wary of too readily attributing outcomes to the experiential effects of reading is that, in the study of literacy, there has been a strong tendency to overinterpret the causal effects of literacy (Graff, 1986; Stanovich, 1993; Wagner, 1987). It is for this reason that the analyses reported here were structured in a fairly conservative manner vis-à-vis the effects of print exposure. In these analyses, the tendency for those who are high in verbal abilities to be avid readers is already folded into the zero-order correlation between the earlier measure of verbal ability and print exposure and is thus removed when the partial correlation with a verbal ability at a later point in time is examined. Regression logic is conservative because the earlier zero-order linkage between verbal ability and exposure to print might in part reflect the causal effect of the latter. A particular score on the TRT reflects not just free reading in the year the task was administered but is also a proxy for literacy activities that have been ongoing since the child's first reading experiences. Thus, in allowing previous verbal ability to enter the regression equation first, some variance that rightfully should be attributed to print exposure is removed. A properly specified longitudinal model might well apportion more variance to print exposure.

Finally, entering the TVRT as a covariate in these analyses accomplishes more than simply removing the variance in the criterion variable associated with television exposure. It also increases the specificity with which the analysis isolates the variance associated with reading experience. Because the TVRT shares all the processing requirements of the TRT and ART, the TVRT also provides an excellent control for method variance. Although the cognitive requirements of the TRT and ART are quite low, to whatever extent these extraneous processing requirements are associated with performance on the criterion measures, they are removed by entering the TVRT in the equation first. Although scores on the TVRT were correlated with the criterion measures (*r*s = .36–.59), TRT scores still accounted for significant variability even after the effects of the TVRT were removed.

We view our results as providing further support for the conclusion that print exposure can account for individual differences in cognitive growth in the verbal domain. Print exposure is both a consequence of developed reading ability and a contributor to further growth in that ability and in other verbal skills. These results strengthen the case for advocating a more prominent role for reading activity in models of reading development and in general theories of cognitive development (Anderson et al., 1988; Booth & Hall, 1994; Guthrie, Schafer, & Hutchinson, 1991; Hayes, 1988; Olson, 1994; Stanovich, 1986, 1993; Stanovich & Cunningham, 1993).

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