SCIENTIFIC STUDIES OF READING, 2(1), 81–96

The Influence of Print Exposure on Syllogistic Reasoning and Knowledge of Mental-State Verbs

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This study examined the influence of print exposure on syllogistic reasoning and knowledge of mental-state verbs. One hundred thirty-three college students completed measures of reading comprehension, knowledge of mental-state verbs, syllogistic reasoning, and print exposure. A series of hierarchical regression analyses indicated that the print-exposure measure accounted for significant unique variance in performance on a measure of knowledge of mental-state verbs, even after years of college completed, grade point average, and reading comprehension were statistically controlled. Print exposure proved to be a less robust predictor of performance on a syllogistic reasoning task when examined with a parallel series of analyses. These findings suggest that even the variation in literacy activity found among college students is associated with the ability to interpret texts by enhancing the ability to deal with subtle distinctions among mental-state terms. However, the view that print exposure fosters decontextualized reasoning, as typified in syllogistic reasoning, received only very modest support from this study.

Differential experience with print has been an important mechanism in several theories of cognitive change (e.g., Greenfield, 1972; Luria, 1976; Olson, 1977,

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1994). Much of the data relevant to these theories has been cross-cultural in nature and has involved comparing literates and nonliterates (e.g., Erickson, 1984; Goody, 1987; Luria, 1976; Olson & Torrance, 1991; Scribner & Cole, 1978, 1981). For example, based on cross-cultural research in Africa, Greenfield (1972) posited that facility with written language developed a set of cognitive competencies that were more elaborate than those associated with purely oral language. Greenfield's argument was based on the context-dependency differences between written and oral language:

> If a speaker of an oral language depends upon the surrounding context to communicate his message, then effective communication presupposes a common context and common point of view for both listener and speaker. ... Speech based on a written language, in contrast, must be relatively independent of context for a number of reasons. (p. 170)

Perhaps Ong (1982) made the case for the cognitive effects of literacy most strongly: "More than any other single invention, writing has transformed human consciousness" (p. 78). The causal mechanism Ong emphasized was that "writing fosters abstractions that disengage knowledge from the arena where human beings struggle with one another. It separates the knower from the known" (pp. 43–44). Olson (1977, 1986) has presented a related causal theory of how literacy comes to influence thought. In his important 1977 essay, Olson contrasted texts (written prose statements) with utterances (informal oral-language statements). Olson's thesis was that "there is a transition from utterance to text both culturally and developmentally and this transition can be described as one of increasing explicitness, with language increasingly able to stand as an unambiguous or autonomous representation of meaning" (p. 258).

Much of the work examining the cognitive consequences of literacy has been cross-cultural in nature. However, the cognitive consequences of literacy can be studied without necessarily using a cross-cultural comparison (see Stanovich, 1993). This study, for example, examined the cognitive consequences of literacy within a generally literate society. Our procedure exploited the fact that, even within a generally literate culture, individuals vary tremendously in degree of exposure to print (see Anderson, Wilson, & Fielding, 1988; Guthrie & Greaney, 1991). Even among a group of individuals who have the same level of assessed reading-comprehension ability, remarkably large differences are found in their degree of engagement in print-related activities (see Stanovich & West, 1989), and the correlates of this natural variation can be studied. Comparing literates and illiterates is the exclusive design of choice only if the effects of literacy are believed to be completely discontinuous—with no cognitive consequences of variation in amount of print exposure among literate individuals. We speculate that the discontinuity

assumption is false and that there is measurable cognitive variation among people who differ only in their amount of reading.

Levels of print exposure are correlated with many other cognitive and behavioral characteristics. Avid readers tend to be different from nonreaders on a wide variety of cognitive skills, behavioral habits, and background variables (see Guthrie, Schafer, & Hutchinson, 1991; Kaestle, 1991; Zill & Winglee, 1990). Attributing any particular outcome to print exposure uniquely is thus extremely difficult. We used a hierarchical regression logic first introduced by Anderson et al. (1988) to deal with this specific problem. The logic of the regression analysis allows any control variables entered first into the regression equation to explain any variance that they can in the criterion variable. After these control variables have been entered, the print-exposure measures are added. Thus, the procedure allows the investigator to assess whether reliable variance remains to be explained after the control variables are entered and whether print exposure is associated with this remaining variance. Thus, in the analyses reported here, we first regressed out general measures of cognitive ability before examining the relation between print exposure and the criterion variables. The logic of our analytic strategy is quite conservative, because in certain analyses we have actually partialed out variance in abilities that are likely to be developed by print exposure itself (see Cipielewski & Stanovich, 1992; Stanovich, 1986, 1993). However, the explanatory ambiguities surrounding a variable such as print exposure have led us to continue to structure the analyses in a "worst case" manner as far as print exposure is concerned.

There are numerous difficulties involved in assessing individual differences in exposure to print. Activity-diary methods, in which daily-activity records are filled out by subjects (see Anderson et al., 1988; Greaney, 1980; Greaney & Hegarty, 1987; Rice, 1986; Taylor, Frye, & Maruyama, 1990), result in estimates of the absolute amount of time spent on literacy activities. Other techniques are available if one wants only an index of relative differences in exposure to print. For example, a variety of questionnaire and interview techniques has been used to assess relative differences in print exposure (e.g., Estes, 1971; Guthrie, 1981; Guthrie & Greaney, 1991; Guthrie & Seifert, 1983; Lewis & Teale, 1980; Sharon, 1973–1974; Walberg & Tsai, 1983), but many of these techniques are encumbered with social-desirability confounds. Responses are distorted due to the tendency to report socially desirable behaviors (see Furnham, 1986; Paulhus, 1984)—in this case, the tendency to report more reading than actually occurs (see Ennis, 1965; Sharon, 1973–1974; Zill & Winglee, 1990). This problem is particularly acute in cases such as our present study, in which relatively educated people are being asked questions about a socially valued activity (i.e., reading).

In our study, we used two recognition measures of print exposure—the Author Recognition Test (ART) and the Magazine Recognition Test (MRT)—that have proved to be robust predictors in earlier studies (e.g., Stanovich & West, 1989; West & Stanovich, 1991). In addition, these print-exposure measures have shown con-

vergent validity with other indicators, such as daily-activity diaries (see Allen, Cipielewski, & Stanovich, 1992), and they have been shown to predict reading behavior in natural settings (see West, Stanovich, & Mitchell, 1993). Both ART and MRT use a signal-detection logic whereby subjects must recognize actual target items (real authors and real magazines) embedded among foils (names that are not authors or magazine titles, respectively). There are several advantages to this checklist-with-foils method. First, it is immune to the social-desirability effects that 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 tasks can be completed quickly, and the cognitive demands of the task are quite low.

In our earlier studies, we focused on the outcome variables (orthographic knowledge, spelling skill) most closely related to the exercise of literacy (see Cunningham & Stanovich, 1991). We have also examined several indicators of the extensiveness of the declarative knowledge base (see Stanovich & Cunningham, 1992, 1993; Stanovich, West, & Harrison, 1995). In a sense, our investigations started where Scribner and Cole's (1981) investigation ended. That is, in the first part of their investigation, Scribner and Cole concentrated on looking for effects of literacy on tasks tapping developmental change in general cognitive processes. The tasks in the second part of their investigation—rebus reading, integrating auditory information, word pronunciation, communication games—were more closely tied to aspects of literacy, and the specific effects of literacy on these tasks were easier to demonstrate.

In our program of research on the cognitive consequences of differences in print exposure, we have inverted the investigative chronology of Scribner and Cole (1981) by starting with tasks that are more closely linked to literacy skills. Contingent upon positive outcomes in these domains, we have gradually begun to examine slightly more general cognitive processes. Thus, we established our methodology (see Stanovich & West, 1989) by examining criterion variables—orthographic knowledge and spelling—that should clearly be linked to individual differences in print exposure. In this study, we expanded the range of criterion variables to encompass more specific types of vocabulary-acquisition and thinking skills.

CRITERION VARIABLES IN THIS STUDY

One new criterion variable—the mental-state verbs task—was developed as a text-interpretation task. Development of this task was strongly influenced by the work of Olson and Astington (1990), who argued that the acquisition of certain metalinguistic and metacognitive terms is uniquely tied to literacy and experience with print. A simple set of verbs (e.g., *say, tell*) is used for talking about what a person says and what he or she means by it. A more elaborated set is used for talking not only about what a speaker says but also about texts and their interpretations (see Astington & Olson, 1990; Booth & Hall, 1994; Hall, Scholnick, & Hughes, 1987; Olson & Torrance, 1987).

Cognitive words (e.g., *think, know*) are a subdivision of the internal-state lexicon (see Hall & Nagy, 1986). Mental-state terms express "sincerity" conditions for a speech act (see Austin, 1962; Searle, 1969; Vendler, 1972): To "say" or state sincerely that it is raining, one must believe that it is raining; to promise sincerely to go swimming, one must intend to go swimming; and so on (see Olson & Astington, 1986). One particularly important use of mental-state verbs is in characterizing the mental states of others (see Astington & Olson, 1990). When applied to the self, mental terms are equivalent to expressions of possibility and certainty. *I think* versus *I know* expresses varying degrees of commitment to the truth of the proposition. Some of these metacognitive terms are more complex variants of the mental-state verbs *think* (e.g., *infer, confirm, assume*) and *know* (e.g., *perceive, recall, comprehend*) and the verb *say* (e.g., *concede, assert, imply*). The particular focus of the mental-state verbs task used in this study was the terms relevant to the interpretation of texts that have been emphasized by Olson (1986, 1994). Writing, according to Olson (1986), invites the distinction between what a text says and what is meant; the first is "given," and the second is taken as "interpretation." One way literacy affects thought is through elaborating ways for talking about talk and thought. Olson and Astington (1990) pointed out that the massive borrowing of vocabulary from Latin into English in the 16th and 17th centuries contained as a conspicuous part "the speech act and mental state verbs that have come to play such a large part in psychology and philosophy of mind" (p. 712).

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

roots *think* (e.g., *infer, confirm, assume*), *know* (e.g., *perceive, recall, comprehend*), and *say* (e.g., *concede, assert, imply*).

In order to investigate the link between print exposure and the acquisition of a complex mental-state and speech-act lexicon, we adapted a task developed by Astington and Olson (1990) and extended by Booth and Hall (1994). The task is designed to test whether students can choose the appropriate complex variant in a particular context. However, Astington and Olson's study focused on developmental trends and did not examine actual individual differences in print exposure within a specific age level. Any developmental trends in the sensitivity to mental-state distinctions may have been due to the myriad variables associated with maturation rather than to literacy experience per se. In contrast, this study focused on individual differences in print exposure within a group of participants who were roughly the same age. We intended to determine whether there is an association between familiarity with these verbs and differential exposure to print.

Our second task was designed to examine the property of decontextualization, which has been emphasized by literacy theorists (e.g., Akinnaso, 1981; Denny, 1991; Goody, 1977, 1987; Olson, 1977, 1994; Ong, 1967, 1982). An interest in decontextualized-reasoning skills as foundation for rational thought goes back at least to Piaget (1926), who considered the concept of decentration as pivotal in children's cognitive development. One indicator of decontextualized thought that has been of interest at least since the work of Luria (1976) is syllogistic reasoning (see Scribner & Cole, 1981; Stanovich, in press; Stanovich & West, 1997). Following on these previous investigations, a syllogistic-reasoning task was used in this study. The full range of relations between logic and content was tested: Some problems had conclusions consistent with real-world knowledge, others had conclusions that were inconsistent with real-world knowledge, and still others had conclusions without content (neutral items). It might be hypothesized that the link between literacy and syllogistic reasoning would be strongest when the content of the conclusion is inconsistent with the logical conclusion, because this condition most clearly defines decontextualized thought.

METHOD

Participants

Participants were 46 undergraduate and 87 preservice education students who had recently completed BA degrees. All students were attending a university in southern Ontario. Of the total sample of 133 students, 90 were female and 43 were male. Mean age of students was 25.8 years (SD = 5.7 years). Because the sample varied in years of education, this variable was entered as a covariate in several of the analyses that follow. Subjects reported their grade point averages (GPAs) as either letters or percentiles, so these scores were converted to standardized scores.

Tasks

Reading-comprehension measure. A shortened version of the Nelson–Denny Reading Comprehension subtest (Form F; Brown, Bennett, & Hanna, 1981) was used to assess reading ability. For this measure, participants read six passages and answered four multiple-choice questions for each passage. Mean number of questions correct was 19.8 (SD = 2.7). The Cronbach alpha reliability estimate for this measure was .62, and the split-half reliability (Spearman–Brown corrected) was .66. Raw scores were used in the analyses.

Print-exposure measure. Adaptations of ART and MRT were used (see Stanovich & Cunningham, 1992, 1993). Both tasks use a signal-detection logic whereby actual target items (real authors and real magazines) are embedded among foils (names that are not authors or magazine titles, respectively). Participants scan the list and check the names they know to be real names; the foils on the list prevent participants from simply checking all of the items. For this study, a few authors and magazines in the questionnaires were replaced with well-known Canadian authors and magazines as determined in informal pilot work. On ART were 45 writers/authors and 41 foils; on MRT were 60 magazines and 34 foils. Instructions resulted in only a few foils' being checked on ART and MRT (Ms = 0.8 and 1.8, respectively). Scoring of these tasks 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 (see Snodgrass & Corwin, 1988). ART and MRT mean scores were .48 (SD = .22) and .56 (SD = .16), respectively. Cronbach alpha reliability estimates were .93 (ART) and .92 (MRT), and ART and MRT performance was highly correlated (r = .75). A composite print-exposure index was created by adding ART and MRT scores after they had been converted to standardized scores. Although the composite measure of print exposure was used in the analyses that follow, substitution of either ART or MRT scores resulted in a virtually identical pattern of results.

Mental-state verbs task. The mental-state verbs task was adapted from a task developed by Astington and Olson (1990) and extended by Booth and Hall (1994). Olson and Astington (1990; Astington & Olson, 1990) have argued that the acquisition of certain metalinguistic and metacognitive terms are uniquely tied to literacy and experiences with print. Some of these metacognitive terms are variants of the mental-state verbs *think* (e.g., *infer, confirm, assume*) and *know* (e.g., *perceive, recall, comprehend*) and the verb *say* (e.g., *concede, assert, imply*). Facility with these mental-state terms was assessed through the mental-state verbs

task, which uses a series of 38 short passages that are each followed by four multiple-choice alternatives. For each passage, participants indicate which of the four multiple-choice terms corresponds to the appropriate mental state in the passage. Two examples of items from this task are presented in Appendix A. Mean score on this task was 29.6 ($SD = 3.6$). The Cronbach alpha reliability estimate for this measure was .57, and the split-half reliability (Spearman–Brown corrected) was .58.

Syllogistic-reasoning task. Syllogistic-reasoning items were borrowed from Markovits and Nantel (1989). Our task included 24 items, each of which consisted of a premise and a conclusion. For each item, participants were asked whether the conclusion had been logically drawn from the premise. Items fell into three 8-item categories determined by the relation between the validity of the conclusion and the factual content of the conclusion. Eight items were consistent, 8 were inconsistent, and 8 were neutral (see Markovits & Nantel, 1989). The 8 consistent items had conclusions that were factually correct when they were valid and factually incorrect when they were invalid—that is, logical validity was consistent with real-world knowledge. The 8 inconsistent items had conclusions that were factually correct when they were invalid and factually incorrect when they were valid—that is, logical validity was inconsistent with real-world knowledge. The 8 neutral items used imaginary content. In order to clarify for participants that the conclusion was to be based on logic rather than on prior knowledge, the notion of a "logical alien" was invoked (see Stanovich et al., 1995). An example of each type of item is given in Appendix B. Item types were intermixed throughout the task. The overall score on the syllogistic-reasoning task was the total number of items answered correctly ($M = 18.3$, $SD = 4.3$). The Cronbach alpha reliability estimate for this measure was .86, and the split-half reliability (Spearman–Brown corrected) was .88.

RESULTS AND DISCUSSION

In the first set of analyses, the sample was split into two groups high and low in print exposure. The measure used for the median split of the groups was the composite index of print exposure based on ART and MRT performance. This composite index (termed *ARTMRTZ*) was formed by first standardizing ART and MRT scores and then summing the standardized scores. Table 1 displays the performance of the two groups (formed by the median split on ARTMRTZ) on the other variables in the study. Not surprisingly, the two groups were substantially different on the variables that were the basis of the dichotomization (ART, MRT, ARTMRTZ). As Table 1 indicates, though, the two groups also performed significantly different on the mental-state verbs task and on all components of the

TABLE 1
Mean Scores of Students With Highest and Lowest Scores on Composite Measure of Print Exposure

	Lowest Scores[a]		*Highest Scores*[b]		
Variable	*M*	*SD*	*M*	*SD*	*t(131)*
Print-exposure measure					
ART	.30	.15	.65	.12	14.90***
MRT	.44	.13	.67	.09	12.34***
ARTMRTZ[c]	−1.46	1.26	1.55	0.84	16.21***
Criterion variable					
Mental-state verbs task	27.99	3.47	31.21	3.05	5.70***
Syllogisms[d]—All 24 items	17.14	4.29	19.42	4.06	3.15**
Syllogisms—8 neutral items	5.89	1.75	6.79	1.49	3.19**
Syllogisms—8 consistent items	6.39	1.41	6.97	1.31	2.44*
Syllogisms—8 inconsistent items	4.85	1.83	5.66	1.72	2.63**
Covariate					
College year[e]	3.67	1.54	4.52	1.09	3.70***
GPA[f]	−0.26	0.90	0.31	0.98	3.48***
Nelson–Denny Reading Comprehension	18.85	2.95	20.70	2.16	4.14***

[a] $n = 66$. [b] $n = 67$. [c] Sum of Author Recognition Test (ART) and Magazine Recognition Test (MRT) scores (in standardized scores). [d] Syllogisms = syllogistic-reasoning task. [e] First-year undergraduate student (1) to graduate student (5). [f] Standard scores used because participants reported their grades as either letters or percentiles.

*$p < .05$. **$p < .01$. ***$p < .001$.

syllogistic-reasoning task. Finally, the two groups differed in years of college completed (college years), GPAs, and Nelson–Denny Reading Comprehension scores.

Performance on the mental-state verbs task displayed a significant correlation (.46; $p < .001$) with the print-composite measure. However, a more stringent test of the association between the print-exposure measure and the mental-state verbs task is provided by analyses controlling for the possible confounding influences of general ability, level of education, and reading comprehension. Table 2 presents the results from two different regression analyses in which increasingly strong tests of the specificity of the link with print exposure were examined. Performance on the mental-state verbs task was used as the criterion variable in both analyses. In the first regression analysis, college year and GPA were entered first; they accounted for 17.7% of the variance in performance on the mental-state verbs task. When the print-exposure measure was entered third, it accounted for a statistically significant 9.5% of unique variance.

The second regression analysis added, after college year and GPA, a third covariate—performance on the Nelson–Denny Reading Comprehension subtest.

TABLE 2
Hierarchical Regression Analysis Predicting Performance on Mental-State Verbs Task

Variable[a]	r[b]	R	R^2 *Change*	*F to Enter*	*Final* β	*Final F*
Three steps						
1. College year	.34***	.336	.113	16.69***	.155	3.48
2. GPA	.36***	.421	.064	10.13**	.172	4.16*
3. ARTMRTZ	.46***	.522	.095	16.84***	.343	16.84***
Four steps						
1. College year	.34***	.336	.113	16.69***	.155	3.74
2. GPA	.36***	.421	.064	10.13**	.159	3.84
3. Nelson–Denny[c]	.42***	.539	.114	20.64***	.263	10.74**
4. ARTMRTZ	.46***	.573	.038	7.21**	.234	7.21**

Note. $n = 133$.
[a]See Table 1 footnotes for explanation of variables. [b]Zero-order correlation. [c]Nelson–Denny Reading Comprehension.
*$p < .05$. **$p < .01$. ***$p < .001$.

Collectively, these three covariates accounted for 29.1% of the variance in performance on the mental-state verbs task. However, even under this more stringent control for spurious correlation, the print-exposure measure accounted for a statistically significant 3.8% of unique variance. In fact, print exposure was a stronger unique predictor than either college year or GPA, as can be inferred from the beta weights in the final equations (Final ß column, Table 2). Thus, although the beta weight for the reading-comprehension measure was larger than that for the print-exposure measure, the beta weight for the latter was higher than that for either college year or GPA.

Particular attention should be paid to the conservative nature of these analyses. For example, college year is probably partly a proxy for the type of experience that leads one to induce the subtle distinctions between the mental-state verbs necessary for good performance on this task. Additionally, note that, by structuring the analyses in this way, we do not mean to imply that print exposure is not a determinant of reading-comprehension ability. Indeed, we would argue that there are grounds for believing that exposure to print does facilitate growth in comprehension ability (see Cipielewski & Stanovich, 1992; Stanovich, 1986, 1993). However, in recognition of the correlational nature of our data, we have attempted to construct the most conservative analysis possible by deliberately allowing the Nelson–Denny Reading Comprehension measure to steal some variance rightfully attributed to the print-exposure measure. That print exposure survives as a predictor in such a biased analysis indicates that it is a potent predictor of the verbal ability tapped by the mental-state verbs task.

Performance on the syllogistic-reasoning task displayed a smaller correlation with print exposure (.30) than did performance on the mental-state verbs task (.46); however, the former was still statistically significant. Table 3 indicates that print exposure remained a significant predictor of performance on the mental-state verbs task after college year and GPA had been entered into the equation but not when Nelson–Denny performance was added as a third covariate. Additionally, contrary to expectation, there was no tendency for print exposure to be a stronger predictor of performance on the inconsistent syllogisms than on the neutral or consistent syllogisms.

We conducted our study to investigate the influence of print exposure on syllogistic reasoning and knowledge of mental-state verbs. The data obtained demonstrated that the print-exposure measure was correlated with the mental-state verbs task and the syllogistic-reasoning task.

Results of the hierarchical regression analyses indicated that the print-exposure measure accounted for significant unique variance in performance on the mental-state verbs task even after we statistically controlled for college year, GPA, and reading comprehension. Although the print-exposure measure displayed a significant correlation with syllogistic reasoning, it failed to account for unique variance in syllogistic reasoning after the reading-comprehension measure was added as the third covariate in the regression equation.[1] Other aspects of the results from the syllogistic-reasoning task were likewise disappointing. For example, it might have been expected that the inconsistent items would show the strongest correlation with

[1]Print exposure did account for significant variance in syllogistic reasoning when reading-comprehension performance was the only covariate in the equation.

TABLE 3
Hierarchical Regression Analysis Predicting Performance on Syllogistic-Reasoning Task

Variable[a]	r[b]	R	R^2 *Change*	*F to Enter*	*Final* β	*Final F*
Three steps						
1. College year	.13	.127	.016	2.15	.004	0.00
2. GPA	.19*	.199	.023	3.15	.086	0.84
3. ARTMRTZ	.30***	.311	.058	8.20**	.267	8.20**
Four steps						
1. College year	.13	.127	.016	2.15	.004	0.00
2. GPA	.19*	.199	.023	3.15	.075	0.66
3. Nelson–Denny[c]	.33***	.352	.085	12.43***	.239	6.94**
4. ARTMRTZ	.30***	.379	.019	2.90	.168	2.90

Note. $n = 133$.
[a]See Table 1 footnotes for explanation of variables. [b]Zero-order correlation. [c]Nelson–Denny Reading Comprehension.
*$p < .05$. **$p < .01$. ***$p < .001$.

the print-exposure measures because they were the most direct measures of decontextualized-reasoning skill. However, this outcome did not obtain. The print-exposure measures were roughly equally correlated with all three components of the syllogistic-reasoning task (consistent items, neutral items, inconsistent items).

The theoretical link between print exposure and decontextualized reasoning is thus somewhat more tenuous than the link between print exposure and a verbal task such as distinguishing mental-state verbs. The latter link, however, has much more grounding in the research literature. For example, there is much research on the differences between spoken and written language at the lexical and syntactic levels. Written texts are more lexically rich (see Baines, 1996; Hayes, 1988; Hayes & Ahrens, 1988), and the syntax in writing tends to be more complex (see Halliday, 1985). Although this difference is one of degree—as it is possible to cite examples of textlike speech and vice versa (see Redeker, 1984; Tannen, 1982, 1985)—in a statistical sense there are significant quantitative differences between speech and writing on several language variables, particularly at the lexical level. For example, Hayes (1988; Hayes & Ahrens, 1988; see also Baines, 1996) has demonstrated that samples of speech and text differ in lexical density.

Thus, there is ample evidence from the mere statistical distribution of linguistic information in texts and speech to at least suggest mechanisms whereby print exposure might be related to performance on a task such as choosing among mental-state verbs. No similar direct mechanisms have been studied that would link print exposure to the more theoretically tenuous notion of decontextualized thought. However, the relations found in this study at least suggest that further examination of this link might be warranted. Although the preceding discussion of the results involving these tasks has emphasized the tentativeness of the links actually found, these caveats should perhaps be tempered by reiterating that partialing reading comprehension in all of the regression analyses may be partialing too much. A less conservative interpretation would emphasize that print exposure did display significant zero-order relations with the decontextualized-reasoning task. Finally, it should be noted that our findings were obtained with a sample having a relatively restricted range of abilities (i.e., college students and recent college graduates). Thus, this study does seem to provide some evidence for Olson's (1986, 1994) theoretical claim that print exposure may enhance the ability to interpret texts by facilitating the ability to deal with subtle distinctions among mental-state terms.

ACKNOWLEDGMENTS

This research was supported by Social Sciences and Humanities Research Council of Canada Grant 410–95–0315 to Keith E. Stanovich and by the James Madison University Program of Grants for Faculty Leaves to Richard F. West.

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Manuscript received August 27, 1996
Final revision received May 15, 1997
Accepted June 10, 1997

APPENDIX A:
TWO ITEMS FROM THE MENTAL-STATE VERBS TASK

s Adam's birthday tomorrow. Barbara is just sneaking out of the house to buy a esent for him when he sees her and asks her where she is going. Barbara says, Ve're out of milk. I'm going to the store."

A. Barbara *means* that she is going to buy milk.
B. Barbara *concedes* that she is going to buy milk.
C. Barbara *asserts* that she's going to buy milk.
*D. Barbara *implies* that she is going to buy milk.

Kate was trying to retrieve a file from her floppy disk. She was not successful. She vas very upset. "Maybe there is some problem with my computer," she thought. he took the disk to her friend's place and tried it in his computer but the result was ie same. She thought there must be something wrong with my floppy disk.

A. Kate *suggests* that there is something wrong with her floppy disk.
B. Kate *predicts* that there is something wrong with her floppy disk.
C. Kate *implies* that there is something wrong with her floppy disk.
*D. Kate *infers* that there is something wrong with her floppy disk.

APPENDIX B:
EXAMPLES OF ITEMS FROM THE SYLLOGISTIC-REASONING TASK

Directions: "Imagine that an alien from another planet has just landed on Earth. The alien's thought processes are very logical, but it knows nothing about Earth. Although the alien will be told about a number of things here on Earth, what it is told may not always be true. We are interested in your opinion about what the logical alien would conclude based on what it is told."

Example of Consistent Item

A. The alien is told that all fish can swim.
B. The alien is also told that tuna are fish.
C. The logical alien would conclude that tuna can swim, *a. yes b. no.

Example of Inconsistent Item

A. The alien is told that all flowers have petals.
B. The alien is also told that roses have petals.
C. The logical alien would conclude that roses are flowers, a. yes *b. no.

Example of Neutral Item

A. The alien is told that all lapitars wear clothes.
B. The alien is also told that podips wear clothes.
C. The logical alien would conclude that podips are lapitars, a. yes *b. no.