

Research Report

THE INCIDENTAL ACQUISITION OF INFORMATION FROM READING

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Abstract—In a study of ninety college seniors, measures of exposure to print predicted individual differences in vocabulary and cultural literacy after differences in general ability (SAT scores) had been statistically controlled, but did not predict differences in grade point average or knowledge of the field of major (psychology). Measures of exposure to nonprint media (television and films) predicted variance in cultural literacy, but not in vocabulary, after cognitive ability had been controlled. The data challenge the view that knowledge acquisition is determined only by the efficiency of cognitive components that encode and store information. Instead, the results indicate that differences in exposure to information are a significant independent contributor to differences in knowledge across individuals. The investigation further demonstrated the convergent validity of two briefly administered indicators of individual differences in exposure to print.

Disputes about the origin of individual differences in acquired knowledge are a recurring source of contention within educational, developmental, and cognitive psychology. Some theories place great emphasis on differences in environmental opportunities, whereas others place greater emphasis on differences in the ability to encode and store information. Explaining individual differences in vocabulary provides a case in point. Considerable evidence indicates that children's vocabulary sizes are correlated with parental education and indicators of environmental quality (Hall, Nagy, & Linn, 1984; Mercy & Steelman,

1982; Wells, 1986). Thus, it has been argued that vocabulary differences of the type revealed by standardized IQ tests are primarily the result of differential opportunities for word learning (e.g., Block & Dworkin, 1976). This conjecture might be termed the environmental opportunity hypothesis.

The environmental opportunity hypothesis is countered by theorists who emphasize that differences in vocabulary are caused by variation in the efficiency of the cognitive mechanisms responsible for inducing meaning from context. Proponents of what we might call the cognitive efficiency hypothesis argue that experiential factors are not implicated—or at least are of secondary importance—in explaining vocabulary differences (see Jensen, 1980, pp. 146–147; Sternberg, 1984, p. 307).

The cognitive efficiency hypothesis is not necessarily restricted to the domain of vocabulary acquisition. It could, in theory, apply to virtually all knowledge acquisition. The cognitive efficiency hypothesis thus potentially undercuts all developmental theories that emphasize the importance of knowledge structures in determining intelligent performance (e.g., Ceci, 1990) by essentially trivializing them. According to the cognitive efficiency view, differences in knowledge base arise merely as epiphenomena of differences in the efficiency of more basic psychological processes.

In the present investigation, we examined an experiential variable that presents perhaps the most serious challenge to any cognitive efficiency hypothesis: reading. Specifically, we examined whether individual differences in print exposure—and differences in exposure to other media—can account for individual differences in acquired declarative knowledge after differences in general ability had been controlled. The current test of the cognitive efficiency hypothesis occurs in the context of a research program in which we have been exploring the cognitive consequences of indi-

vidual differences in quantity of reading (Cunningham & Stanovich, 1991; Stanovich & West, 1989).

The knowledge domains we have sampled for study vary with respect to whether they reflect conscious, intentional learning of material in formal educational settings or whether they in part implicate the acquisition of information incidentally and informally in nonschool settings. Our two key measures of formal, school learning were college grade point average and a content test on material from the subjects' major field. Our other two knowledge measures—vocabulary and cultural literacy—are amalgamations of information acquired from formal schooling and from incidental learning in nonschool settings.

METHOD

Subjects

The subjects were 90 senior psychology majors (22 males and 68 females) who participated in a university-wide assessment of graduating seniors. They were assessed close to the end of the spring semester. Current overall grade point averages (GPAs) were verified by the university assessment office (mean = 3.1, SD = 0.5), as were high school Scholastic Aptitude Test (SAT) scores. In the analyses that follow, the total SAT score (SAT-verbal plus SAT-mathematical) was employed. None of the essential data patterns change if either verbal or mathematical SAT is substituted for the total score. The mean SAT total was 1088 (SD = 122).

Tasks

Psychology content knowledge

As part of the senior assessment, these students completed the Area Concentration Achievement Test (ACAT) in

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Psychology (Curriculum D, Austin Peay State University, 1990), a 48-item multiple-choice test covering the undergraduate psychology curriculum. The four areas emphasized on the test were experimental design, developmental psychology, history and systems, and statistics. Standard scores from this instrument were used in the analyses presented below (mean = 531, SD = 74). The split-half reliability of the test (Spearman-Brown corrected) was .69.

The Author Recognition Test

The Author Recognition Test (ART) is a device for assessing differences in exposure to print that was designed to circumvent tendencies toward socially desirable responding (see Stanovich & West, 1989). The logic by which the ART circumvents the social desirability problems inherent in most reading-exposure measures is a simple yet powerful one that borrows from signal detection theory. The ART is a checklist in which the subject indicates whether or not they are familiar with the name of a particular popular author/writer by putting a checkmark next to the name. The subject is prevented from simply checking all of the names by the presence of foils—names of people who are not popular writers/authors.

Because of time limitations on the availability of the students participating in the senior assessment, the version of the ART employed in the present investigation was a short-form, condensed version of the 100-item ART used in previous investigations (see Stanovich & West, 1989). The short-form version was a 25-item instrument containing the names of 16 authors and 9 foils. The 16 authors appearing on the ART are listed in Appendix A, along with the percentage of times that the item was checked. The items chosen had displayed good statistical properties in the earlier investigation and in pilot work. The 9 foils used on the ART were names taken from the Editorial Board of Volume 22 (1987) of *Reading Research Quarterly*. The 25 names were listed in alphabetical order, mixing targets and foils. The instructions on the ART read as follows: "Below you will see a list of 25 names. Some of the people in the list are popular writers (of

books, magazine articles, and/or newspaper columns) and some are not. Please read the names and put a check mark next to the names of those individuals who you know to be writers. Do not guess, but only check those who you know to be writers." These instructions resulted in only a few foils being checked. The mean number of foils checked per subject was 0.4 and 66 of the 90 subjects checked no foils.

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 mean score was .458 (SD = .206). The split-half reliability (Spearman-Brown corrected) of the task was .74. There was no time limit for completing the task, but it took most subjects only a minute or two, many less than a minute.

The Magazine Recognition Test

The logic of the Magazine Recognition Test (MRT) was analogous to that of the ART, but it was designed to tap a possibly different type of out-of-school reading. Again, a short-form version of a larger 100-item instrument (see Stanovich & West, 1989) was employed. The 25 items on the MRT consisted of the names of 16 magazines (see Appendix A) and nine foils. The nine foil names (see Appendix C of Stanovich & West, 1989, for examples) did not appear in the 60,000 listings in *The Standard Periodical Directory* (Manning, 1988). The 25 names were listed in alphabetical order, mixing targets and foils. The instructions for the MRT were analogous to those used on the ART. The mean number of foils checked per subject was 0.7 and 54 of the 90 subjects checked no foils. Scoring on the task was determined by taking the proportion of correct items that were checked and subtracting the proportion of foils checked (see Snodgrass & Corwin, 1988). The mean score was .722 (SD = .190). The split-half reliability (Spearman-Brown corrected) of the task was .62.

Newspaper recognition checklist

This instrument was logically analogous to the other recognition measures. Twelve names of high-circulation, nationally visible newspapers (e.g., *Washington Post*, *Christian Science Monitor*, *Chicago Tribune*) were mixed with twelve foil names. Instructions, administration, and scoring were analogous to the other checklist measures. The mean score was .354 (SD = .164). The split-half reliability (Spearman-Brown corrected) of the task was .74.

Television programs recognition checklist

Twelve names of network television programs (nine from the three major networks and three from Fox) were mixed with twelve foil names. Nine of the twelve programs were currently running at the time the study was conducted and three had recently been discontinued. Instructions, administration, and scoring were analogous to the other checklist measures. The mean score was .494 (SD = .176). The split-half reliability (Spearman-Brown corrected) of the task was .57.

Television name recognition checklist

The television name recognition measure is closely analogous to the ART in that it employs names, but the names are those of television celebrities rather than authors. The TV name checklist consisted of 74 names, 30 of which were foil names. Of the 44 target names, 13 were the names of news reporters (taken from the three major networks and CNN), 16 were the names of television actors, and 15 were the names of characters on television programs. The programs, from a variety of genres, were either currently running or recently terminated. Instructions, administration, and scoring were analogous to the other checklist measures. The mean score was .499 (SD = .144). The split-half reliability (Spearman-Brown corrected) of the task was .84.

Film recognition checklist

Twelve names of commercial films shown in theaters (as opposed to made-for-television movies) were mixed with twelve foil names. Most of the twelve

films had had substantial box-office proceeds (according to *Variety* magazine's Box Office Report) in the months preceding the study. Instructions, administration, and scoring were analogous to the other checklist measures. The mean score was .388 (SD = .124). The split-half reliability (Spearman-Brown corrected) of the task was .56.

Cultural literacy test

The cultural literacy test (CLT) was a recognition measure designed to tap familiarity with some of the historical events and individuals that have formed modern society. The CLT contained 30 target names and 15 foil names. Fifteen of the target names came from the well-known cultural knowledge list compiled by Hirsch (1987). The remaining 15 target items were chosen from the Appendix of Multi-Cultural Literacy items compiled by Simonson and Walker (1988) in order to illustrate the male and European bias in Hirsch's (1987) list. Performance on the two sets of items was highly correlated ($r = .68$) and the two sets displayed nearly identical relationships with other variables in the study. Thus, performance on the mixed list of 30 items will be the primary dependent variable in the analyses that follow. The items appearing on the cultural literacy test are listed in Appendix B, along with the percentage of times that the item was correctly checked. Instructions, administration, and scoring were analogous to the other checklist measures. The mean score was .675 (SD = .145). The split-half reliability (Spearman-Brown corrected) of the task was .77.

Vocabulary checklist

Several studies have demonstrated that the checklist-with-foils format employed in the previous tasks is a reliable and valid way of assessing individual differences in vocabulary knowledge and has proven to be at least as sensitive and valid as multiple choice tests (Anderson & Freebody, 1983; Cooksey & Freebody, 1987; White, Slater, & Graves, 1989; Zimmerman, Broder, Shaughnessy, and Underwood, 1977). Thus, this format was retained for our measure of vocabulary. The stimuli for the task were 27 words and 13 pronounceable non-

words taken from the stimulus list of Zimmerman et al. (1977) and employed in their work on vocabulary differences among college students. The words and nonwords were intermixed via alphabetization. The subjects were told that some of the letter strings were actual words and that others were not and that their task was to read through the list of items and to put a checkmark next to those that they knew were words. Scoring was analogous to the other checklist measures. The mean score was .626 (SD = .152). The split-half reliability (Spearman-Brown corrected) of the task was .78.

Procedure

Subsequent to taking the Area Concentration Achievement Test in psychology, the students completed the tasks in the following order: MRT, ART, movie recognition, television program recognition, cultural literacy recognition, vocabulary checklist, newspaper recognition, and television name recognition.

RESULTS

All of the measures of print exposure displayed significant correlations with both cultural literacy and vocabulary task performance (a full correlation matrix can be obtained by writing the first author). However, the zero-order correlations do not address the issue of the specificity of the relationships. That is, they do not indicate whether exposure predicts differences in a knowledge domain once general ability has been controlled. A series of hierarchical regression analyses were conducted in order to examine this question. The analyses presented in Table 1 partialled general ability as measured by the SAT total scores before entering the exposure measures in an attempt to predict performance on the vocabulary checklist, cultural literacy test, GPA, and ACAT.

The top half of Table 1 contains the R s resulting from forcing first SAT-total into the equation. Below the line are the cumulative R s that resulted when each of the six exposure measures was entered as the second step. The bottom half of

Table 1. Hierarchical regression analyses

Independent Variables		Dependent Variables			
Cumulative R					
Step 1	Vocab	CLT	GPA	ACAT	
SAT	.510	.381	.343	.306	
Step 2					
ART	.564	.570	.345	.306	
MRT	.583	.558	.360	.348	
Newspaper recognition	.524	.525	.357	.328	
Television programs	.514	.419	.375	.312	
Television names	.531	.566	.356	.328	
Film recognition	.519	.489	.374	.307	
Independent Variables		Dependent Variables			
R^2 Change					
Step 1	Vocab	CLT	GPA	ACAT	
SAT	.260*	.145*	.118*	.093*	
Step 2					
ART	.058*	.180*	.001	.000	
MRT	.080*	.167*	.011	.028	
Newspaper recognition	.015	.131*	.009	.015	
Television programs	.004	.031	.022	.004	
Television names	.022	.176*	.009	.014	
Film recognition	.009	.094*	.022	.001	

* $p < .01$.

Note. Vocab = vocabulary checklist; CLT = cultural literacy test; GPA = grade point average; ACAT = Area Concentration Achievement Test in Psychology.

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the table presents the R^2 change values at each step of the analysis and whether the R^2 change values were significant at that step.

The results for the four dependent variables diverged considerably. None of the six measures of exposure predicted GPA or ACAT performance when entered after SAT performance, whereas five of the six exposure measures accounted for significant additional variance on the cultural literacy task. This result is predictable if it is assumed that the exposure measures reflect nonschool opportunities for acquisition of information and that GPA and ACAT performance reflects the intentional learning of school material. In contrast, the cultural literacy measure is an amalgamation of information acquired from formal schooling and from incidental learning in nonschool settings. The results for the vocabulary measure were somewhat different. Here, although the ART and MRT predicted a substantial amount of unique variance (5.8% and 8.0%, respectively) after SAT was partialled, none of the other variables was a significant unique predictor.

Further hierarchical regression analyses designed to probe the specificity with which exposure to print (as measured by the ART and MRT) could predict performance on the vocabulary task were run. In one analysis, we entered GPA and ACAT performance into the equation subsequent to the SAT. Presumably these measures would pick up any additional variance (not already accounted for by the SAT) due to cognitive ability and the motivation for scholastic achievement. After all three variables are in the equation, the multiple R with the vocabulary task is .565. Nevertheless, both the ART and MRT predicted significant additional variance in vocabulary when entered last (6.0% and 6.1%, respectively). A second hierarchical regression provided an even more stringent test of the specificity with which the print exposure measures could predict vocabulary performance. Scores on the television name task were entered subsequent to SAT, GPA, and ACAT scores, but prior to the ART and MRT. Entering television names in this analysis accomplishes more than simply removing the variance in vocabulary associated with television exposure. It also

increases the specificity with which the analysis isolates the variance in vocabulary associated with reading experience. Because the TV name checklist shares all the processing requirements of the ART and MRT (the TV name and ART are identical in requiring recognition of people's names), the TV name checklist also provides an excellent control for method variance. However, even when entered subsequent to these four predictors, the ART and MRT accounted for significant additional variance (3.9% and 4.3%, respectively). This outcome was replicated when the CLT was the criterion variable (6.9% and 8.7% unique variance accounted for by the ART and MRT, respectively).

DISCUSSION

The results of this investigation indicate that the strong form of the cognitive efficiency hypothesis is untenable. This conclusion was particularly true for the domain of general cultural knowledge. Performance on our measure of cultural literacy was predicted by exposure to print, television, and movies even after controlling for ability. The outcome for vocabulary was somewhat different. There, only reading appeared to account for additional variance after ability had been controlled. Experience with other media (films and television) did not account for unique variance in vocabulary. (It should be noted that subsidiary analyses, not reported here, indicated that the ability of the TV name task to predict variance on the cultural literacy measure was primarily due to the news reporter names, rather than the entertainer names, on that instrument.) The failure of the "visual" media to display significant partial correlations with vocabulary is consistent with work on the differential lexical density of television versus print texts (Hayes & Ahrens, 1988). Once one has obtained approximately a fourth-grade vocabulary, print—as opposed to television and general conversation—is much more likely to contain words not already in the lexicon (Hayes, 1988; Hayes & Ahrens, 1988).

The data provide several indications that our experiential measures relate to knowledge acquired primarily through incidental exposure rather than through explicit teaching. Consider the differ-

ences between our four primary dependent measures. The vocabulary checklist and cultural literacy test index knowledge acquired both in and outside of school. They reflect incidentally acquired information as well as formally acquired information. In contrast, GPA and ACAT performance primarily index the acquisition of knowledge from a college curriculum: knowledge explicitly presented and intentionally learned. It is thus interesting that none of the exposure indicators predicted the efficiency with which subjects intentionally acquired knowledge once general cognitive ability had been controlled. This result is in marked contrast to the ability of the exposure measures (particularly the reading measures) to predict performance on the vocabulary and general knowledge tasks. This pattern of results is an indication that we were successful in constructing the ART and MRT so that they would tap out-of-school reading rather than curriculum exposure.

Exposure to print was a strikingly potent predictor in the regression analyses of vocabulary and cultural literacy. Consider that the ART and MRT—two checklists consisting of a total of 32 items that the subject fills out in 2–3 minutes—pick up variance in vocabulary and cultural knowledge that is unaccounted for by the SAT—a 2-hour test that is the result of prodigious psychometric tinkering conducted over a period of decades—in conjunction with the student's GPA and ACAT performance (both indicators of all of the global abilities and motivational factors that determine academic performance over a period of several years).

One final reason why this outcome is so striking is that the regressions are seriously biased against print exposure. This is because the verbal abilities that contribute to the total SAT score are in part developed by reading experience (Anderson, Wilson, & Fielding, 1988; Hayes, 1988; Juel, 1988; Share, McGee, & Silva, 1989; Share & Silva, 1987; Stanovich, 1986; van den Bos, 1989). The structure of the analyses thus allows the verbal components of the SAT score to steal part of the variance that would rightly belong to print exposure if the causal model were specified correctly. We have used such a model not because we believe in its causal structure (to the

contrary, see Stanovich, 1986) but because we wanted to construct a "worst-case" situation for print. If print exposure can still predict a cognitive outcome in such an analysis it is likely that it would survive virtually any tertium quid.

The results reported here do not, of course, say anything about how the differential exposure to print came about. We have only demonstrated that variance in general ability is not completely coextensive with variance in amount of reading. Although it is true that more intelligent individuals tend to read more, cognitive ability and reading experience can be at least partially dissociated. The variance in print exposure not attributable to a connection with general ability is reliably linked to variance in certain knowledge domains. Nevertheless, the origins of the partial dissociation are not addressed by the present study. Certainly environmental differences (cultural opportunities, parental modeling, quality of schooling) may be a contributing factor (Anderson et al., 1988). But personality dispositions toward literacy activities may also play a role, and the environmental and genetic determinants of such behavioral propensities are completely unknown (but see Plomin, Corley, DeFries, & Fulker, 1990).

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Appendix A.

Percentage Recognition of Authors on the ART		Percentage Recognition of Target Items on the MRT	
Isaac Asimov	58.9	Car and Driver	68.9
Barbara Cartland	23.3	Esquire	93.3
James Clavell	33.3	Field & Stream	95.6
Ian Fleming	72.2	Forbes	96.7
Stephen J. Gould	34.4	Gentlemen's Quarterly	76.7
Andrew Greeley	25.6	Harper's Magazine	56.7
Dean Koontz	16.7	Ladies Home Journal	82.2
Judith Krantz	77.8	McCall's Magazine	97.8
Louis L'Amour	51.1	Motor Trend	62.2
James Michener	73.3	New Yorker	77.8
Sidney Sheldon	87.8	Omni	84.4
Danielle Steel	87.8	Popular Science	81.1
J.R.R. Tolkien	84.4	Psychology Today	97.8
Irving Wallace	26.7	Rolling Stone	97.8
Joseph Wambaugh	10.0	Scientific American	38.9
Bob Woodward	37.8	Town & Country	73.3

Appendix B. Percentage recognition of items on the cultural literacy test

Yasir Arafat	95.5
Louis Armstrong	97.8
Ingmar Bergman	67.4
Steven Biko	34.8
Paul Cezanne	39.3
Marie Curie	77.5
Miles Davis	69.7
Amelia Earhart	96.6
Enrico Fermi	18.0
Aretha Franklin	98.9
Carlos Fuentes	29.2
Marvin Gaye	98.9
Greta Garbo	94.4
George Gershwin	86.5
George Harrison	83.1
Billie Holiday	78.7
Harry Houdini	88.8
Nelson Mandela	88.8
Douglas MacArthur	87.6
Margaret Mead	69.7
Georgia O'Keeffe	50.6
Rosa Parks	59.6
John Pershing	20.2
Sylvia Plath	39.3
Cole Porter	56.2
Walter Raleigh	73.0
Norman Rockwell	97.8
Will Rogers	87.6
Jean Jacques Rousseau	67.4
Margaret Sanger	32.6

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