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Knowledge Growth and Maintenance Across the Life Span: The Role of Print Exposure

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One hundred thirty-three college students (mean age = 19.1 years) and 49 older individuals (mean age = 79.9 years) completed 2 general knowledge tasks, a vocabulary task, a working memory task, a syllogistic reasoning task, and several measures of exposure to print. A series of hierarchical regression analyses indicated that when measures of exposure to print were used as control variables, the positive relationships between age and vocabulary, and age and declarative knowledge, were eliminated. Within each of the age groups, exposure to print was a significant predictor of vocabulary and declarative knowledge even after differences in working memory, general ability, and educational level were controlled. These results support the theory of fluid-crystallized intelligence and suggest a more prominent role for exposure to print in theories of individual differences in knowledge acquisition and maintenance.

In the study of intellectual growth and decline, much attention has focused on the psychometric theory of fluid-crystallized intelligence (Baltes, 1987; Carroll, 1993; Horn, 1982; Horn & Cattell, 1967; Horn & Hofer, 1992; Lohman, 1993; Rabbitt, 1993; Smith & Baltes, 1990). Fluid abilities are processes such as memory and reasoning that operate across a range of domains and that are posited to be relatively independent of specific environmental experiences. In contrast, "crystallized abilities are postulated to reflect one's experiential history, and are assessed by tests of vocabulary, general information, and nearly all types of acquired knowledge" (Salthouse, 1988, p. 239). Fluid abilities are known to decline substantially with age, whereas crystallized abilities either decline much less or exhibit continual growth throughout most of the adult years (Baltes, 1987; Horn, 1982; Horn & Donaldson, 1980; Horn & Hofer, 1992). Horn (1989) has termed "the abilities that decline with brain damage and with age in adulthood" (p. 96) *vulnerable* abilities and those that do not decline with age and return to nearly pre-injury levels following brain damage *maintained* abilities (see also Horn & Hofer, 1992).

Although much research effort has been expended on describing cumulative growth in crystallized intelligence, little is known about the experiential correlates of knowledge growth in older individuals. Horn (1989) has argued that very little is known about "how lifestyle factors, operating over adulthood, produce enhancement, overdetermination, and maintenance of crystallized knowledge" (p. 102). The exercise of cognitive skills has often been considered vital to the preservation of intellectual function (Schaie, 1984; Schwartzman, Gold, Andres, Arbuckle, & Chaikelson, 1987). For example, educational experience is a predictor of intellectual functioning in older individuals (e.g., Schwartzman et al., 1987). It is assumed that education (which is received early in life) in part determines the extent and quality of many intellectual activities later in life. It is presumably these later activities that are so crucial to the preservation of cognitive capacities. Thus, although considerable development of cognitive skills and abilities can result from formal educational experiences, it is the lifetime use of these skills that is assumed to have the beneficial effect.

Reading is one of the primary mechanisms by which we exercise our intellectual faculties and increase our knowledge of the world (e.g., Stanovich, 1993; Stanovich & Cunningham, 1993). Yet tremendous variation in literacy habits exists (Anderson, Wilson, & Fielding, 1988; Guthrie & Greaney, 1991; Sharon, 1973–1974; Stanovich, 1993; Zill & Winglee, 1990). Although avid readers may process literally millions of words a year (Anderson et al., 1988), there are also many quite capable readers who rarely choose to read. Do these vast differences in print exposure have significant consequences for the maintenance and growth of intellectual capacities with age? Most previous research in cognitive aging that has examined reading experience has focused on a single criterion variable: prose recall. This research has uncovered only modest effects of print exposure (Hartley, 1989; Rice & Meyer, 1986; Rice, Meyer, & Miller, 1988).

In this study, we investigated the extent to which age-related growth in declarative knowledge can be accounted for by differential experience with print. We operationalized crystallized, as have others (e.g., Charness & Bieman-Copland, 1992; Horn & Hofer, 1992), in terms of measures of vocabulary and declarative cultural knowledge. In previous studies, we have

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demonstrated that differences in reading volume can account for a considerable portion of variance in knowledge and vocabulary acquisition among children (Cunningham & Stanovich, 1991) and young adults (Stanovich & Cunningham, 1992, 1993; West & Stanovich, 1991). Here, we examine whether the association between age and the accumulation of declarative knowledge across the life span (Camp, 1989) can be explained by individual differences in print exposure. We used an analytic logic used by Salthouse and Mitchell (1990) to explore experiential correlates of the age-related decline in fluid abilities. We generalized their logic to the study of crystallized abilities that exhibit positive correlations with age.

The Salthouse and Mitchell (1990) study addressed the disuse hypothesis: the idea that declines in certain cognitive functions are in part a result of lack of practice that engages the relevant faculties. They examined whether the negative correlation between age and spatial visualization ability was attenuated once variation in the amount of experience at visualization was removed. They addressed the question by first determining how much variance in spatial visualization was accounted for by age. By way of multiple regression they then estimated the unique contribution of age after the variance accounted for by various questionnaire measures of visualization experience had been partialed. By comparing the unpartialed to the partialed estimated of variance explained by age, Salthouse and Mitchell (1990) were able to estimate what proportion of the age-associated variance in spatial visualization was due to differences in experience. They found that only about 14% of the decline in spatialization skill with age was due to experiential differences, thus casting doubt on the disuse hypothesis.

The Salthouse and Mitchell (1990) study was focused on experiential explanations of cognitive decline. In the present investigation, we used their analytic logic to investigate declarative knowledge bases that display cumulative growth with age. We attempted to estimate whether a particular experiential variable—print exposure—mediates the positive relation between age and declarative knowledge. The knowledge domains that we investigated were that of general cultural knowledge and vocabulary, and we used measures of these knowledge bases that have been shown to be sensitive to differential print exposure among individuals within an age group (Stanovich & Cunningham, 1992, 1993). To demonstrate discriminant validity for our measures of print exposure, we examined two measures of fluid ability (a working memory task and a syllogistic reasoning task) that are less likely to be affected by an experiential variable such as print exposure.

Method

Participants

The older participants were 49 individuals (11 men and 38 women) recruited from two church-affiliated residential retirement communities. Their ages ranged from 66 to 95 years (M = 79.9 years, SD = 6.3 years). All of them were retired and Caucasian, and all wore glasses. All older participants reported having received at least a high school diploma or equivalent, 36 reported having received a college degree, and 22 reported having also received either a master's, professional, or doctoral degree. On a self-assessed health rating scale ranging from 1 (*poor*) to 5 (*excellent*), the older participants' mean rating were 3.10 (SD = 1.3) for vision, 3.27 for hearing (SD = 1.3), and 3.39 (SD = 1.0) for overall health. All of the regression analyses to be reported below were rerun using the three health and sensory ability questions as additional covariates. No significant or nonsignificant effect changed status when these covariates were added, so they are not discussed further.

The college students were 133 undergraduates (37 men and 96 women) recruited through an introductory psychology subject pool at a medium-sized state university. The students were predominately Caucasian (84%), and their mean age was 19.1 years (SD = 2.1 years). The mean reported high school grade-point average (GPA) of the students was 3.46 (SD = .31) on a 4-point grading scale. The current mean reported college GPA was 2.97 (SD = .47).

Print Exposure Measures

Activity Preference Questionnaire. The instructions for the Activity Preference Questionnaire were as follows:

> Below you will be given a choice between engaging in one of two activities. Please put a check mark next to the one that you prefer. Please mark only one. That is, even if you like both activities, please mark only the one you like best. Similarly, even if you dislike both activities, mark the one that you would prefer to do. For each item, please mark only one choice.

The instructions were followed by 12 forced choices in the format: "I would rather (a) listen to music of my choice, (b) watch a television program of my choice." Six of the questions concerned reading, and the other six served as fillers in order to attenuate the focus on reading. In these six items, "read a book of my choice" was juxtaposed with "watch a television program of my choice," "play an outdoor sport of my choice," "listen to music of my choice," "talk with friends of my choice," "attend a movie of my choice," and "spend time on my hobbies." The participant's score on the task was simply the number of times that reading was chosen over one of these six activities. Scores thus ranged from 0 to 6. The split-half reliability of task was .74 (Spearman–Brown corrected).

Reading habits composite. Along with a series of demographic questions, participants answered five questions about their reading habits and these five questions were used to form the reading habits composite variable. The items were multiple-choice questions that probed whether they read for pleasure (*almost never, a couple of times a year,* etc.), subscribed to or bought magazines on a regular basis, read newspapers (*more than one a day, one each day, occasionally,* etc.), how many books they had read during the year (0, 1–2, 3–10, etc.), and how much they liked to read (*not very much, a little, very much*). The responses on these questions were scored in the direction of higher scores reflecting more reading. All pairwise combinations of the questions displayed positive correlations, and 8 of the 10 correlations were statistically significant (median correlation = .38). Thus, the scores on the five items were standardized and summed to form the composite reading habits variable.

Author Recognition Test (ART). The ART is a recognition checklist measure of print exposure that was designed to circumvent the problem of questionnaire contamination by tendencies to produce socially desirable responses (see Stanovich & West, 1989). The ART is a checklist in which participants indicate whether they are familiar with the name of a particular popular author by putting a check mark next to the name. The participant is prevented from simply checking all of the names by the presence of foils—names of people who are not popular writers or authors. Thus, the measure has a signal-detection logic that allows for the control of differential response bias by taking into account the number of foils checked. The recognition checklist measures of print exposure used in this investigation have shown convergent validity with other indicators such as daily activity diaries (Allen, Cipielewski, &

Stanovich, 1992), and they have been shown to predict reading behavior in natural settings (West, Stanovich, & Mitchell, 1993).

The version of the ART used in this investigation contained 40 target author names and 40 foils and was similar to that used in earlier investigations (see Stanovich & Cunningham, 1992, 1993). The 40 authors appearing on the ART are listed in the Appendix, along with the percentage of times that the item was checked by each of the groups. Many of the book authors regularly appear on best-seller lists and most have sold hundreds of thousands, if not millions, of volumes (see Stanovich & Cunningham, 1992; and Stanovich & West, 1989, for sales statistics). Several of the authors were on the best-seller lists at the time the study was conducted. Although no statistical sampling of authors was carried out, an attempt was made to mix writers from a wide variety of genres. Thus, most major categories of nonfiction (e.g., science, politics–current events, humor, religion, history, biography, business or finance, travel) and fiction (e.g., mystery or detective, romance or Gothic, spy or intrigue, occult or supernatural, historical novels, Westerns, short stories, science fiction) were represented. In constructing the list, authors were selected who were most likely to be encountered outside of the classroom, so that the ART would be a proxy measure of out-of-school print experience. Thus, an attempt was made to avoid authors who are regularly studied in the school curriculum. None of the authors appears in Ravitch and Finn's (1987) survey of the high school literature curriculum.

The 40 foils in the ART were names taken from the Editorial Board of Volume 22 (1987) of *Reading Research Quarterly.* Full names for both foils and targets were used in all cases except where the individual habitually used initials (e.g., S. E. Hinton). The instructions to the participant read as follows:

> Below you will see a list of 80 names. Some of the people in the list are popular writers (of books, magazine articles, and/or newspaper columns) and some are not. You are to 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. Remember, some of the names are people who are not popular writers, so guessing can easily be detected.

These instructions resulted in only a few foils being checked. The mean number of foils checked per participant was 1.01. The mode was zero ($N = 104$), and 159 of the 182 participants checked two or fewer foils.

Scoring on the task was determined by taking the proportion of the target 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 split-half reliability of the number of correct items checked was .89 (Spearman–Brown corrected).

It is clear that the ART (as well as the other checklist tasks to be described below) reflects only relative individual differences in exposure to print. It obviously does 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; Guthrie & Greaney, 1991). That the measures are very indirect proxy indicators is of course problematic in some contexts but, alternatively, it is sometimes a strength. Clearly, hearing about an author on television without having been exposed to the actual written work is problematic. The occurrence of this type of situation obviously reduces the validity of the task. However, consider a postexperimental comment sometimes made by participants: They knew a certain name was that of an author but had never read anything that the author had written. When questioned about how they knew that the person was a writer, the participants invariably replied that they had seen one of the author's books in a bookstore, had seen an author's book in the "new fiction" section at the library, had read a review of the author's work in *Newsweek,* had seen an advertisement in the newspaper, and so on. In summary, knowledge of that author's name was a proxy for reading activities, even though the particular author had not actually been read. Thus, although there are clearly ways of gaining familiarity with the names that would reduce validity (TV, radio), many behaviors leading to familiarity with the author names are themselves proxies for reading experience.

Magazine Recognition Test. The logic and structure of the Magazine Recognition Test (MRT) was analogous to that of the ART, but it was designed to tap a possibly different type of reading. Although the ART contains writers whose work sometimes appears in magazines and newspapers, it is nevertheless heavily biased toward authors of books. The MRT was thus designed to balance the ART by sampling magazine reading exclusively.

The 80 items on the MRT consisted of the names of 40 magazines and 40 foils. The 40 magazines appearing on the MRT are listed in the Appendix, along with the percentage of times that the item was checked by each of the groups. Statistics taken from *The Standard Periodical Directory* (Manning, 1988) indicated that 14 of the 40 publications on the MRT had circulations over 1 million, and 32 had circulations of over 500,000. The mean circulation of the items on the MRT was 1,314,755, and the median circulation was 782,650. The percentage recognition of the MRT items for all of the participants in this study combined displayed a correlation of .70 with the natural logarithm of the magazine's circulation. The 40 fictitious foil names (e.g., *Future Forecast, Neuberger Review, Wellington's Home Digest;* see Appendix C of Stanovich & West, 1989) did not appear in the 60,000 listings in *The Standard Periodical Directory* (Manning, 1988). The 80 names were listed in alphabetical order, mixing targets and foils. The instructions for the MRT were analogous to those used for the ART. The mean number of foils checked per participant was 3.6. The mode was zero ($N = 39$), and 100 of the 182 participants checked two or fewer foils. Scoring on the task was determined by taking the proportion of the 40 correct items that were checked and subtracting the proportion of foils checked. The split-half reliability of the number of correct items checked was .85 (Spearman–Brown corrected).

Newspaper Recognition Checklist. This instrument was logically analogous to the other recognition measures. Fifteen names of high-circulation, nationally visible newspapers (e.g., *Washington Post, Christian Science Monitor, Chicago Tribune*) were mixed with 11 fictitious foil names (e.g., *National News Chronicle, Washington Tribune*). The 15 newspapers appearing on this checklist are listed in the Appendix, along with the percentage of times that the item was checked by each group. The scoring for this task was analogous to the other checklist measures. The split-half reliability (Spearman–Brown corrected) of the task was .71.

Declarative Knowledge Measures

Cultural literacy test. Participants were administered a 45-item, multiple-choice cultural literacy test. Forty items were selected from Form A of the Cultural Literacy Test (Riverside Publishing, 1989), an instrument designed to assess the general cultural literacy of students in grades 11 and 12. Seventeen of these items came from the Science subsections ("Which of the following concepts is part of Darwin's theory of evolution?" "In what part of the body does the infection called pneumonia occur?" "Which of the following is a cause of acid rain?") and 23 of the items came from the Social Sciences subsections (e.g., "Who was the American president who resigned his office as a result of the Watergate scandal?" "What is the term for selling domestic merchandise abroad?" "What is the term for the amount of money charged for a loan and calculated as a percentage of that loan?") The remaining five questions were true–false items (e.g., "The oxygen we breathe comes from plants"; "Lasers work by focusing sound waves") drawn from the survey of scientific literacy conducted by the Public Opinion Laboratory of Northern Illinois University (J. D. Miller, 1989). The score on the task was simply the number of items answered correctly. The split-half reliability (Spearman–Brown corrected) of the task was .79.

Cultural literacy checklist. The cultural literacy checklist was a recognition measure designed to tap familiarity with some of the historical events and individuals that have formed modern society. The version of the cultural literacy checklist used in the present investigation was similar to that used in an earlier investigation (see the Appendix of West & Stanovich, 1991), except that a few items were replaced by other candidates. The cultural literacy recognition measure contained 30 target names. Fifteen of the names came from the well-known cultural knowledge list compiled by Hirsch (1987). These 15 items were chosen from the following six categories: artists (e.g., Norman Rockwell), entertainers (e.g., Harry Houdini), military leaders or explorers (e.g., Walter Raleigh), musicians (e.g., George Gershwin), philosophers (e.g., Jean Jacques Rousseau), and scientists (e.g., Marie Curie). Twelve items were chosen from the Appendix of Multi-Cultural Literacy items compiled by Simonson and Walker (1988) in order to balance the predominantly male and European names in Hirsch's (1987) list (e.g., Yasir Arafat, Miles Davis, Nelson Mandela, Rosa Parks, Margaret Sanger). Three additional items were also added (Pat Schroeder, Cesar Chavez, George McGovern). Performance on the Hirsch set and on the multicultural set was highly correlated ($r = .71$), and the two sets displayed nearly identical relationships with other variables in the study. Thus, performance on the mixed list of 30 items is the primary dependent variable in the analyses that follow. The 30 target names were mixed with 15 foil names by way of alphabetization. Scoring was analogous to the other checklist measures. The split-half reliability (Spearman–Brown corrected) of the task was .86.

Vocabulary checklist. Several studies have demonstrated that the checklist-with-foils format used in the previous tasks is a reliable and valid way of assessing individual differences in vocabulary knowledge (Anderson & Freebody, 1983; Cooksey & Freebody, 1987; Meara & Buxton, 1987; White, Slater, & Graves, 1989; Zimmerman, Broder, Shaughnessy, & Underwood, 1977). In particular, the checklist format has proven at least as sensitive and valid as multiple-choice tasks (Anderson & Freebody, 1983; White et al., 1989). Thus, this format was retained for our measure of vocabulary. The stimuli for the task were 42 words and 20 pronounceable nonwords (sampled from Zimmerman et al., 1977). The majority of the items were taken from the stimulus list of Zimmerman et al. (1977) and used in their work on vocabulary differences among college students (e.g., *confluence, denotation, litany, suffuse, ubiquitous;* see West et al., 1993, for further examples). The words and nonwords were intermixed by way of alphabetization. The students were told that some of the letter strings were actual words and that others were not and that their task was to read through the list of items and to put a check mark next to those that they knew were words. Scoring was analogous to the other checklist measures. The split-half reliability (Spearman–Brown corrected) of the task was .90.

Fluid Ability Measures

Working memory. The working memory task that we used was modeled on the computation span task used by Salthouse and Babcock (1991; see also Salthouse, 1991). In this task, the participant must solve arithmetic problems that are orally presented, while simultaneously trying to remember the final number in each of the problems. After being read the instructions (adapted from Salthouse & Babcock (1991), participants received three practice sets that were each one problem in length. Following this, participants received three trials at problem set sizes that increased from one to seven problems in length. Sets were performed in order of increasing number of computational problems and thus the number of to-be-remembered digits. However, participants were not asked to progress beyond the point where they were unsuccessful on four consecutive recall attempts. The computational problems were read to the participants at a normal pace, with a pause of approximately 2 s between each problem.

Following the scoring procedures of Salthouse and Babcock (1991; Salthouse, 1991), the working memory span of each participant was determined by taking the largest number of items recalled in the correct order on at least two of the three problems of a given set length, provided that the computations for these problems also had been performed correctly. Using this criterion, our older participants had a mean working memory span of 2.18 items, similar to the mean in Salthouse and Babcock's (1991) sample of 70- to 87-year-olds (1.96). Our college students had a mean working memory span of 4.15 items, similar to the mean in Salthouse and Babcock's (1991) sample of 20- to 29-year-olds (3.89). An alternative, and more sensitive, scoring system is to simply sum the items on which the computational problems and the corresponding to-be-remembered stimuli were correct. The correlation between these raw scores and the working memory span measure was .87, and the two variables displayed virtually identical correlational relationships with other variables in the study. Thus, the raw score is used in the analyses that follow. Salthouse and Babcock (1991) have estimated the reliability of the computation span to be in the .84 to .90 range for a sample of 18- to 87-year-old individuals.

Syllogistic reasoning task. Considerable research has been conducted on the so-called belief-bias effect in syllogistic reasoning (e.g., Evans, Barston, & Pollard, 1983; Markovits & Bouffard-Bouchard, 1992; Markovits & Nantel, 1989). The phenomenon is one where participants judge an argument to be true or false on the basis of the empirical truth of the conclusion rather than the logical validity of the argument even when they are reminded to focus on the latter. Previous research (e.g., Nehrke, 1972) has indicated that the magnitude of the belief-bias effect does not increase with age even though overall performance on syllogisms of all types deteriorates with age. In our study, participants evaluated eight syllogisms where logic was in conflict with believability. The problems were adapted from the work of Markovits and Nantel (1989). The older participants received the following instructions:

> 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.

Each syllogism problem had the following form: "The alien is told that (A). The alien is also told that (B). The logical alien would conclude that (C). yes/no." Examples of the syllogisms are

1. (A) All things that are smoked are good for the health; (B) Cigarettes are smoked; (C) Cigarettes are good for the health.
2. (A) All flowers have petals; (B) Roses have petals; (C) Roses are flowers.

Four of the problems had conclusions that followed logically but were unbelievable, as in Example 1 (empirically derived believability ratings are presented in the Markovits & Nantel, 1989 study). Four problems had conclusions that did not follow logically but were believable, as in Example 2.

The notion of the "logical alien" was invoked to further clarify that the conclusion was to be based on logic rather than prior knowledge. Inadvertently, our college students were given more standard instructions that read as follows:

> In the following problems, you will be given two premises that you

> must assume are true. A conclusion from the premises then follows. You must decide whether the conclusion follows logically from the premises or not. You must suppose that the premises are all true and limit yourself only to the information contained in the premises. This is very important. Decide if the conclusion follows logically from the premises, whether or not the premises are true, and mark either "a" or "b" on the score sheet.

We have given the alien instructions with an independent sample of college students, however, and discovered that they enhance performance only to a small degree (65% correct versus 62% correct on the same eight items used here). Because the alien instructions were used for the older participants—who displayed a performance deficit on the task—the difference in instructions is not responsible for the significant difference between participant groups. Instead, the performance deficit of the older participants is probably slightly underestimated. The score on the syllogistic reasoning task was the number of correct answers on the eight items. The split-half reliability (Spearman–Brown corrected) of the task was .73.

SAT Scores: College Students

For some of the within-group analyses reported below, we desired a measure of general cognitive ability for the college students. Scholastic Aptitude Test (SAT) scores were not available to us because of university restrictions, so we had students report their verbal and mathematical SAT scores. The mean reported verbal SAT score of the 130 students who filled in this part of the questionnaire was 535 ($SD = 68$), the mean reported mathematical SAT score was 580 ($SD = 77$), and the mean total SAT score was 1,114 ($SD = 104$). These figures approximate the university's averages.

Students next indicated their degree of confidence in their memory of their scores on a 5-point scale (degree of confidence: *high, moderately high, somewhat high, low, very low*). Of the sample, 75% indicated that their degree of confidence was high or moderately high, and only one student out of 130 indicated very low confidence. Finally, the students were asked to indicate whether they granted permission for the experimenters to look up their SAT scores. Of the 130 students who filled out this part of the questionnaire, 122 gave permission. Previous investigators (Dollinger & McMorrow, 1992) have found that students giving permission for standardized test scores to be looked up performed higher than students not giving such permission on a variety of cognitive tasks. The obvious inference to be drawn is that the standardized scores of the nonpermission-granting students were lower. Our results are consistent with this pattern. The mean reported total scores of the permission-granting students (1,119) was higher than the mean reported scores of the students not granting permission (1,029). Because all of the correlational relationships to be reported below obtained whether or not students were excluded on the basis of confidence or permission granting, reported SAT scores from the entire sample are used in the analyses reported below.

There were several indications in the data that the SAT scores were accurately reported. First, the reported verbal scores displayed a correlation of .60 with performance on the vocabulary checklist, whereas the latter displayed a correlation of only .17 with mathematical SAT (the difference between dependent correlations, Cohen & Cohen, 1983, p. 57, was highly significant: $t[127] = 4.23, p < .001$). Second, the correlation between the total SAT scores and performance on the vocabulary checklist in this study (.52) was very similar to the .51 correlation obtained in a study in which we were able to verify the SAT scores (West & Stanovich, 1991).

Procedure

Participants were tested either individually or in groups of two or three persons in one 60- to 70-min session. The order of tasks was the same for all participants: working memory, activity preference questionnaire, MRT, ART, newspaper recognition checklist, cultural literacy checklist, vocabulary checklist, cultural literacy test, and syllogistic reasoning task.

Results

Group Differences

Table 1 presents the mean scores of the college students and the older participants on all of the main variables in the study. The older participants outscored the college students on all three measures of declarative knowledge, although the difference on the cultural literacy test did not attain statistical significance. In contrast, the college students scored significantly higher than the older group on the working memory task and on the syllogistic reasoning task. The difference in the former case was particularly large. These results are consistent with the trend in the literature for crystallized abilities to continue to grow with age (hence Horn's, 1989, term *maintained* abilities) and for working memory and other fluid abilities to decline with age (hence Horn's, 1989, term *vulnerable* abilities).

The older participants indicated a significantly stronger preference for reading on the two questionnaire measures of print exposure: the activity preference questionnaire and reading habits composite variable. The differences on these instruments were quite large. For example, on the activity preference measure, the college students preferred reading to—on the average—only 1½ of the six comparison activities (television, music, talking, movies, outdoor sports, hobbies), whereas the older participants preferred reading to more than four of the alternative activities.

Although there were large differences on the questionnaire measures of print exposure, the older participants outperformed the college students on only one of the checklist measures of print exposure (newspaper recognition). However, the near equality of the overall scores on the ART and MRT masks some extremely large differences between the groups on individual items. The Appendix indicates items from the ART and the MRT that displayed significant differences between the groups. These differences are not entirely systematic, but some trends are clearly discernible—differences that probably reflect actual differences in types of reading. For example, older participants were more likely than younger participants to be familiar with writers of nonfiction (e.g., Sylvia Porter, Barbara Tuchman, Alvin Toffler, Bob Woodward, David Halberstam), whereas the college students were more likely to be familiar with mass-market fiction writers (e.g., Stephen King, Sidney Sheldon, Tom Clancy, Danielle Steel). Older participants were more familiar with magazines emphasizing politics and contemporary events (e.g., *Harper's, Atlantic, New Republic, Mother Jones*), whereas the college students were more familiar with science magazines (e.g., *Discover, Omni*) and specialty magazines about cars, sports, computers, and music (e.g., *Rolling Stone, Car and Driver, Byte, Road & Track, Sporting News*). It is difficult to ascertain, however, whether this variation in item exposure is due to the age differences in the sample or to differences in educational attainment (45% of the older sample had attained advanced degrees of some type).

Although the item differences on the ART and MRT are quite

Table 1
Mean Scores (and Standard Deviation) of College Students (n = 133) and Older Adults (n = 49) on the Variables in the Study

Variable	Students		Older adults		
	M	*SD*	*M*	*SD*	*t*(180)
Declarative knowledge measures					
Cultural literacy test	33.5	5.4	34.8	5.8	−1.37
Cultural literacy checklist	.621	.167	.706	.165	−3.08**
Vocabulary checklist	.552	.147	.696	.158	−5.75***
Fluid ability measures					
Working memory (raw score)	12.0	4.1	5.9	2.6	9.61***
Syllogistic reasoning	4.98	2.17	3.86	1.49	3.33***a
Print exposure measures					
Activity preference	1.57	1.7	4.12	1.4	−9.45***
Reading habits composite	−1.26	2.8	3.56	1.9	−11.02***
ART	.327	.14	.316	.19	0.44
MRT	.512	.15	.488	.13	0.97
Newspaper checklist	.396	.14	.512	.19	−4.44***

Note. ART = Author Recognition Test; MRT = Magazine Recognition Test.
[a] The degree of freedom for the syllogisms task is 178.
$^{**}p < .01$, two-tailed. $^{***}p < .001$, two-tailed.

interesting, because of the critical dependence of these measures on item sampling, analyses run on the entire group will use the activity preference task and the reading habits questionnaire as measures of reading experience. It is these measures—and not the ART and MRT—that replicate the trend, found in previous studies (e.g., Rice, 1986; Rice & Meyer, 1986; Salthouse, Kausler, & Saults, 1988), for older individuals to engage in more reading behavior.

Are Age Differences in Declarative Knowledge Mediated by Print Exposure?

The results reported in Table 1 converge with previous research: Indicators of declarative knowledge are positively associated with age, but measures of general reasoning display negative relationships (e.g., Baltes, 1987; Horn, 1982, 1989). The analyses reported in Table 2 use a regression logic (see Salthouse, 1991; Salthouse & Mitchell, 1990) to examine whether relationships involving age are mediated by experiential factors. The logic involves measuring the amount of variance in a criterion variable that is accounted for by age and then re-estimating the variance accounted for by age after the experiential variable has been entered into the equation. A comparison of the two estimates allows for the calculation of the percentage reduction in variance explained by age when the experiential variable is taken into account. For example, the first analysis in Table 2 indicates that age accounts for 4.0% of the variance in performance on the cultural literacy checklist. When two measures of reading habits (the reading habits composite and the activity preference measure) were entered into the equation, they accounted for 15.3% of the variance that was independent of age. In contrast, when age was entered after the measures of reading habits, it explained a nonsignificant 1.1% of the variance. Although the absolute reduction in variance explained did not quite attain statistical significance, $F(1, 178) = 2.74$, $.05 < p < .10$, the measures of reading habits reduced the association between cultural literacy checklist performance and age by 72.5% (4.0 minus 1.1 divided by 4.0).

The results displayed in the next pair of regressions—where vocabulary checklist performance is the criterion variable—are parallel but even stronger. Age accounted for 14.6% of the variance in vocabulary checklist performance when entered first into the equation. However, when age was entered after the two measures of reading habits, it accounted for only 0.3% unique variance. The absolute reduction in variance explained was highly significant, $F(1, 178) = 15.26$, $p < .001$. Thus, there was a 97.9% reduction in the variance explained by age when reading habits were taken into account. Performance on the multiple-choice cultural literacy test was not subjected to this type of analysis, because that task demonstrated a very low zero-order relationship with age. Nevertheless, the analyses conducted on the data from the cultural literacy checklist and the vocabulary checklist indicate that associations between performance on these tasks and age can largely be eliminated when variance associated with reading habits is removed. The results indicate that growth in these knowledge bases over time could possibly be due to the cumulative effects of print exposure.

The next two sets of analyses reveal that the pattern is markedly different when performance on two measures of fluid ability (syllogistic reasoning and working memory) are examined. Here, because the association with age is negative, we ask whether the decline in these abilities with age is attenuated for individuals with a large amount of reading experience. The first set of forced entry regressions indicates that age accounts for 6.1% of the variance in syllogistic reasoning performance when entered first and also accounts for an identical 6.1% after the reading habits measures have been entered. In this task, the age-related decline in performance is not attenuated at all for individuals who have a high degree of experience with print. Here, we have the converse of the situation with the vocabulary checklist—where all of the age-related growth in ability could be at-

Table 2
Hierarchical Regression Results for the Entire Sample

Variable–Forced entry	R	R^2 change	F to enter	Final beta	Final F
Criterion Variable: Cultural Literacy Checklist Performance					
1. Age	.199	.040	7.44**	−.143	2.54
2. Reading habits	.381	.105	22.08**	.275	8.25**
3. Activity preference	.440	.048	10.62**	.299	10.62**
1. Reading habits	.378	.143	30.05**	.275	8.25**
2. Activity preference	.426	.039	8.47**	.299	10.62**
3. Age	.440	.011	2.54	−.143	2.54
Criterion Variable: Vocabulary Checklist Performance					
1. Age	.382	.146	30.70**	.073	0.73
2. Reading habits	.480	.085	19.78**	.245	7.21**
3. Activity preference	.521	.040	9.87**	.274	9.87**
1. Reading habits	.466	.217	49.82**	.245	7.21**
2. Activity preference	.518	.051	12.57**	.274	9.87**
3. Age	.521	.003	0.73	.073	0.73
Criterion Variable: Syllogistic Reasoning					
1. Age	.247	.061	11.52**	−.349	12.93**
2. Reading habits	.260	.007	1.33	.051	0.24
3. Activity preference	.265	.002	1.49	.121	1.49
1. Reading habits	.087	.008	1.37	.051	0.24
2. Activity preference	.092	.001	0.02	.121	1.49
3. Age	.265	.061	12.93**	−.349	12.93**
Criterion Variable: Working Memory Performance					
1. Age	.595	.354	98.60**	−.666	68.17**
2. Reading habits	.598	.004	1.07	.052	0.38
3. Activity preference	.600	.002	0.50	.058	0.50
1. Reading habits	.321	.103	20.65**	.052	0.38
2. Activity preference	.338	.011	2.29	.058	0.50
3. Age	.600	.246	68.17**	−.666	68.17**

Note. $N = 182$ for all regressions except syllogistic reasoning, where $N = 180$.
* $p < .05$. ** $p < .01$.

tributed to print exposure. An intermediate outcome occurs for the working memory task. Age accounted for 35.4% of the variance when entered first and for 24.6% of the variance when entered subsequent to the reading habits measures. Thus, the age-related variance in working memory performance was attenuated by 30.5% (35.4 minus 24.6 divided by 35.4) when reading habits were partialed. The absolute reduction in variance explained was statistically significant, $F(1, 178) = 14.88$, $p < .001$. However, a substantial negative relationship remained even after reading habits were taken into account. Also, the reading habits themselves accounted for little unique variance in working memory performance (0.6% variance) once age was partialed. Thus, the linkage between reading habits and performance on the working memory task is largely the result of variance, which overlaps with age.

In summary, the regressions indicated that the measures of reading habits explained a substantial portion of the connection between age and declarative knowledge but very little of the negative association between age and fluid reasoning abilities. These findings are consistent with theories of intelligence that view crystallized intelligence as more experientially based. In the next set of analyses, we examined whether these conclusions hold when the relationships among the variables are examined within each of the age groups.

Correlates of Individual Differences Within Age Groups

Table 3 presents the correlations among the variables within each of the groups. The correlations for the older sample are presented above the diagonal, and the correlations for the college sample are presented below the diagonal.

We structured a series of forced-entry regression so as to address the question of whether measures of print exposure would predict the criterion variables after variance in general ability had been partialed. For example, in the first regression reported in Table 4, working memory is entered first as a predictor of the performance of the college students on the cultural literacy checklist. Forced next into the equation is the SAT total score. Collectively, these two measures of general cognitive ability account for 10.8% of the variance. Listed next are the five mea-

Table 3
Intercorrelations Among the Primary Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
Participant variables													
1. SAT total		—	—	—	—	—	—	—	—	—	—	—	—
2. Age			−.08	−.24	−.33	−.17	−.30	−.04	.02	−.13	−.33	−.34	−.02
3. Years of education	—	—		.60	.39	.57	.24	.17	−.06	.02	.22	.34	.51
Declarative knowledge measures													
4. Cultural literacy test	.32	—	—		.65	.73	.51	.47	.19	.05	.53	.56	.55
5. Cultural literacy checklist	.32	—	—	.56		.71	.33	.24	.08	.10	.69	.68	.38
6. Vocabulary checklist	.51	—	—	.36	.54		.39	.31	.09	.00	.50	.51	.48
Fluid ability measures													
7. Working memory (raw score)	.36	—	—	.09	.09	.28		.34	.13	.00	.16	.34	.12
8. Syllogistic reasoning	.47	—	—	.28	.18	.29	.15		.00	−.02	.21	.27	.20
Print exposure measures													
9. Activity preference	.33	—	—	.15	.41	.41	.06	.14		.37	.35	.32	.15
10. Reading habits composite	.29	—	—	.18	.37	.39	.09	.11	.45		.34	.17	.09
11. ART	.40	—	—	.45	.63	.63	.08	.26	.50	.46		.64	.37
12. MRT	.39	—	—	.32	.48	.41	.02	.27	.31	.30	.54		.48
13. Newspaper checklist	.23	—	—	.29	.54	.29	−.04	.06	.27	.22	.46	.44	

Note. Correlations above the diagonal are for the older sample (correlations greater than .28 in absolute value are statistically significant at the .05 level, two-tailed). Correlations below the diagonal are for the college sample (correlations greater than .17 in absolute value are statistically significant at the .05 level, two-tailed). ART = Author Recognition Test; MRT = Magazine Recognition Test. Dashes indicate no data.

sures of reading habits: the three checklist measures, the reading habits questionnaire, and the activity preference measure. Regression statistics are listed for each of the five measures when each is entered as the third variable in the regression equation. The results indicate that each measure of reading habits accounts for significant variance in performance on the cultural literacy checklist after variance in general cognitive ability has been partialed out. The variance explained by reading behavior ranged from 8.0% for the reading habits questionnaire to 28.2% for the ART, the latter a substantial figure given that measures of cognitive ability had already been partialed.

The next regression analysis indicated that the measures of reading habits accounted for less unique variance on the multiple-choice cultural literacy test. However, the three checklist measures did account for significant unique variance, and the ART accounted for 11.1% unique variance. The differential sensitivity of the print exposure measures is consistent with past research that has indicated that, within an age group, the checklist measures are more sensitive indicators of print exposure than are more traditional questionnaire measures (Stanovich & Cunningham, 1992; Stanovich & West, 1989). The next regression, conducted on vocabulary checklist performance, indicated that all five reading habits measures accounted for unique variance, but the ART was by far the most potent variable, accounting for 20.4% unique variance.

The results for the declarative knowledge tasks are in complete contrast to those obtained when performance on the fluid ability measures are used as criterion variables. The next regression analysis indicates that none of the measures of reading habits accounted for variance in syllogistic reasoning when working memory and SAT scores are entered into the equation. The final analysis indicates, similarly, that none of the measures of reading habits accounted for variance in working memory when SAT scores are entered into the equation.

A parallel set of analyses were conducted on the data from the older participants, and these are presented in Table 5. In these analyses, age was entered first into the equation (because there were small negative relations involving age within the older participant sample), followed by working memory performance and the years of education that the individual had received. The contribution of each of the five reading habits measures was then assessed when each was entered as the fourth step. The results indicate that the ART was a significant unique predictor of performance on all three of the measures of declarative knowledge (cultural literacy checklist, multiple-choice cultural literacy test, vocabulary checklist), accounting for 29.6%, 12.8%, and 13.0% of the variance, respectively. Similarly, the MRT accounted for significant unique variance on all of the declarative knowledge measures. The newspaper recognition task was a significant unique predictor in two out of three cases. In contrast, the reading habits questionnaire and activity preference measure were not unique predictors. These results again converge with previous findings indicating that, within an age group, the checklist measures are more sensitive indicators of print exposure (Stanovich & Cunningham, 1992). The fourth and fifth regression analyses produced results analogous to those conducted on the college sample. None of the measures of reading habits accounted for variance in syllogistic reasoning when age, working memory, and years of education were entered into the equation. Similarly, none of the measures of reading habits accounted for variance in working memory when age and years of education were entered.

Discussion

Recent theories of cognitive development have emphasized the importance of domain knowledge as a determinant of information-processing efficiency (Alexander, 1992; Bjorklund, 1987; Byrnes, 1995; Ceci, 1989, 1990, 1993; Charness, 1989; Chi, 1985; Chi, Glaser, & Farr, 1988; Glaser, 1984; Hoyer, 1987;

Table 4
Hierarchical Regression Analyses on the Data of the College Sample

Variable–Forced entry	R	R^2 change	F to enter
Criterion Variable: Cultural Literacy Checklist Performance			
1. Working memory	.047	.002	0.29
2. SAT total	.332	.108	15.41**
3. ART	.626	.282	58.34**
3. MRT	.492	.132	21.97**
3. Newspaper checklist	.572	.217	40.54**
3. Reading habits	.436	.080	12.45**
3. Activity preference	.462	.104	16.56**
Criterion Variable: Cultural Literacy Test Performance			
1. Working memory	.045	.002	0.26
2. SAT total	.333	.109	15.60**
3. ART	.469	.111	17.64**
3. MRT	.372	.028	4.01*
3. Newspaper checklist	.392	.043	6.38*
3. Reading habits	.342	.006	0.88
3. Activity preference	.337	.002	0.31
Criterion Variable: Vocabulary Checklist Performance			
1. Working memory	.267	.071	9.79**
2. SAT total	.521	.201	34.98**
3. ART	.690	.204	49.06**
3. MRT	.562	.044	8.19**
3. Newspaper checklist	.550	.030	5.48*
3. Reading habits	.582	.066	12.68**
3. Activity preference	.584	.069	13.35**
Criterion Variable: Syllogistic Reasoning			
1. Working memory	.115	.013	1.70
2. SAT total	.474	.212	34.13**
3. ART	.478	.003	0.57
3. MRT	.478	.003	0.60
3. Newspaper checklist	.479	.004	0.67
3. Reading habits	.476	.002	0.27
3. Activity preference	.474	.000	0.01
Criterion Variable: Working Memory Performance			
1. SAT total	.362	.131	19.26**
2. ART	.372	.008	1.14
2. MRT	.390	.021	3.24
2. Newspaper checklist	.384	.016	2.48
2. Reading habits	.363	.001	0.13
2. Activity preference	.366	.003	0.49

Note. $N = 130$ for all analyses, except for syllogisms where $N = 128$. SAT = Scholastic Aptitude Test; ART = Author Recognition Test; MRT = Magazine Recognition Test.
* $p < .05$. ** $p < .01$.

Keil, 1984; Schneider & Bjorklund, 1992; Tetewsky, 1992). For example, Hoyer (1987) has argued that "the point that content knowledge can outweigh the effects of other age-related differences in intelligence has important implications for the study of intellectual development during the later years" (p. 121). Given that the knowledge-dependency of cognitive functioning is a central tenet of many contemporary developmental theories—particularly those concerned with cognitive growth and decline in later life—it is surprising that there has not been more attention directed to the experiential correlates of knowledge acquisition.

In this study, we examined a variable that is a prime candidate for an experiential factor linked to growth in declarative knowledge: exposure to print. Although we did find strong linkages between reading habits and declarative knowledge, we also found that the effects of exposure to print appear to be quite strictly limited to declarative knowledge domains. Thus, the results are consistent with a conceptualization in terms of crystallized and fluid intelligence (or, alternatively, with conceptualizations that distinguish practiced vs. unpracticed skills; see Rabbitt, 1993). The effects of the experiential variable of print exposure were very selectively confined to measures of crystallized intelligence and were largely absent on measures of cognitive skills in the domain of fluid abilities. Nevertheless, print exposure was a robust predictor of the former abilities in this study. Linkages between declarative knowledge and age could be almost entirely explained in terms of differences in print exposure. The most powerful within-group indicators of print exposure, the ART and MRT, remained significant predictors of declarative knowledge after controlling for within-group age, working memory, years of education (in the case of the older participants), and SAT scores (in the case of the college students). In the case of the college students, the logic of our analytic strategy is quite conservative, because the verbal portion of the SAT taps abilities that are at least in part developed by print exposure itself (Stanovich, 1986, 1993). Thus, these analyses probably partial out some variance that is rightly attributed to the reading habits measures. Despite such biases in the analyses, the print exposure measures still emerged as significant independent predictors.

There are, in fact, several possible mechanisms by which print exposure could become a mechanism for the growth and preservation of crystallized knowledge. Reading is a very special type of interface with the environment, providing the organism with unique opportunities to acquire declarative knowledge. For example, most theorists agree that a substantial proportion of vocabulary growth during childhood and adulthood occurs indirectly through language exposure (G. A. Miller & Gildea, 1987; Nagy & Anderson, 1984; Nagy, Herman, & Anderson, 1985; Sternberg, 1985, 1987). If most of one's vocabulary is acquired outside of formal schooling, then the only opportunities to acquire new words occur when an individual is exposed to a word in written or oral language that is outside the current vocabulary. Work by Hayes (1988) and Hayes and Ahrens (1988; see also, Akinnaso, 1982; Biber, 1986; Chafe & Danielewicz, 1987; Corson, 1985) has indicated that moderate- to low-frequency words—precisely those words that differentiate individuals with high- and low-vocabulary sizes—appear much more often in common reading matter than in common speech. These relative differences in the statistical distributions of words in print and in oral language have direct implications for vocabulary development.

Additionally, print is a uniquely rich source of content knowledge. The world's storehouse of knowledge is readily available for those who read, and much of this information is not usually attained from other sources. Personal experience provides only

Table 5
Hierarchical Regression Analyses on the Data of the Older Sample (N = 49)

Variable–Forced entry	R	R^2 change	F to enter
Criterion Variable: Cultural Literacy Checklist Performance			
1. Age	.331	.109	5.78*
2. Working memory	.412	.061	3.35
3. Years of education	.523	.104	6.44*
4. ART	.755	.296	30.30**
4. MRT	.714	.235	21.10**
4. Newspaper checklist	.568	.049	3.17
4. Reading habits	.527	.004	0.24
4. Activity preference	.530	.006	0.41
Criterion Variable: Cultural Literacy Test Performance			
1. Age	.239	.057	2.84
2. Working memory	.514	.207	12.94**
3. Years of education	.712	.242	22.09**
4. ART	.796	.128	15.31**
4. MRT	.761	.073	7.64**
4. Newspaper checklist	.767	.083	8.82**
4. Reading habits	.712	.001	0.07
4. Activity preference	.732	.029	2.74
Criterion Variable: Vocabulary Checklist Performance			
1. Age	.169	.029	1.38
2. Working memory	.394	.126	6.90*
3. Years of education	.629	.240	17.85**
4. ART	.725	.130	12.06**
4. MRT	.684	.073	6.06*
4. Newspaper checklist	.668	.051	4.06*
4. Reading habits	.629	.001	0.02
4. Activity preference	.635	.008	0.55
Criterion Variable: Syllogistic Reasoning			
1. Age	.040	.002	0.07
2. Working memory	.349	.120	6.29*
3. Years of education	.360	.008	0.42
4. ART	.396	.027	1.42
4. MRT	.395	.026	1.38
4. Newspaper checklist	.383	.017	0.88
4. Reading habits	.360	.000	0.01
4. Activity preference	.363	.002	0.09
Criterion Variable: Working Memory Performance			
1. Age	.299	.090	4.63*
2. Years of education	.369	.046	2.50
3. ART	.370	.001	0.03
3. MRT	.418	.038	2.08
3. Newspaper checklist	.369	.000	0.01
3. Reading habits	.372	.001	0.10
3. Activity preference	.398	.022	1.19

Note. ART = Author Recognition Test; MRT = Magazine Recognition Test.
* $p < .05$. ** $p < .01$.

narrow knowledge of the world and is often misleadingly unrepresentative (Baron, 1985, 1994; Dawes, 1988; Gilovich, 1991; Kahneman, Slovic, & Tversky, 1982; Nisbett & Ross, 1980). The most commonly used electronic sources of information (television and radio) lack depth (Comstock & Paik, 1991; Hayes & Ahrens, 1988; Huston, Watkins, & Kunkel, 1989; Iyengar & Kinder, 1987; Zill & Winglee, 1990), and research has consistently indicated that reading displays higher correlations with world and cultural knowledge than does television viewing (Allen et al., 1992; West et al., 1993; West & Stanovich, 1991; Zill & Winglee, 1990).

As is the case with any correlational study, despite considerable convergence in the pattern of results—as well as convergence with previous research (e.g., Stanovich, 1993; Stanovich & Cunningham, 1993)—several outcomes of the current study are open to alternative explanations. For example, any systematic difference in the participant groups other than the hypothesized differences in print exposure could be an alternative explanation of the superior declarative knowledge of the older group. One possibility is educational level—which might be a proxy for general intellectual level. As noted in the Method section, 45% of the older sample had attained advanced degrees. This may well be higher than the expected proportion among this particular student sample, particularly when the cohort differences are taken into account. Thus, the older sample may well be of higher general intellectual ability. Nevertheless, the analyses reported in Table 5 indicate that at least within the older sample, educational level could not account for the association between declarative knowledge and print exposure.

It is also possible that the older participants were more culturally aware than the younger participants and that this might be reflected in their use of other media sources. However, the older participants in this study preferred television watching significantly less often than the students on the activity preference measure, 1.53 vs. 1.99, $t(180) = 2.77$, $p < .01$. This result converges with those of other studies in indicating that more avid readers are not also more exposed to television (Allen et al., 1992; Neuman, 1988; West et al., 1993).

Because the connection between crystallized intelligence and print exposure is correlational, it is also possible that causality runs at least partly in the opposite direction: People who have acquired large amounts of knowledge about a domain may tend to read more about that domain. However, the breadth of content of the measures of cultural knowledge, vocabulary, and print exposure used in this and other studies (e.g., Stanovich & Cunningham, 1993) probably ensures that this type of reverse causality is accounting for only a small part of the relationship.

More problematic is the issue of whether we have fairly sampled the domain of fluid intelligence. Perhaps our tasks were too far removed from the type of memory and reasoning that is exercised by reading and thus do not provide a fair test of whether reading experience might facilitate memory and reasoning. Nevertheless, our working memory span task was of the type that has been repeatedly implicated in theories of reading that posit an important role for working memory (see Baddeley, 1986; Daneman & Tardif, 1987; Just & Carpenter, 1987). Additionally, we used syllogisms that required overcoming belief bias (see Markovits & Nantel, 1989) precisely because they necessitate the type of decontextualized reasoning skill that many cognitive theorists of literacy have argued is uniquely facilitated by the exercise of literacy (Akinnaso, 1981; Goody, 1977, 1987; Olson, 1977, 1986, 1994; Ong, 1982). Although it is true that this reasoning style probably does not usually operate online during most actual reading experiences, it is posited to develop as a spinoff of repeated interaction with the relative objectivity of texts when compared to oral speech (Goody, 1977; Olson, 1977, 1986; Ong, 1982).

One additional implication of our results concerns the findings reported in Table 5. The patterns observed in these regression analyses have implications for the interpretation of individual differences in cognitive profiles within an elderly sample. For example, Rabbitt (1993) noted that the difference between vocabulary and measures of memory, reasoning, and fluid intelligence increases from age 50 through age 80+ and that individuals vary widely in terms of the discrepancies that they show. He therefore suggested that "for any older individual the current discrepancy between his or her attainments on vocabulary tests and on other measures of performance may be a convenient index of the age-related decrement that he or she has experienced up to the date of assessment" (Rabbitt, 1993, p. 395). The analyses in Table 5 are essentially examining the predictors of individual differences in the discrepancies between working memory and vocabulary (and the two other declarative knowledge measures). What these analyses show is that the degree of discrepancy between vocabulary and working memory is positively associated with print exposure and educational level. Indeed, further analyses demonstrated that if working memory performance was entered into a regression equation, followed by two measures of print exposure (ART and MRT), then age was no longer a significant predictor of performance on the vocabulary measure, cultural literacy test, and cultural literacy checklist. These analyses, and those reported in Table 5, suggest that although the differences between vocabulary and other cognitive measures may partly indicate the magnitude of decline in the cognitive measure, as Rabbitt (1993) suggests, the magnitude of the difference is also influenced by experiential variables that affect vocabulary growth. The difference score cannot be interpreted as solely an indicator of cognitive decline.

Finally, cognitive theories that view individual differences in basic processing capacities as at least partly determined by differences in knowledge bases (e.g., Ceci, 1990) elucidate a mechanism by which print exposure can be said to influence cognitive development. Print exposure is simply a more distal factor that determines individual differences in knowledge bases, which in turn influence performance on a variety of basic information processing tasks (see Ceci, 1990). Thus, whatever causal power accrues to content knowledge in these theories also partially accrues to print exposure as a mechanism of cognitive change. Thus, when speculating about variables in people's ecologies that could account for cognitive variability, print exposure is worth investigating, because such variables must have the requisite potency to perform their theoretical roles. A class of variable that might have such potency would be one that has long-term effects because of its repetitive or cumulative action. Schooling is obviously one such variable (Cahan & Cohen, 1989; Ceci, 1990, 1991; Ferreira & Morrison, 1994; Morrison, 1987). However, print exposure is another factor that varies enormously from individual to individual and that accumulates over time. As shown here, these individual differences are associated to a strong degree with individual differences in general knowledge across the life span and with differences among individuals of roughly similar age.

References

Akinnaso, F. N. (1981). The consequences of literacy in pragmatic and theoretical perspectives. *Anthropology & Education Quarterly, 12,* 163-200.

Akinnaso, F. N. (1982). On the difference between spoken and written language. *Language and Speech, 25,* 97-125.

Alexander, P. A. (1992). Domain knowledge: Evolving themes and emerging concerns. *Educational Psychologist, 27,* 33-51.

Allen, L., Cipielewski, J., & Stanovich, K. E. (1992). Multiple indicators of children's reading habits and attitudes: Construct validity and cognitive correlates. *Journal of Educational Psychology, 84,* 489-503.

Anderson, R. C., & Freebody, P. (1983). Reading comprehension and the assessment and acquisition of word knowledge. In B. Huston (Ed.), *Advances in reading/language research* (Vol. 2, pp. 231-256). Greenwich, CT: JAI Press.

Anderson, R. C., Wilson, P. T., & Fielding, L. G. (1988). Growth in reading and how children spend their time outside of school. *Reading Research Quarterly, 23,* 285-303.

Baddeley, A. D. (1986). *Working memory.* New York: Oxford University Press.

Baltes, P. B. (1987). Theoretical propositions of life-span developmental psychology: On the dynamics between growth and decline. *Developmental Psychology, 23,* 611-626.

Baron, J. (1985). *Rationality and intelligence.* Cambridge, England: Cambridge University Press.

Baron, J. (1994). *Thinking and deciding* (2nd ed.). Cambridge, England: Cambridge University Press.

Biber, D. (1986). Spoken and written textual dimensions in English: Resolving the contradictory findings. *Language, 62,* 384-414.

Bjorklund, D. F. (1987). How age changes in knowledge base contribute to the development of children's memory: An interpretive review. *Developmental Review, 7,* 93-130.

Byrnes, J. P. (1995). Domain-specificity and the logic of using general ability as an independent variable or covariate. *Merrill-Palmer Quarterly, 41,* 1-24.

Cahan, S., & Cohen, N. (1989). Age versus schooling effects on intelligence development. *Child Development, 60,* 1239-1249.

Camp, C. J. (1989). World-knowledge systems. In L. W. Poon, D. C. Rubin, & B. A. Wilson (Eds.), *Everyday cognition in adulthood and late life* (pp. 457-482). Cambridge, England: Cambridge University Press.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies.* Cambridge, England: Cambridge University Press.

Ceci, S. J. (1989). On domain specificity . . . more or less: General and specific constraints on cognitive development. *Merrill-Palmer Quarterly, 35,* 131-142.

Ceci, S. J. (1990). *On intelligence . . . more or less: A bio-ecological treatise on intellectual development.* Englewood Cliffs, NJ: Prentice-Hall.

Ceci, S. J. (1991). How much does schooling influence general intelligence and its cognitive components? A reassessment of the evidence. *Developmental Psychology, 27,* 703-722.

Ceci, S. J. (1993). Contextual trends in intellectual development. *Developmental Review, 13,* 403-435.

Chafe, W., & Danielewicz, J. (1987). Properties of spoken and written language. In R. Horowitz & S. J. Samuels (Eds.), *Comprehending oral and written language* (pp. 83-113). San Diego, CA: Academic Press.

Charness, N. (1989). Age and expertise: Responding to Talland's challenge. In L. W. Poon, D. C. Rubin, & B. A. Wilson (Eds.), *Everyday cognition in adulthood and late life* (pp. 437-456). Cambridge, England: Cambridge University Press.

Charness, N., & Bieman-Copland, S. (1992). The learning perspective: Adulthood. In R. J. Sternberg & C. A. Berg (Eds.), *Intellectual development* (pp. 301-327). Cambridge, England: Cambridge University Press.

Chi, M. T. H. (1985). Changing conception of sources of memory development. *Human Development, 28,* 50-56.

Chi, M. T. H., Glaser, R., & Farr, M. (Eds.). (1988). *The nature of expertise.* Hillsdale, NJ: Erlbaum.

Cohen, J., & Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Comstock, G., & Paik, H. (1991). *Television and the American child.* San Diego, CA: Academic Press.

Cooksey, R. W., & Freebody, P. (1987). Aspects of a computer-managed test of children's reading vocabulary: Reliability, validity, and characterization of knowledge. *Reading Psychology, 8,* 103–118.

Corson, D. (1985). *The lexical bar.* Oxford, England: Pergamon.

Cunningham, A. E., & Stanovich, K. E. (1991). Tracking the unique effects of print exposure in children: Associations with vocabulary, general knowledge, and spelling. *Journal of Educational Psychology, 83,* 264–274.

Daneman, M., & Tardif, T. (1987). Working memory and reading skill re-examined. In M. Coltheart (Ed.), *Attention and performance* (Vol. 12, pp. 491–508). London: Erlbaum.

Dawes, R. M. (1988). *Rational choice in an uncertain world.* San Diego, CA: Harcourt Brace Jovanovich.

Dollinger, S. J., & McMorrow, M. A. (1992). Something to hide? Consent-granting for release of standardized scores. *Personality and Individual Differences, 13,* 411–416.

Evans, J. B. T., Barston, J., & Pollard, P. (1983). On the conflict between logic and belief in syllogistic reasoning. *Memory & Cognition, 11,* 295–306.

Ferreira, F., & Morrison, F. J. (1994). Children's metalinguistic knowledge of syntactic constituents: Effects of age and schooling. *Developmental Psychology, 30,* 663–678.

Gilovich, T. (1991). *How we know what isn't so: The fallibility of human reason in everyday life.* New York: Free Press.

Glaser, R. (1984). Education and thinking: The role of knowledge. *American Psychologist, 39,* 93–104.

Goody, J. (1977). *The domestication of the savage mind.* New York: Cambridge University Press.

Goody, J. (1987). *The interface between the written and the oral.* Cambridge, England: Cambridge University Press.

Guthrie, J. T., & Greaney, V. (1991). Literacy acts. In R. Barr, M. L. Kamil, P. Mosenthal, & P. D. Pearson (Eds.), *Handbook of reading research* (Vol. 2, pp. 68–96). New York: Longman.

Hartley, J. (1989). Memory for prose: Perspectives on the reader. In L. W. Poon, D. C. Rubin, & B. A. Wilson (Eds.), *Everyday cognition in adulthood and late life* (pp. 135–156). Cambridge, England: Cambridge University Press.

Hayes, D. P. (1988). Speaking and writing: Distinct patterns of word choice. *Journal of Memory and Language, 27,* 572–585.

Hayes, D. P., & Ahrens, M. (1988). Vocabulary simplification for children: A special case of 'motherese'? *Journal of Child Language, 15,* 395–410.

Hirsch, E. D. (1987). *Cultural literacy.* Boston: Houghton Mifflin.

Horn, J. L. (1982). The theory of fluid and crystallized intelligence in relation to concepts of cognitive psychology and aging in adulthood. In F. I. M. Craik & S. Trehub (Eds.), *Aging and cognitive processes* (pp. 847–870). New York: Plenum Press.

Horn, J. L. (1989). Cognitive diversity: A framework for learning. In P. Ackerman, R. Sternberg, & R. Glaser (Eds.), *Learning and individual differences* (pp. 61–116). New York: W. H. Freeman.

Horn, J. L., & Cattell, R. B. (1967). Age differences in fluid and crystallized intelligence. *Acta Psychologica, 26,* 1–23.

Horn, J. L., & Donaldson, G. (1980). Cognitive development in adulthood. In O. Brim & J. Kagan (Eds.), *Constancy and change in human development* (pp. 91–123). Cambridge, MA: Harvard University Press.

Horn, J. L., & Hofer, S. (1992). Major abilities and development in the adult period. In R. J. Sternberg & C. A. Berg (Eds.), *Intellectual development* (pp. 44–99). Cambridge, England: Cambridge University Press.

Hoyer, W. (1987). Acquisition of knowledge and the decentralization of *g* in adult intellectual development. In C. Schooler & K. W. Schaie (Eds.), *Cognitive functioning and social structure over the life course* (pp. 120–141). Norwood, NJ: Ablex.

Huston, A., Watkins, B. A., & Kunkel, D. (1989). Public policy and children's television. *American Psychologist, 44,* 424–433.

Iyengar, S., & Kinder, D. R. (1987). *News that matters: Television and American opinion.* Chicago: University of Chicago Press.

Just, M., & Carpenter, P. A. (1987). *The psychology of reading and language comprehension.* Boston: Allyn & Bacon.

Kahneman, D., Slovic, P., & Tversky, A. (1982). *Judgment uncertainty: Heuristics and biases.* Cambridge, England: Cambridge University Press.

Keil, F. C. (1984). Mechanisms of cognitive development and the structure of knowledge. In R. Sternberg (Ed.), *Mechanisms of cognitive development* (pp. 81–99). New York: Freeman.

Lohman, D. F. (1993). Teaching and testing to develop fluid abilities. *Educational Researcher, 22(7),* 12–23.

Manning, M. (1988). *The standard periodical directory* (11th ed). New York: Oxbridge Communications.

Markovits, H., & Bouffard-Bouchard, T. (1992). The belief-bias effect in the reasoning: The development and activation of competence. *British Journal of Developmental Psychology, 10,* 269–284.

Markovits, H., & Nantel, G. (1989). The belief-bias effect in the production and evaluation of logical conclusions. *Memory & Cognition, 17,* 11–17.

Meara, P., & Buxton, B. (1987). An alternative to multiple choice vocabulary tests. *Language Testing, 4,* 142–151.

Miller, G. A., & Gildea, P. M. (1987). How children learn words. *Scientific American, 257*(3), 94–99.

Miller, J. D. (1989, January). *Scientific literacy.* Paper presented at the annual meeting of the American Association for the Advancement of Science, San Francisco, CA.

Morrison, F. J. (1987, November). *The "5-7" shift revisited: A natural experiment.* Paper presented at the meeting of the Psychonomic Society, Seattle, WA.

Nagy, W. E., & Anderson, R. C. (1984). How many words are there in printed school English? *Reading Research Quarterly, 19,* 304–330.

Nagy, W. E., Herman, P. A., & Anderson, R. C. (1985). Learning words from context. *Reading Research Quarterly, 20,* 233–253.

Nehrke, M. (1972). Age, sex, and educational differences in syllogistic reasoning. *Journal of Gerontology, 27,* 466–470.

Neuman, S. B. (1988). The displacement effect: Assessing the relation between television viewing and reading performance. *Reading Research Quarterly, 23,* 414–440.

Nisbett, R. E., & Ross, L. (1980). *Human inference: Strategies and shortcomings of social judgment.* Englewood Cliffs, NJ: Prentice-Hall.

Olson, D. R. (1977). From utterance to text: The bias of language in speech and writing. *Harvard Educational Review, 47,* 257–281.

Olson, D. R. (1986). The cognitive consequences of literacy. *Canadian Psychology, 27,* 109–121.

Olson, D. R. (1994). *The world on paper.* Cambridge, England: Cambridge University Press.

Ong, W. J. (1982). *Orality and literacy.* London: Methuen.

Rabbitt, P. (1993). Does it all go together when it goes? *Quarterly Journal of Experimental Psychology, 46A,* 385–434.

Ravitch, D., & Finn, C. E. (1987). *What do our 17-year-olds know?* New York: Harper & Row.

Rice, G. E. (1986). The everyday activities of adults: Implications for prose recall: I. *Educational Gerontology, 12,* 173–186.

Rice, G. E., & Meyer, B. (1986). Prose recall: Effects of aging, verbal ability, and reading behavior. *Journal of Gerontology, 41,* 469–480.

Rice, G. E., Meyer, B., & Miller, D. (1988). Relation of everyday activities of adults to their prose recall performance. *Educational Gerontology, 14,* 147–158.

Riverside Publishing. (1989). *Cultural Literacy Test.* Chicago: Author.

Salthouse, T. A. (1988). Resource-reduction interpretations of cognitive aging. *Developmental Review, 8,* 238–272.

Salthouse, T. A. (1991). Mediation of adult age differences in cognition by reductions in working memory and speed of processing. *Psychological Science, 2,* 179–183.

Salthouse, T. A., & Babcock, R. L. (1991). Decomposing adult age differences in working memory. *Developmental Psychology, 27,* 763–776.

Salthouse, T. A., Kausler, D., & Saults, J. S. (1988). Investigation of student status, background variables, and feasibility of standard tasks in cognitive aging research. *Psychology and Aging, 3,* 29–37.

Salthouse, T. A., & Mitchell, D. (1990). Effects of age and naturally occurring experience on spatial visualization performance. *Developmental Psychology, 26,* 845–854.

Schaie, K. W. (1984). Midlife influences upon intellectual functioning in old age. *International Journal of Behavioral Development, 7,* 463–478.

Schneider, W., & Bjorklund, D. F. (1992). Expertise, aptitude, and strategic remembering. *Child Development, 63,* 461–473.

Schwartzman, A., Gold, D., Andres, D., Arbuckle, T., & Chaikelson, J. (1987). Stability of intelligence: A 40-year follow-up. *Canadian Journal of Psychology, 41,* 244–256.

Sharon, A. T. (1973–1974). What do adults read? *Reading Research Quarterly, 9,* 148–169.

Simonson, R., & Walker, S. (1988). *The Graywolf annual five: Multicultural literacy.* St. Paul, MN: Graywolf Press.

Smith, J., & Baltes, P. B. (1990). A life-span perspective on thinking and problem-solving. In M. Schwebel, C. Maher, & N. Fagley (Eds.), *Promoting cognitive growth over the life span* (pp. 47–69). Hillsdale, NJ: Erlbaum.

Snodgrass, J. G., & Corwin, J. (1988). Pragmatics of measuring recognition memory: Applications to dementia and amnesia. *Journal of Experimental Psychology: General, 117,* 34–50.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly, 21,* 360–407.

Stanovich, K. E. (1993). Does reading make you smarter? Literacy and the development of verbal intelligence. In H. Reese (Ed.), *Advances in child development and behavior* (Vol. 24, pp. 133–180). San Diego, CA: Academic Press.

Stanovich, K. E., & Cunningham, A. E. (1992). Studying the consequences of literacy within a literate society: The cognitive correlates of print exposure. *Memory & Cognition, 20,* 51–68.

Stanovich, K. E., & Cunningham, A. E. (1993). Where does knowledge come from? Specific associations between print exposure and information acquisition. *Journal of Educational Psychology, 85,* 211–229.

Stanovich, K. E., & West, R. F. (1989). Exposure to print and orthographic processing. *Reading Research Quarterly, 24,* 402–433.

Sternberg, R. J. (1985). *Beyond IQ: A triarchic theory of human intelligence.* Cambridge, England: Cambridge University Press.

Sternberg, R. J. (1987). Most vocabulary is learned from context. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (pp. 89–105). Hillsdale, NJ: Erlbaum.

Tetewsky, S. (1992). Familiarity effects in visual comparison tasks and their implications for studying human intelligence. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18,* 577–594.

West, R. F., & Stanovich, K. E. (1991). The incidental acquisition of information from reading. *Psychological Science, 2,* 325–330.

West, R. F., Stanovich, K. E., & Mitchell, H. R. (1993). Reading in the real world and its correlates. *Reading Research Quarterly, 28,* 34–50.

White, T. G., Slater, W. H., & Graves, M. F. (1989). Yes/no method of vocabulary assessment: Valid for whom and useful for what? In S. McCormick & J. Zutell (Eds.), *Cognitive and social perspectives for literacy research and instruction* (38th Yearbook of the National Reading Conference, pp. 391–397). Chicago: National Reading Conference.

Zill, N., & Winglee, M. (1990). *Who reads literature?* Cabin John, MD: Seven Locks Press.

Zimmerman, J., Broder, P. K., Shaughnessy, J. J., & Underwood, B. J. (1977). A recognition test of vocabulary using signal-detection measures, and some correlates of word and nonword recognition. *Intelligence, 1,* 5–31.

(*Appendix follows on next page*)

Appendix

Results of Recognition Measures

Table A1
Percentage Recognition on the Author Recognition Test

Author	Older participants	College students
Maya Angelou	49.0	43.0
Isaac Asimov	49.0	52.0
Judy Blume	14	96.0*
Erma Bombeck	94.0*	52.0
Barbara Cartland	25.0*	3.0
Carlos Castaneda	14.0*	3.0
Tom Clancy	35.0	73.0*
Arthur C. Clarke	16.0	16.0
James Clavell	14.0	25.0
Stephen Coonts	2.0	18.0*
Ian Fleming	59.0	58.0
Dick Francis	25.0*	11.0
Stephen J. Gould	14.0	25.0
Andrew Greeley	22.0	15.0
David Halberstam	20.0*	3.0
Alex Haley	94.0	56.0
Frank Herbert	0.0	0.1
S. E. Hinton	0.0	27.0*
John Jakes	29.0*	13.4
Erica Jong	37.0*	6.0
Stephen King	35.0	96.0*
Dean Koontz	2.0	38.0
Judith Krantz	37.0	52.0*
Louis L'Amour	39.0	41.0
Robert Ludlum	35.0	36.0
James Michener	74.0*	40.0
Sylvia Porter	63.0*	26.0
Sidney Sheldon	25.0	79.0*
Danielle Steel	57.0	93.0*
Paul Theroux	10.0	6.0
Alvin Toffler	22.0*	3.0
J. R. R. Tolkien	46.9	72.0*
Barbara Tuchman	39.0*	10.0
John Updike	55.0	73.0*
Leon Uris	43.0*	8.0
Irving Wallace	33.0*	14.0
Alice Walker	20.0	54.0*
Joseph Wambaugh	22.0*	10.0
Tom Wolfe	49.0	43.0
Bob Woodward	39.0*	21.0

* $p < .05$, two-tailed.

Table A2
Percentage Recognition on the Magazine Recognition Test

Magazine	Older participants	College students
Analog Science Fiction	2.0	4.0
Architectural Digest	27.0	57.0*
Atlantic	69.4*	39.0
Business Week	76.0	74.0
Byte	6.0	43.0*
Car and Driver	14.0	79.0*
Changing Times	61.0*	13.0
Consumer Reports	88.0	95.0
Discover	20.0	81.0*
Down Beat	4.0	5.0
Ebony	86.0	94.0
Esquire	96.0	92.0
Field & Stream	10.0*	78.0
Forbes	78.0	85.0
Gentlemen's Quarterly	4.0	67.0*
Harper's Magazine	96.0*	60.0
House & Garden	94.0*	63.0
Jet	12.0	69.0
Ladies Home Journal	100.0*	70.0
Mademoiselle	84.0	93.0*
McCall's Magazine	98.0	93.0
Mother Earth News	12.0	6.0
Mother Jones	20.0*	2.0
Mother Trend	33.0	65.0*
New Republic	45.0*	19.0
New Yorker	90.0	81.0
Newsweek	96.0	96.0
Omni	33.0	64.0*
Personal Computing	4.0	35.0*
Popular Science	92.0	85.0*
Psychology Today	49.0	58.0
Redbook	96.0	90.0
Road & Track	16.0	45.0
Rolling Stone	29.0	98.0
Scientific American	41.0	41.0
Seventeen	84.0	94.0*
Sports Illustrated	92.0	95.0
The Sporting News	10.0	31.0*
Town & Country	74.0	72.0
Travel & Leisure	29.0	41.0*

* $p < .05$, two-tailed.

(*Appendix continues on next page*)

Table A3
Percentage Recognition on the Newspaper Recognition Test

Newspaper	Older participants	College students
Atlanta Constitution	49.0*	8.0
Boston Globe	80.0*	53.0
Chicago Sun-Times	25.0	47.0*
Chicago Tribune	78.0	73.0
Christian Science Monitor	98.0*	48.0
Cleveland Plain Dealer	47.0*	2.0
Denver Post	21.0*	8.0
Houston Chronicle	12.0	10.0
Los Angeles Times	41.0	66.0*
Miami Herald	49.0	49.0
New York Times	94.0	99.0
Philadelphia Inquirer	71.0*	16.0
San Francisco Chronicle	10.0	9.0
USA Today	94.0	98.0
Washington Post	98.0	99.0

* $p < .05$, two-tailed.

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