The Development of Short-Term and Incidental Memory: A Cross-cultural Study

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Wagner, Daniel A. *The Development of Short-Term and Incidental Memory: A Cross-cultural Study.* Child Development, 1974, **45**, 389–396. 5 age groups (CA 7–9, 10–12, 13–16, 20–21, ~ 27) of Ss were selected from 2 contrasting populations in urban and rural Yucatan. Whereas all urban Ss were in school, only the 2 younger rural age groups were in school—older rural Ss had little or no schooling. The Ss were tested on a short-term and incidental memory task. The developmental changes in memory performance of the urban-educated Ss were very similar to those reported for analogous tasks with American middle-class Ss. The performance of rural Ss did not show these consistent developmental changes. This fact, along with the results of several features of the data, support the hypothesis that formal schooling is an important factor in the development of mnemonic skills in short-term memory. Data from the incidental memory task implied that the development of selective attention is independent of short-term memory development and is probably influenced by both school and certain cultural factors.

Recent American research has indicated that short-term and incidental memory follow different, and distinct, developmental functions. Improvements in performance with age in short-term memory have been attributed to increased use of strategies involving, among other things, verbal mediation (Belmont & Butterfield 1971; Flavell 1970), and verbal rehearsal (Hagen 1971). On the other hand, it has been proposed that incidental memory is a function of the development of selective attention. Generally, incidental memory has been found to increase well into middle childhood (ages 12–15) and then decrease. It has been assumed that this increase in performance is the result of increases in information processing up to a certain age, whereupon the child is able to focus his attention more selectively on the important (or central) task demanded of him (Hagen & Hale 1972; Maccoby & Hagen 1965; Siegel & Stevenson 1966).

These previous studies used American children where age and education correlate almost perfectly, and it is difficult, therefore, to determine which of these factors is responsible for the cognitive changes. The findings from previous cross-cultural studies (e.g., Cole, Gay, Glick, & Sharp 1971) indicate that both factors may play a role.

The present study was undertaken in Yucatan, Mexico, to assess the relative contributions of age, cultural setting, and formal education to the development of short-term and incidental memory.

Subjects were obtained from two populations in the Yucatan peninsula of southern Mexico. A contrast was made with respect to culture and education by selecting both an urban and a rural setting. The urban setting was Merida, the largest city (150,000) and capital of the state of Yucatan. Aspects of Merida's modernity include growing industrialization, radio and television, cinema, large numbers of public and private schools, a university, and practically universal education through secondary school.

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The rural setting was the town (*pueblito*) of Mayapan. Mayapan *pueblito* was accessible in 1972 by foot, horseback, or an occasional four-wheel-drive vehicle from the nearest town, about 9 miles away, which, in turn, was about 4 hours from Merida by bus. Mayapan was typical of many towns off the road system of Yucatan in that it had no electricity, running water, or regular communication with other towns. Three teachers taught the government-run school for the first through fourth grades. Most children attended grades 1 and 2, while somewhat fewer attended grades 3 and 4; only a very few of these children ever left Mayapan for further education in the larger towns.

Method

Subjects and setting.—All in-school Ss were obtained nonsystematically from their classrooms. University students and older rural Ss were selected from volunteers so as to balance the groups as much as possible for sex. Characteristics of both urban and rural Ss are presented in table 1.

All teaching in both school systems was done in Spanish. The Merida population was predominantly *mestizo*, mixed Spanish and Mayan Indian, and, in general, spoke Spanish in the home and in the street. However, the Mayapan population was of almost pure Mayan extraction, and, in general, the local Mayan dialect was spoken in the home and in the fields. It seemed apparent to the author and the head teacher (who was *mestizo* and spoke little Maya) that many students in the local Mayapan school did not understand the school material, where both books and instruction were in Spanish. It can be assumed that the general quality of education for the Mayapan schoolchildren was inferior to that of the Merida schoolchildren.

TABLE 1

URBAN AND RURAL SUBJECT GROUPS

Cultural Setting and Group Age Range	N	Mean Age	Education (Mean Years)
Urban (Merida):			
7–8	32	7.6	2
10–11	32	10.5	5
14–15	32	14.1	8
20–21	32	20.1	12
25–27	20	25.4	15
Rural (Mayapan):			
7–9	20	8.0	1.5
10–12	20	11.1	3.5
13–16[a]	20	14.5	2.2
20–21[a,b]	20	20.4	1.1
22–35[a]	20	27.5	1.0

[a] These groups were not in school; all other groups were attending school.
[b] Only in this group were Ss not divided evenly by sex; this group contained 18 males and two females.

Stimuli and test materials.—Test materials were adapted from Hagen (1967). The stimuli consisted of a set of seven white stimulus cards, with each card (1½ × 3 inches) containing two colored pictures pasted on one side. Each of the seven cards had a particular object and a particular animal (one above the other; three with the animals above, and four below), taken from a well-known Mexican game called *lotteria,* similar to American bingo. The pictures were about 1 × 1¼ inches, and there was about a 1/16-inch space between the two pictures on the card. Each animal was paired with one object: fish-boot, frog-picture, bird-ladder, spider-bell, shrimp-bottle, deer-bowl, scorpion–flower pot. Pretests determined that these pictures were generally recognizable to both urban and rural Ss at all ages.

Fourteen sets of these seven stimulus cards were constructed and arranged in a fixed randomized order; each set had its own separate test packet. In each packet, following the seventh stimulus card, was a special probe card (consisting of a single animal or object) to test for one of the seven serial positions—this was the "central" (short-term memory) task. Two large 4 × 6-inch index cards, one containing all seven animals in a circular design, the other containing the objects, were used for pretest stimulus recognition prior to the central task and as a part of the incidental memory task. Two additional packets of single animals and single objects were used as probe stimuli in the incidental memory task. For the practice session, an equivalent but smaller set of different stimuli consisting of three animals and three objects was used. A white cloth was used as the testing surface and was placed on a table or desk top.

Procedure.—The Ss were taken one at a time from the classroom to the testing room, which was usually an unused classroom (but in Mayapan it was the mayor's office). All Ss were tested for central and incidental memory with the same task stimuli. The materials were balanced such that animals were central and objects were incidental for half the Ss and the reverse for the rest of the Ss. The central task consisted of locating a particular central stimulus among a series of seven that were briefly presented to S and then placed face down in front of S. Following 14 trials on the central task, S was tested for incidental memory by being asked to recognize which animals went with which objects, on the basis of information from the previously shown animal-object pairing in the central task.

The experimenter and S sat on opposite sides of the table or desk, facing each other. The E began the practice trials by saying, in Spanish to the urban Ss, or in Maya to the rural Ss:

> We are now going to play a game with some animals and objects which you know very well. Before we play the *real* game, we are going to play a practice game, so that I know that you understand the game. Do you know these three objects and three animals? Now, the idea of this game is to remember where each of these animals (or objects) is as I place them down in front of you. Then I am going to show you an animal (object) and you must point out, but not turn up, the card where that animal is in the row. I will then tell you whether you were correct or not, and I will prove it by showing you where the animal (object) is located. Remember, it is necessary to remember only where the animals (objects) are. The objects (animals) are not important.

The E then went through six trials with the practice game, explaining if necessary what was meant by "animal" or "object." If S got three or more responses correct, E proceeded to the central task. If S made fewer than three correct responses, he was dropped from the experiment. Fewer than 2% of all Ss failed to meet this criterion. The E then continued:

> Good, now I know you understand the idea of the game. The real game has the same idea, but the animals and objects will be different. Also, there will be seven cards, not just three. Now I want you to tell me the name of all these animals and objects. Now you know all the animals and objects to be used in the real game. As in the practice game, *only* remember where the animals (objects) are. Also, to make the game more interesting for you, I am going to give you one piece of gum [or 20 centavos or 1 peso, with older Ss receiving the higher rewards] for each correct answer—that is, for each animal (object) you find. Do you understand everything?

At the appropriate time, if S did not know the name of a stimulus, E supplied it; E accepted a reasonable facsimile (e.g., *pesca* for *pescado*). During naming, the animals and objects were presented in separate groups where the central stimuli (e.g., animals) were always named first. Presentation proceeded in a row from the S's left to his right. The E held each card in view for approximately 2 seconds and then placed it face down. The stimulus cards were arranged so that the series of seven cards and the 14 test trials formed two 7 × 7 perfectly randomized matrices, where no picture appeared next to the same pictures either horizontally or vertically in the array. Thus, each serial position was tested twice and each stimulus tested twice, but in a different serial position each time. The score for performance on the central task was defined as the total number of animals (objects) correctly located on the 14 trials.

After completion of the 14 central task trials, E began the incidental memory task as follows:

> Good! Now the game is going to change. Do you remember that each card had an animal and an object on it? I want you to tell me which of these objects (animals) was accompanied by this animal (object). Do as well as you can. I will tell you the correct answers and how many you got correct after we have finished the game. Again I will give you one piece of gum (or 20 centavos or 1 peso) for each correct answer. Understand?

When necessary, E explained more. He then tested S on all seven objects (animals). Performance on the incidental memory task was defined as the number of correct pairings out of the seven possible pairs.

In order to insure comprehension of the task and appropriate motivation of the subjects, several weeks of pretesting were carried out. This pretesting was devoted to achieving an adequate translation of the material into Spanish and Maya and to optimizing the effect of incentives on performance.

Results

Central task.—Performance on the central task was assessed for two scores: total number of correct responses and number of correct responses for each serial position. A separate analysis indicated no significant differences attributable to sex, so this factor will not be discussed further.

A three-way analysis of variance, group (2) × age (5) × serial position (7), with repeated measures on one factor (serial position), and unequal cells (Winer 1962, p. 242), showed all main effects to be significant: group $F(1,238) = 46.29$, $p < .01$; age $F(4,238) = 7.91$, $p < .01$; and serial position $F(6,1428) = 26.04$, $p < .01$. The interaction of group × age × serial position was not significant, $F(24,1428) = 1.13$, but each of the possible two-way interactions was significant, and will be presented individually.

The group × age interaction, $F(4,238) = 5.38$, $p < .01$, may be seen in figure 1, where "proportion correct" is the total number of correct responses divided by the total possible correct responses. The source of the interaction is obvious from figure 1 and is supported by an analysis of the simple effects of age; only the score of the urban group increased with age, $F(4,238) = 11.93$, $p < .01$. Further analyses of these data indicated no significant differences between rural and urban 7–9 and 10–12 age groups. A significant difference was found at ages 13–16, $t(50) = 2.64$, $p < .025$, which subsequently increased, $p < .01$.

The group × serial position interaction, $F(6,1428) = 2.20$, $p < .05$, is shown in figure 2. The urban groups showed a considerable primacy effect, while the rural groups did not. The age × serial position interaction, $F(24,1428) = 1.89$, $p < .01$, indicated that, with age, primacy increased more than other portions of the serial position curve. Figure 3 presents a breakdown of these data which clarifies the locus of intergroup differences within a trial. The top panel of figure 3 shows the primacy effect (position 1), the second panel shows the recency effect (position 7), and the bottom panel shows the "middle-positions" measure (mean of positions 3, 4, 5). The middle-positions measure was calculated to provide a measure with less of the presumed effects of specific memory skills or processes which enhance performance at both the primacy and recency portions of the serial position curve.

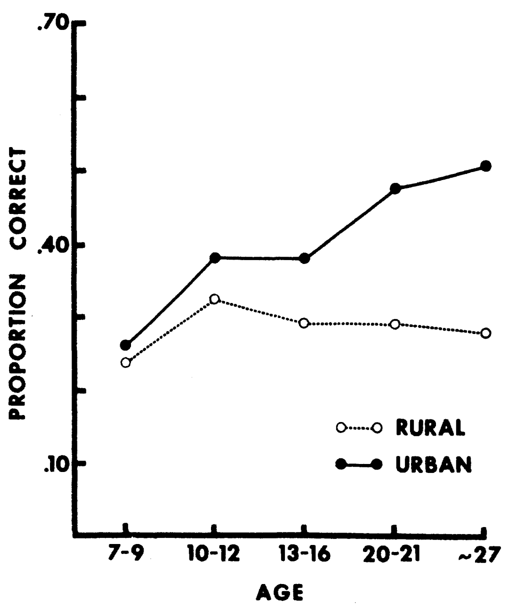

Fig. 1.—Central task recall over age in rural and urban groups (summed over serial positions).

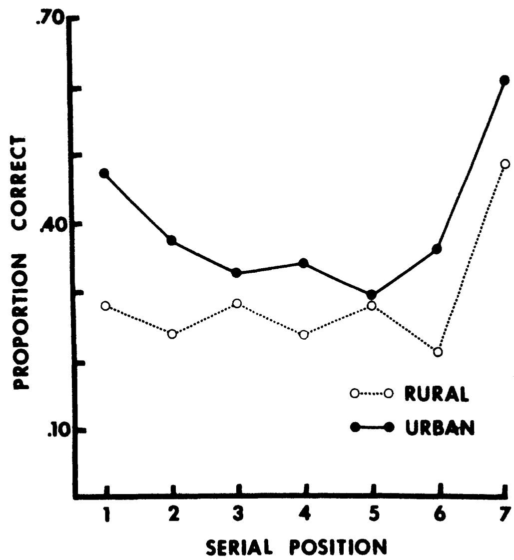

Fig. 2.—Central task recall by serial position in rural and urban groups (summed over ages).

Analysis of the primacy effect showed that the main effects for group, $F(1,238) = 18.47$, $p < .01$, and age, $F(4,238) = 4.08$, $p < .01$, were significant, as well as the group × age interaction, $F(4,238) = 1.41$, $p < .05$. This interaction indicated that while primacy remained generally constant over age in rural groups, it increased with age in the urban groups. There were no significant differences in primacy recall between urban and rural groups at either ages 7–9 or 10–12.

Analysis of the recency effect showed that the urban group scored significantly higher than the rural group, $F(1,238) = 5.91$, $p <$

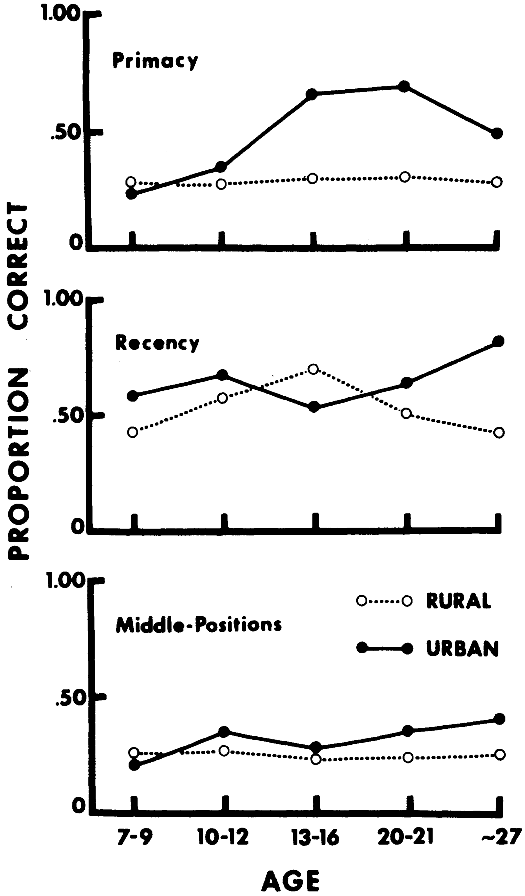

FIG. 3.—Primacy, recency, and middle-positions recall by age and group.

.05; and that the overall effect of age was not significant. The group × age interaction was significant, $F(4,238) = 3.16$, $p < .05$, showing that while the urban group had a somewhat increased recency performance with age, the rural group did not.

Analysis of the middle-positions measure showed that the urban group scored slightly but reliably higher than the rural group, $F(1,238) = 5.56$, $p < .05$; and that the main effect for age was also significant, $F(4,238) = 2.87$, $p < .05$. Although the group × age interaction did not quite reach significance, $F(4,238) = 2.04$, $p < .10$, it appears from figure 3 that the middle-positions measure remained relatively constant over age for the rural group, while an increase with age occurred in the urban group.

The breakdown of data in figure 3 supports the previous analyses of data depicted in figures 1–2. It seems apparent that the locus of age-related increases in recall for urban Ss and group-related differences in recall are largely attributable to the early portion of the within-trial recall process, the primacy effect.

Incidental task.—The incidental memory task score was the number of correct pairings of animals and objects recalled following completion of the central task. These data are presented in figure 4. Analysis indicated overall higher urban performance, $F(1,238) = 15.65$, $p < .01$. While the main effect for age was also significant, $F(4,238) = 3.28$, $p < .05$, the decline in urban performance from ages 13–16 to age 27 was significant, $t(50) = 2.25$, $p < .025$. A similar decline may be seen in the rural performance from ages 20–21 to age 27, $t(38) = 2.75$, $p < .01$.

Additional data.—In an effort to separate the factors of schooling and cultural setting, a group of 32 relatively unschooled urban *mestizo* adults (mean age = 29.1 years; mean education = 2.9 years) was tested. Results from this group showed that on the central task these Ss, while significantly different from schooled urban adults, $t(50) \geqslant 3.06$, $p \leqslant .01$ on all scores except primacy, had scores similar to unschooled rural adults, all t tests not significant, $t(50) \leqslant 1.62$, $p \geqslant .10$: central task score = 0.32; primacy = 0.39; recency = 0.50; middle positions = 0.25. On the incidental task (score = 0.32), the unschooled

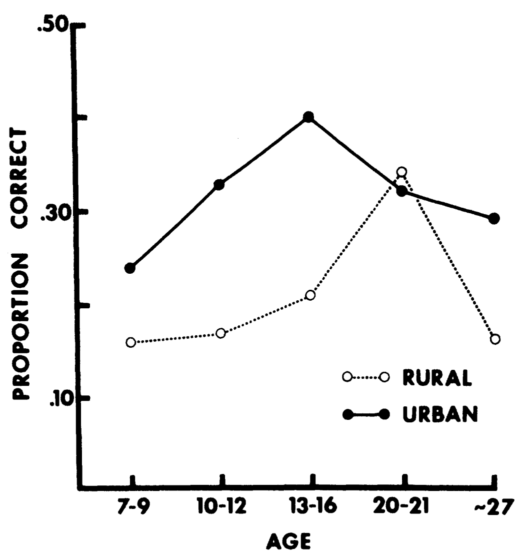

FIG. 4.—Incidental task recall over age in rural and urban groups.

urban adults performed significantly more like schooled urban adults, $t(50) = 0.51$, $p \geqslant .20$, than unschooled rural adults, $t(50) = 0.29$, $p \leqslant .01$.

Individual correlations of the central and incidental task scores were calculated for all age groups. The correlations ranged from $r = -.30$ to $r = +.49$. There were no significant trends in these correlations with increasing age.

Discussion

Such factors as age, cultural setting, and formal education were initially mentioned as possible independent variables in the development of memory. With respect to short-term memory, the data show that age alone cannot account for such development—rural Ss do not show the same developmental changes with age as do urban Ss.

One would like to determine whether these differences are attributable to formal education or the varied influences of cultural setting (e.g., urbanization, media, acculturation, etc.). Some evidence bearing on this question comes from two sources. First, there were no differences in either primacy or central task performance in the two youngest age groups (7–9 and 10–12 years), precisely the groups that were all in school regardless of cultural setting. Differences were significant only between urban Ss who continued school and the rural Ss who did not.

However, with older Ss, schooling and cultural setting are confounded; that is, schooled and unschooled Ss belong to different cultural settings. Therefore, an "extra" group of relatively unschooled urban adults was tested. Results showed that education was more important than cultural setting on short-term memory performance; these Ss performed like unschooled rural adults. These data add further evidence to the hypothesis that formal education is a major factor in memory development. One should bear in mind that present research on the effects of malnutrition on mental development may increase the possibility of confounded variables (nutrition and education) in this study. This seems less likely, however, in light of the fact that performance differences in the expected direction do not occur until about age 14, perhaps later than one would expect nutritional effects to become apparent.

In general, the results of urban Ss replicate American studies of short-term and incidental memory. The overall increase in central (short-term memory) task performance with age and education replicates the studies mentioned earlier. The increase in primacy with age for these Ss is consistent with the theory that verbally mediated rehearsal strategies develop with age and thus improve primacy recall (Flavell 1970; Hagen 1971).

Rural Ss present a somewhat different picture, showing both similarities and differences with previous American studies. Although the rather stable recency (the "echoic" store proposed by Broadbent [1958]) and middle-positions measures were both consistent with developmental short-term memory in urban Yucatan and in the United States, the lack of a developmental increase in performance with age in primacy and central task recall is not. A comparison made between primacy and middle positions in rural groups showed no statistical differences, indicating little or no primacy effect (i.e., primacy over middle positions) even up to adulthood. American studies have assumed that normal older children and adults use verbal rehearsal as a strategy in memory, which produces the primacy effect. In the model of memory proposed by Atkinson and Shiffrin (1968), rehearsal is a "control process" whereby items to be recalled may be transferred into long-term or secondary memory, producing the primacy effect. The implication from the present findings is that rural Ss are not using verbal rehearsal strategies, thereby precluding developmental increases in primacy and central task performance.

A comparison of urban and rural central task data leads one to conclude that there are both quantitative and qualitative differences between these groups. Quantitatively, although urban Ss had higher scores than rural Ss on all measures, these differences may be interpreted as of relatively small importance—probably due to the novelty of the experiment, the experimenter, and many other uncontrolled variables. However, qualitatively, only the primacy effect and its corollary, overall central task recall, were functionally different between urban and rural Ss. The implications of this finding are twofold. First, higher-level mnemonic skills or strategies for remembering (such as verbal rehearsal) may develop only in the context of formal education, not by maturation alone. Second, factors other than schooling must account for the better-than-chance recall in the middle positions and recency portions of the serial position curve. It seems plausible that recency or "echoic" memory may be a universal sort of memory process that can be "tapped" by most Ss, young and old, schooled and unschooled.

Studies of incidental learning and memory have been considered to be a measure of selective attention—the lower the incidental score, the higher the central task score, and thus the better the selective attention of the subject. Curvilinear functions of incidental memory are considered to be supportive of the hypothesis that the development of selective attention begins to inhibit or filter out information processing of irrelevant or incidental stimuli with increasing age. The decline in incidental task performance following age group 13–16 with urban Ss is a clear replication of the studies mentioned previously. Although the oldest rural group showed a similar decline, the fact that there was no concomitant increase in central task performance indicates that this data point may not truly reflect increasing selective attention. Only a replication will determine whether unschooled Ss show the typical inverted U-shaped function or perhaps an asymptotic function.

As before, education and culture are confounded for older Ss in the incidental memory task. Interestingly enough, data from the "extra" group of unschooled urban adults showed that these Ss performed more like schooled urban Ss than unschooled rural Ss. This implies that culture plays a more important role in the development of selective attention than in the development of short-term memory. It is possible that the effect of media (e.g., radio, television, newspapers, etc.) in a cultural setting may have something to do with the development of selective information processing, although further research is necessary before more can be said on this hypothesis.

Finally, the correlations performed on central and incidental scores showed no significant developmental age trends. The data, therefore, do not support the hypothesis that central and incidental information processing are related. Although some studies (e.g., Druker & Hagen 1969; Hagen, Meacham, & Mesibov 1970) have claimed that there exists an increasing "trade-off" with age between central and incidental processing, no such negative correlational trends were found in the present study.

Although the evidence presented here supports the hypothesis that formal schooling is critical for the development of the *spontaneous* use of certain memory strategies, little is known at present as to what aspects of formal schooling affect memory development. It may not be inferred, however, that the rural and uneducated Ss are not capable of using verbal rehearsal strategies or of showing better selective attention. The present study measured only selected aspects of what may be generally called short-term memory and selective attention. As some studies have shown, American-style memory performance may be elicited under appropriate training or constraining in the experimental task (Cole et al. 1971). Furthermore, recent studies with children have shown that young children (Corsini, Pick, & Flavell 1968; Kingsley & Hagen 1969) and lower-class older children (Shultz, Charness, & Berman 1973) can be induced to use mediational strategies to their benefit through proper techniques.

In a recent cross-cultural study of recognition memory, Kagan, Klein, Haith, and Morrison (1973) suggest that although American children perform better than isolated unschooled Guatemalan children at early ages (5 and 8 years), such differences disappear by age 11—thus implying merely a "lag" in development. This finding led Kagan et al. to affirm the statement by a well-known anthropologist that the "functions of the human mind are common to the whole of humanity" (p. 223). As we have seen, however, memory can be analyzed on at least two qualitative levels; and the development of memory depends on more than simple maturation. It is conceivable that recognition memory, as with "echoic" memory, develops maturationally and without formal schooling, but this is apparently not true for all that is considered to be memory. Higher-level mnemonic strategies in memory may do more than "lag" by several years—the present data indicate that without formal schooling, such skills may not develop at all.

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