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ABSTRACT

This paper reports two experiments investigating the effect of schooling and urbanization on short term recall and recognition memory. Subjects were 384 male children and young adults living in Morocco representing urban and rural and schooled and nonschooled backgrounds. Additional subject groups--including Koranic school students, Moroccan rug sellers and University of Michigan students--were also tested to study possible culture-specific influences on memory. In the first experiment, subjects were required to recall the position of a familiar animal in a series of seven briefly presented items. Results indicated that recency recall, or echoic store, was present in all populations studied regardless of age, whereas primacy recall, considered to be a function of verbally mediated rehearsal strategies or control processes, developed with age only for schooled subjects and to a lesser extent for urban nonschooled subjects. In the second experiment, the same subjects were shown 30 pictures of rug patterns (15 original patterns and 15 duplicates) and asked to identify duplicates. Duplicates appeared in lags of 1, 5, 10, and 25 intervening items. Schooled subjects performed better than nonschooled, and rural subjects (schooled and nonschooled) scored better than urban subjects. Results support previous research indicating little age-related change in forgetting rates and, with minor exceptions, no variation in forgetting rate with respect to schooling and environment. Results are discussed in relation to other cross-cultural and memory research. Nine pages of tables and illustrations are included. (SB)

THE EFFECTS OF SCHOOLING AND ENVIRONMENT ON MEMORY DEVELOPMENT

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For more than a century, the topic of "universals" in human behavior has been a controversial one for psychologists, as well as for other social scientists. During this period of controversy, empirical and anecdotal evidence from differing cultural groups has been used both to support and deny the notion of universals in psychological thought. In its most extreme form, anthropologists such as Lucien Levy-Bruhl (1966) have suggested that there was such a thing as "primitive mind," while others, such as Alfred Kroeber (1948) countered that there exists, in fact, a "psychic unity" of all mankind where no fundamental differences exist. Some investigators, such as Michael Cole (Cole & Scribner, 1974) and his associates, have suggested that cultural differences in behavior may be more apparent than real. That is, the earlier contrasting views might be reconciled by claiming that cognitive differences may exist in content only (i.e. what different peoples think about), rather than in cognitive process (i.e. how people think about what they think about.). This sort of explanation is likely to gain substantial support from a variety of social science disciplines.

In fact, there is an increasing tendency to believe in universals in human cognition. The developmental psychologist has only to open any recent test on child development to find the topic of universals writ large. There

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is, indeed, a considerable body of evidence that suggests innate universal psychological processes. A few recent examples would include studies in linguistics and language development by Chomsky (1972), Lenneberg (1969), Slobin (1973), and others, as well as in the area of perception and perceptual development by Rosch (1973), T.G.R. Bower (1974) and many others. Both age-developmental and cross-cultural research has been used effectively by the above investigators to support the notion of cognitive universals.

Given the kind of evidence just mentioned, is it now reasonable to agree with such developmentalists as Kagan and Klein (1973) who, in their well-publicized Guatemala study, stated that "basic cognitive processes...such as perceptual analysis, language and memory...[are]...an inherent competence in the human program" (p.949)? While the evidence on universals in perception and language has been fairly well documented, research on memory development has not, in spite of the fact that this area has been the subject of increasing interest in recent years. The present paper will address itself to the question of universals in human memory, and the potential effects of global cultural factors such as formal schooling and urbanization on memory development.

Before getting into the present data, however, it is useful to briefly outline the theoretical context in terms of theories of memory and memory development. One of the important conceptualizations of memory in recent years is that proposed by Atkinson and Shiffrin (1968). In this theory--which now includes a number of variants--memory is said to be composed of structural features and control processes. In such an information-processing model of memory, structural features include: sensory (or echoic) store; short-term store; and long-term store. Each of these stores has a relatively fixed capacity and fixed decay rates. Control processes are what guide information through the system or structure, and are often (though not always) considered to be under the potential conscious control of the individual. These processes have also been termed strategies for remembering, or simply, mnemonics.

Research by developmentalists such as Brown (1975), Flavell (1970), Hagen (1971) and many others have provided a considerable body of evidence in support of such a model for studying memory in children. Structural features have been shown to be present very early in development, as evidenced by recognition memory studies with young children, where decay or forgetting rates have been found to be unchanging across age (e.g. Wickelgren, 1975). In short-term recall tasks, echoic store or recency effects are present in very young children, and are also relatively invariant over age (e.g. Hagen, 1971; Wagner, 1974). Control processes, on the other hand, have been shown to increase with chronological age in children. Memory strategies such as rehearsal, clustering, categorization and semantic encoding have been shown in a wide variety of studies to increase developmentally (for a review, see Brown, 1975).

Given this developmental model with memory structure developing very early, while control processes develop more slowly through young and middle childhood, the standard environmentalist question may be asked: To what degree do environmental factors affect our model? To what extent are structure and control processes susceptible to environmental influence? Considering the research cited above, it might be reasonable to hypothesize that control processes would be considerably more sensitive to environmental events than structural features, which appear to be relatively stable from early childhood.

The Morocco Study

To gather evidence on these questions, I went to Morocco, where wide environmental variability within a single culture provided an ideal setting for studying such global factors as schooling and urbanization.

In the study, 384 children and young adults (all males) were selected in order to contrast the separate and combined effects of schooling and urbanization on memory development (see Table 1). Additional groups of subjects--including Koranic school students, Moroccan rug sellers, and University of Michigan students--were also tested in order to study possible culture-specific influences on memory. Subjects were tested in their preferred languages by a bilingual Moroccan who served as the experimenter in all testing. In two memory experiments, tasks were chosen because each tapped into specific aspects of structure and control processes.

Experiment I: Short-term Recall

The first experiment studied the development of short-term recall. This memory task, first used extensively by John Hagen and his associates, required the subject to locate the position of a familiar animal in a series of seven briefly presented items, where the to-be-remembered item varied in position from trial to trial over 14 trials. As in Figure 1, the subject was first shown each of seven cards in the top row, which were turned face down after a two second presentation. Following the presentation, the subject was presented with a single "probe' card with a single animal on it, and had to find the same animal in the linear array of seven face-down cards. The household objects on the presentation cards were part of another experiment which is described elsewhere (Wagner, 1976).

The results of this task may be seen in Figures 2 and 3. I will briefly discuss the results here, since an earlier (although less extensive) study which I undertook in Mexico produced essentially identical results, and those data have already been published (Wagner, 1974). The analysis of the results from Experiment I (see Table 2) may be summarized briefly as follows:

1. All main effects (i.e. for age, schooling and urban environment) were significant for total recall (summed over serial positions), primacy recall (i.e. first serial position) and middle-positions recall (i.e. mean of serial positions 3, 4 and 5). For recency recall (i.e. final serial position) there was a small but reliable effect for school. It should be noted that the age effects for primacy and total recall were considerably larger than that of middle-positions.

2. The age X school interaction was significant only for primacy and total recall. This interaction may be interpreted as support for the hypothesis that years of schooling were directly related to performance on primacy recall, and thus subsequent total short-term recall.

3. The significant school X environment interactions for primacy and total recall performance support the hypothesis that the urban schooled children showed the best overall performance as a function of memory skills that produce the primacy effect.

As suggested earlier, memory development can be meaningfully discussed in terms of models that distinguish between structure and control processes. With respect to the present and other results, (for a more complete account, see Wagner, 1977), two points seem clear: first, recency recall or echoic store was present in stable form in all populations studied, regardless of age, schooling or environment; and second, primacy recall--considered to be a function of verbally mediated rehearsal strategies or control processes--developed with age only for schooled subjects, and in somewhat diminished form for urban non-schooled subjects. And, it appears that primacy recallwas what caused improved overall short-term recall in the older schooled groups. While earlier studies have typically been hampered by the confounding of the factors of schooling and urbanization, the present study showed that each factor may have a positive effect on the development of control processes in memory. Thus, it appears that the use of mnemonic strategies may be tied to certain cultural experiences, while echoic store--a structural feature of memory--seems to be present in all individuals regardless of age or special cultural experiences.

Experiment II: Recognition Memory

Models of recognition memory (e.g. Anderson & Bower, 1972; Kintsch, 1970) suggest that there are two primary parameters that determine recognition memory performance: acquisition, the amount of information that enters the memory system, and forgetting rate, the continuous decay of information from memory as a function of time or intervening information to be remembered. The forgetting rate, as discussed earlier in the model of Atkinson and Shiffrin (1968), is considered to be a structural feature of memory: acquisition is more variable, and is considered to be a function of many factors such as the type of stimulus encoding and perceptual set.

Developmental studies of recognition memory, as opposed to recall, have been most often characterized by a lack of age-related trends in performance. In her recent review, Brown (1975) has suggested that such invariance with age is probably a function of the degree to which the recognition memory task does not require active retrieval or acquisition strategies. Furthermore, invariant forgetting rates seem to be responsible for the lack of age-related changes in recognition memory performance, as has been shown in a variety of studies where forgetting rates exhibit little age-related change for either words (e.g. Wickelgren, 1975) or pictures (e.g. Nelson, 1971).

In Experiment II, two main questions were asked: (1) To what degree is rate of forgetting a structural universal, varying little by age or experience?; and (2) To what degree can we specify the nature of variation in rate of acquisition? In order to delineate the life-time experiences that lead to variation in stimulus encoding, which seems to affect rate of acquisition, task stimuli were composed of oriental rug designs, and were selected to be moderately familiar to Moroccan children, very familiar to a non-schooled population (Moroccan rug sellers), and unfamiliar to a very schooled population (University of Michigan undergraduates).

The same subjects as in Experiment I were tested on a modified version of the continuous recognition memory task of Shepard and Teghtsoonian (1961). The stimuli were 207 black and white photographs of Middle-Eastern rugs (see example in Figure 4). The experiment consisted of a practice test of 30 trials, followed by the experimental task of 177 trials. The practice task consisted of 15 original and 15 duplicate rug patterns, which were arranged so that repetitions (i.e. duplicates) occurred at varying intervals or lags in the series. Thus, repetitions of patterns occurred at lags ranging from zero (i.e. duplicate was repeated on the next trial) to 17 (duplicate repeated after 17 intervening patterns). The experimental task consisted of 88 different rug patterns and 88 exact duplicates, which were arranged in a sequential array so that duplicates formed lags of 1, 5, 10, and 25 intervening items. There were 22 repetitions at each of these four lags, which were distributed as evenly as possible over the entire sequence of items. Both practice and experimental stimuli were arranged in two large loose-leaf notebooks, so that when the next pattern was exposed, it covered the previous pattern.

As in the first experiment, each subject was tested individually, and was allowed to go on to the experimental task only if he could master the practice task. For both the practice and experimental tasks, the subject was instructed that each rug pattern would have one and only one duplicate or "sister" rug. He should look at each rug carefully, and say whether the present rug design was appearing for the first or second time. The subject was allowed about five seconds to look and respond to each item before turning to the second item. As in the first experiment, all subjects were tested in their preferred language.

The results of this continuous recognition memory task were based on five derived measures of performance: total correct (the sum of hits and correct rejections for each subject); and d' (an unbiased measure of memory trace) for each lag (1, 5, 10 or 25 intervening items). For each of these measures, three-way analyses of variance, by age (4) X school (2) X environment (2), were performed (see Table 3). The most important features of the analyses may be summarized as follows:

1. Chronological age produced little or no reliable effects for the various recognition measures.

2. Schooling produced significantly increased performance for the longer lags (10 and 25 intervening items), which resulted in a significant schooling effect for total correct.

3. The effect of environment was highly significant. Contrary to the findings in the short-term recall task, the rural subjects, whether schooled or non-schooled, performed significantly better than their urban counterparts on all recognition measures.

Forgetting rates--or the decrease in d' over lag or delay--proved to be very interesting. Forgetting curves are plotted by group in Figure 5.

Statistical profile analyses were performed within each of the groups, and the results confirmed the observation that the forgetting curves were generally invariant or parallel to one another across ages. Since there were essentially no age differences in forgetting rates, these data were pooled across ages and were compared, as single groups, with the data from the three extra groups (Rug Sellers, Koranic students, and Michigan undergraduates) in Figure 6. Profile analyses of these curves indicated that all but the urban schooled and Michigan students had parallel forgetting curves. These latter groups showed significantly less forgetting over lags, but this difference was small in magnitude.

In general, then, these data on recognition memory support previous research that indicated little age-related change in forgetting rates, and, with only minor exceptions, these forgetting rates were also invariant with respect to schooling and environment.

A number of interesting differences were found in total correct and in the rates of acquisition (i.e. the levels of the forgetting curves). While it is unclear why rural subjects performed better than urban subjects in the recognition task--but the opposite in the recall task--such findings strongly imply that situational factors such as motivation or comprehension probably played little role in the performance of most subjects. Furthermore, the fact that rural non-schooled subjects performed better than the urban schooled subjects implies that schooled subjects do not necessarily do well as a function of learned test-taking skills. There are, however, a number of theoretical explanations for these differences in the acquisition parameter, and these are probably related to variations in stimulus encoding abilities between groups, as hypothesized earlier. For example, the non-schooled Moroccan rug sellers scored as high or higher than all other Moroccan subjects, whether schooled or non-schooled.

Familiarity with rugs may not be the only factor involved, however, as the Michigan undergraduates also performed quite well. Reasonable explanations for differences by group in acquisition rates might involve the following factors: increased encodability as a function of familiarity, encoding strategies that tap a deeper level of processing (as in Craik & Lockhart, 1972); and, finally, ability to extract distinctive features (as in the theory of Gibson, 1969). More discussion of this aspect of performance is available elsewhere (Wagner, 1977).

Discussion

In the introduction, models of memory were discussed in terms of both structural features and control processes. It was argued that such structure, if built-in, should be present in all subjects regardless of age or experiential background. Several pieces of evidence seem to support this hypothesis: (a) echoic store was found in all groups, regardless of age or background; and (b) forgetting rates were generally invariant across groups.

Developmental research in memory has shown that control processes--such as verbal rehearsal and clustering--improve between the ages of 5 and 15 years. While chronological age or maturation has been said to be the important independent variable in such research, some earlier cross-cultural studies (Cole et al., 1971; Wagner, 1974) have shown that the development of control processes may be dependent in part on formal schooling. Data from the present study adds further support to the hypothesis that experiential factors, such as schooling and living in an urban environment, influence the development of control processes. The results of the short-term recall experiment showed that verbal rehearsal appeared to be used only by older schooled subjects, and to some extent by urban non-schooled subjects. These data, reflecting the stable use of verbal rehearsal strategies by about age 13, are consistent with data collected among American school children (Hagen, 1971).

There is a variety of evidence that suggests that control processes or mnemonics may be culture-specific--where the "cultures" of both western-style schooling and urban society would be exemplars. Additional evidence is available from other sources. It is well-known that remembering the words to a song is greatly facilitated by singing the song--the tune and rhythm serve as mnemonics. Among the Kpelle in Liberia, Lancy (1975) has reported a similar phenomenon, but adds further that "my informants had great difficulty recalling the songs unless they were singing and dancing" (p.9). Thus, we see a motoric or kinesthetic mnemonic that aids recall. Similar evidence was recently gathered in a study of memory in deaf children (Liben & Drury, 1976). In this study, deaf children created their own, apparently culture-specific or deaf-specific, mnemonics for remembering. The authors observed the use of fingerspelling and the use of mime representations (such as "rocking to represent a curved line") as mnemonics in a short-term recall task. Still other examples of memory aids are numerous in the anthropological literature, and have been summarized in several extensive reviews (e.g. Yates, 1966).

It appears reasonable to conclude that claims such as those quoted earlier from Kagan and Klein (1973)--with respect to an "inherent program" of basic cognitive processes--should be limited to the relatively simple estimates of memory performance they studied. Stated in its strongest form, the present study supports the hypothesis that structural features in memory are universal, while control processes seem to be more culture-specific, or a function of the particular experiences that surround each growing child. While the pattern of results appears to support this hypothesis, it is obviously difficult to claim a completely universal structure of memory, because only certain structural features of memory were studied. Furthermore, although differences in control processes seem to be a function of global lifetime experiences, we are, at present, unable to specify what factors in the school or environment specifically influence the development of such processes. Moreover, we cannot claim that children growing up in some cultures are unable to use certain control processes or that such processes do not exist in some culture, for the present study has dealt only with the kinds of control processes used on specified tasks.

In summarizing the two experiments, I believe it is possible to say that we have provided complementary evidence for current psychological models of memory, by confirming the development, and invariance, of several differing aspects of these models. It is also possible to add memory skills to the growing list of cognitive skills that seem to develop as a function of the schooling experience.

Final Comments

By way of conclusion, I would like to make a few final comments on the nature of this enterprise, and potential directions of future research. A variety of psychologists and anthropologists might react to the present discussion with a sigh and a "so what"? They would say, look, it's really quite simple. We know that all kids have short-term memory--they remember Mommy and Daddy, don't they? We know they have depth perception--they don't bump into trees, do they? We know they have complex cognitive skills--they all learn how to speak, don't they? And so it goes... I believe, however, that the issues are more complex than such criticism would have us believe. Understanding cultural differences in behavior is a difficult and sometimes frustrating task. As Cole, Glick, Labov and others have pointed out, we must take the situational or experimental context into consideration. They would say, what if we were to change the experiment so that it would be more "relevant" to the individual's background? Obviously, this is an important point. But such a point may speak mainly to the potential of all individuals--regardless of race or culture--to achieve the same general intellectual level. Few of us--except for possibly the hard-nosed geneticists--would disagree with such an assertion.

However, the assertion of universal potentialities may be beside the point here. I believe that we should also be studying the ability of individuals to spontaneously use cognitive skills on more-or-less culturally appropriate tasks. (Clearly, no task is going to be perfectly appropriate to all individuals in even a culturally homogeneous group--regardless of our attempts.) For example, we now know that very young children (Hagen, 1971), mild retardates (Brown, 1975), and certain non-schooled groups (Cole et al., 1971; Wagner, 1977) do not spontaneously use mnemonic strategies or control processes on certain recall tasks. All these groups, however, can apparently be induced to show Western adult-like behavior through special training, elicitation techniques, and/or constraining of the task situation. Few of us, however, would agree that young children, mild retardates and non-schooled adults have isomorphic cognitive structures.

When we speak of the effects of schooling process on level of cognitive skills, we are also, and perhaps more fundamentally, concerned with the effects of level of cognitive skills on the schooling process. It seems to me that the question of spontaneity of the production of cognitive strategies must be addressed sooner or later. That is, do individuals or groups of individuals who show cognitive strategies under elicitation techniques have identical abilities to learn in school, when compared with individuals who show such strategies spontaneously? I doubt it, but here again, the issue of context or cultural relevancy makes the issue difficult to clarify.

As a concluding remark, I would like to suggest that we not confuse the difference between the important socio-political point of view that reminds us of the universal potentiality of all individuals, with the more psychological point of view that some real differences in higher level cognitive skills may exist as a function of environmental variation. And, that these latter differences are interesting for both the theoretical and practical concerns of educational development.

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Table 1

Moroccan Subject Groups by Years of Age and Schooling

Group	N	Age		Schooling	
		mean	range	mean	range
Urban/Schooled	24	6.97	6-7	1.00	1
(US)	24	10.50	10-12	3.08	3-4
	24	13.37	13-14	6.90	6-8
	24	18.42	18-19	11.46	10-14
Rural/Schooled	24	8.12	8-9	1.00	1
(RS)	24	10.12	10-11	3.17	3-4
	24	13.65	13-14	7.54	6-10
	24	18.96	18-21	11.58	10-14
Urban/Non-schooled	24	7.54	6-8	.04	0-1
(UN)	24	10.79	10-12	.08	0-1
	24	14.50	13-16	.04	0-1
	24	18.92	17-22	.08	0-1
Rural/Non-schooled	24	7.12	6-8	.08	0-1
(RN)	24	10.71	10-12	.17	0-1
	24	14.33	13-16	.17	0-1
	24	19.79	17-22	.08	0-1
Koranic Students	24	19.42	18-25	2.00	1-6
Rug Sellers	12	26.42	17-36	3.33	0-7

Table 2

Analysis of Variance ($\underline{F}$-scores) for Short-term Recall Measures.

Source	df	Total	Primacy	Middle-Positions	Recency
Age (A)	3,368	22.06**	15.88**	7.22**	2.21
School (S)	1,368	60.87**	14.21**	22.06**	5.88*
Environment (E)	1,368	35.28**	14.21**	19.78**	.02
A X S	3,368	8.75**	10.62**	2.01	.33
A X E	3,368	.91	.32	1.21	3.29*
S X E	1,368	13.88**	10.98**	1.97	9.72**
A X S X E	3,368	1.53	3.75*	3.32*	.65

*$\underline{p} < .05$

**$\underline{p} < .01$

Table 3

Analysis of Variance (F-scores) for Recognition Memory Measures.

Source	df	Total	d'(1)	d'(5)	d'(10)	d'(25)
Age (A)	3,368	2.16	3.66*	3.02	2.80*	1.41
School (S)	1,368	9.28**	.01	.83	7.68**	20.43**
Environment (E)	1,368	71.06**	66.23**	57.85**	45.09**	18.56**
A X S	3,368	2.51	2.45	4.97**	1.58	5.92**
A X E	3,368	.16	2.16	.98	.39	.71
S X E	1,368	.36	7.79**	.67	2.22	3.96*
A X S X E	3,368	.15	.51	.38	.18	.25

*$p < .05$

**$p < .01$

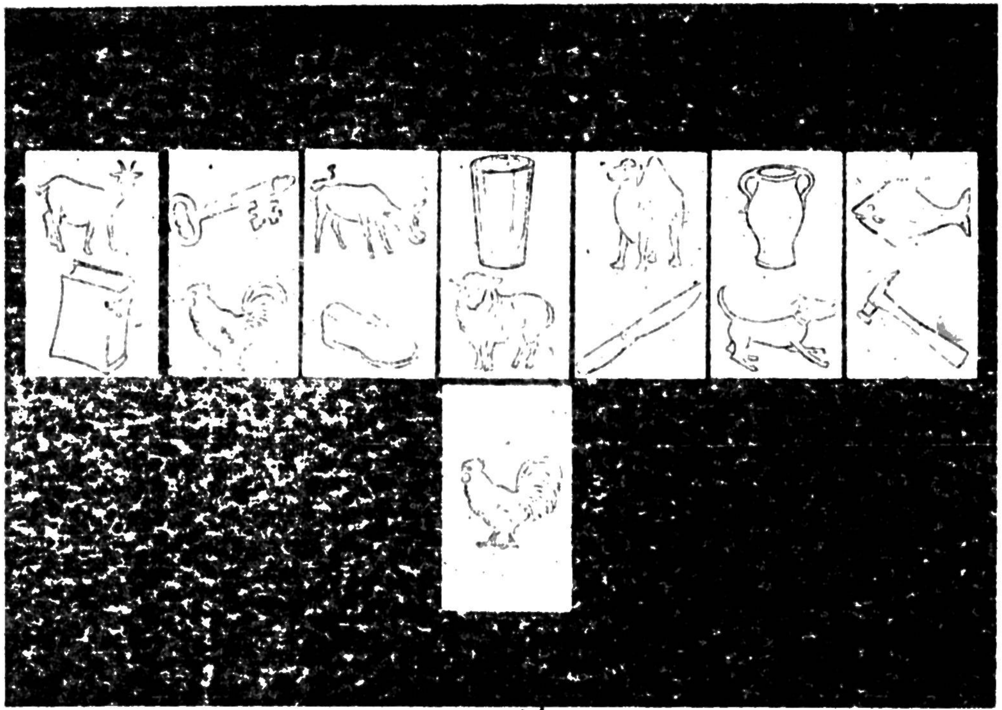

Figure 1. Set of stimuli used in the serial short-term and incidental memory tasks.

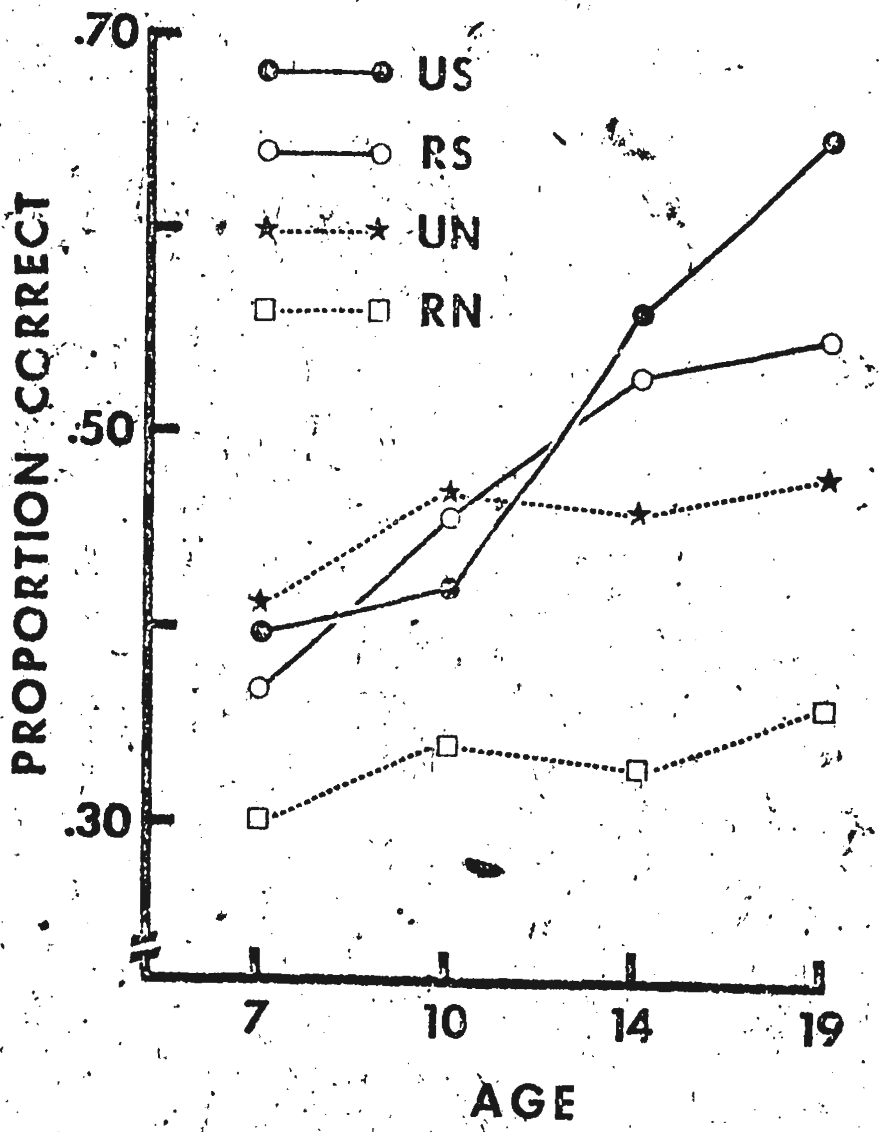

Figure 2. Total short-term task recall (summed over serial position). US = Urban/Schooled; RS = Rural/Schooled; UN = Urban/Non-schooled; RN = Rural/Non-schooled.

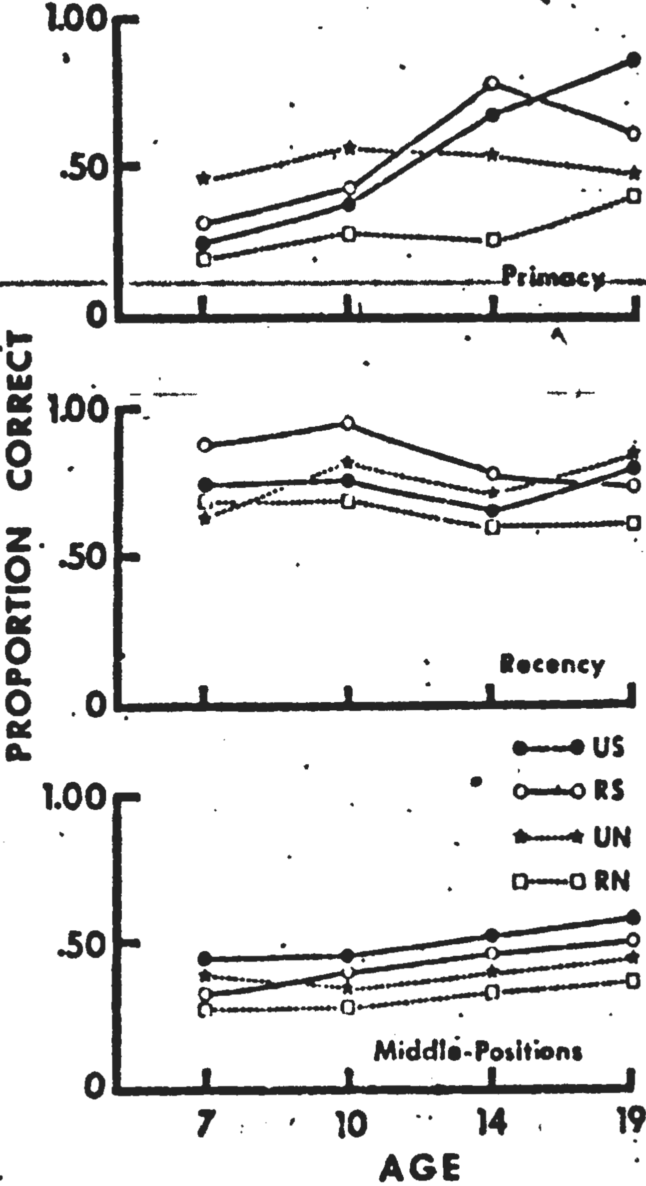

Figure 3. Primacy, recency, and middle-positions recall.

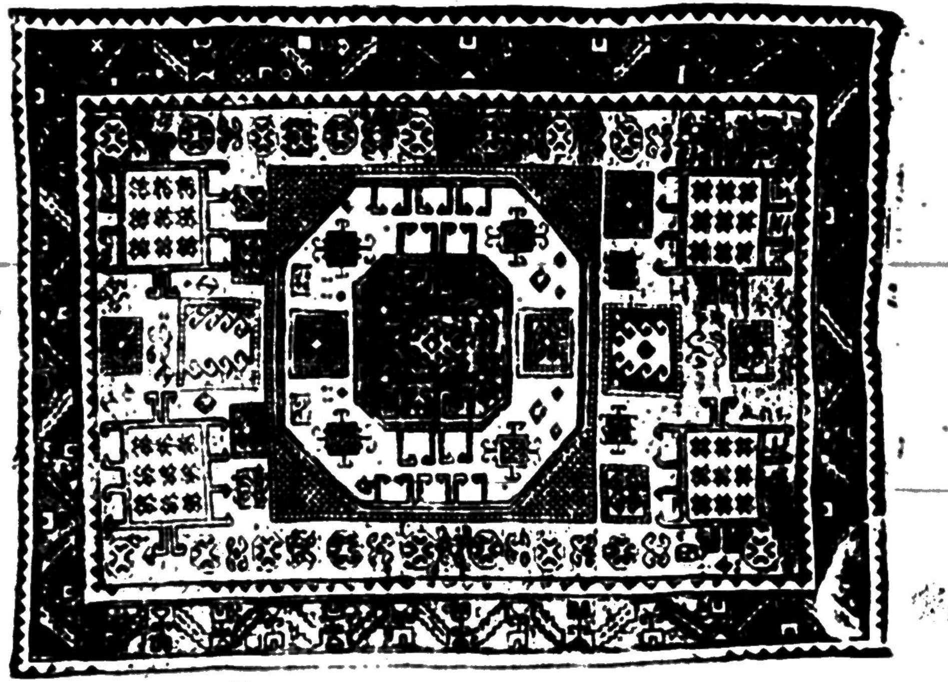

Figure 4. Example of rug pattern stimuli used in the recognition memory task.

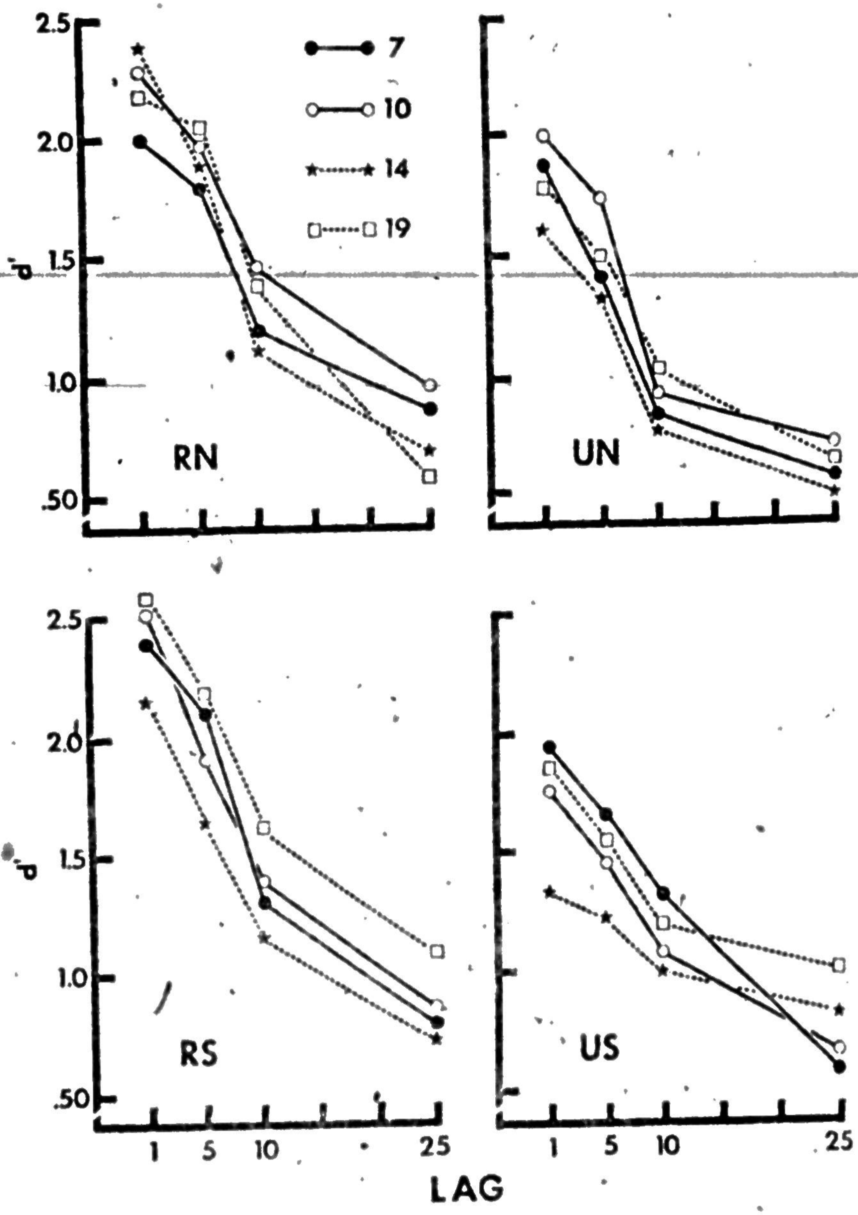

Figure 5. Forgetting curves (mean $\underline{d}'$ over lags) for each main group over ages 7, 10, 14, and 19 years.

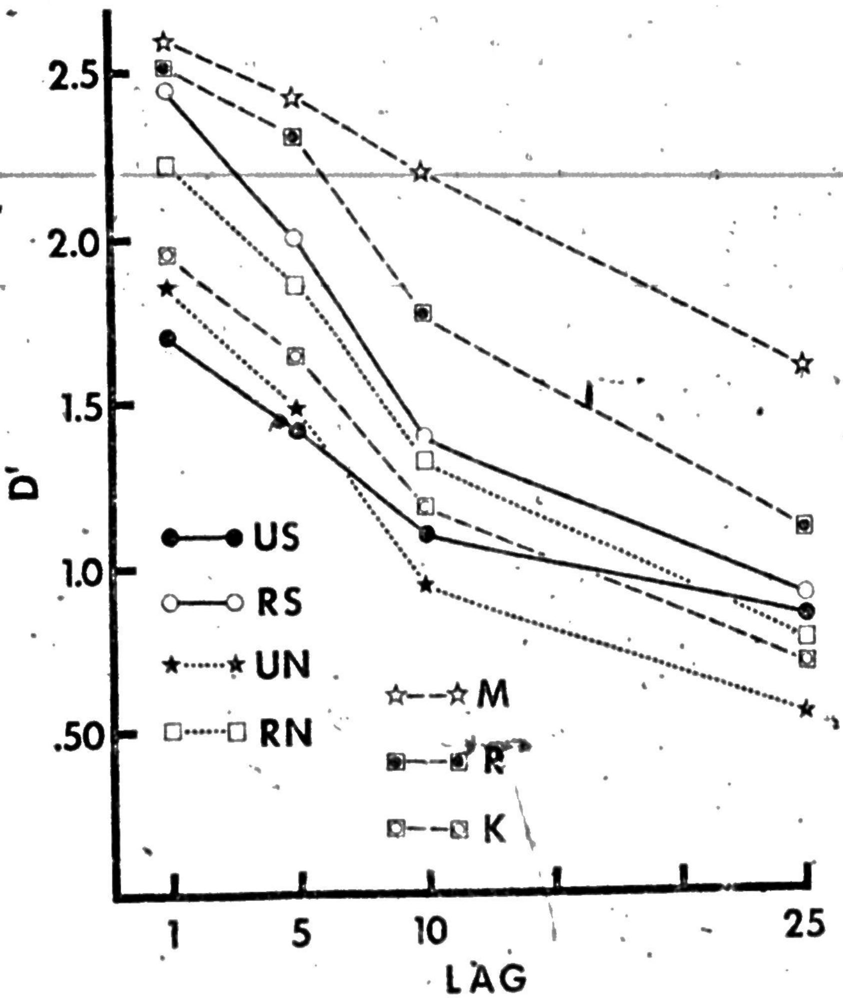

Figure 6. Forgetting curves (mean d' over lags) for each subject population (summed over age).