DOCUMENT RESUME

ED 096 617 CS 001 328

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TITLE Developmental Changes in Long-Term Retention.
PUB DATE Sep 74
NOTE 10p.; Paper presented at the Annual Meeting of the American Psychological Association (82nd, New Orleans, August 30-Sept. 3, 1974)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS *Educational Research; Grade 3; Kindergarten Children; *Learning Processes; *Memory; *Paired Associate Learning; Recall (Psychological); *Retention

ABSTRACT

Two conflicting hypotheses were investigated in this study. The first is based on an interference theory of forgetting and assumes that forgetting is largely a function of proactive interference, i.e., a result of interference by previously learned material. The second is based on the improvement of memory due to basic mechanisms that may operate to produce marked increases in retentive abilities over the first few years of a child's life. The subjects were 45 kindergartners and 45 third graders randomly assigned to three experimental groups. The experimental conditions varied the amount of retention time between the original learning task and the retention tests. The retention intervals were six minutes, 48 hours, and four weeks. The learning task was a list of four paired associates. In each pair, the response term was a high frequency, one-syllable English noun and the stimulus term was the Latin equivalent. The learning task and the retention tests were all conducted orally. The number of items correct on the three retention tests served as the dependent measure for analysis. The results indicated that when the degree of original learning is equated, children as young as five years of age can remember materials as well as third-graders over a retention interval as long as four weeks. (WR)

Developmental Changes in Long-Term Retention[1]

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Until recent years it was widely assumed that as children grow older, they become better retainers of information, i.e., that rate of forgetting decreases with age. The assumption apparently was based on the commonplace observation that when presentation and study conditions are held constant, subsequent recall of material improves with age. Only relatively recently has there been a general awareness of the fallacy of such a conclusion, due in large part to a series of papers by Underwood (e.g., Underwood, 1964) in which he pointed out the necessity to take into account the degree of original learning in studies examining retention differences. In studies completed prior to the appearance of these papers, and in some completed subsequently, the methodology was such that degree of learning and retention were confounded. Thus, if performance differences were obtained on a retention test, one could not be certain whether they reflected differences in rate of forgetting or simply differences in the amount originally learned.

There appear to be very few methodologically sound (as described above) studies dealing with developmental differences

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[1]Paper presented at the 82nd Annual Convention of the American Psychological Association, New Orleans, Louisiana, September, 1974. The authors thank Geoffrey A. DuGue for his help in data collection.

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in human retention. In their survey of short-term memory literature through 1968, Belmont and Butterfield (1969) reviewed only 12 research reports bearing on developmental differences wherein the original learning problem may have been handled adequately. Moreover, five of those 12 were beset with other difficulties which rendered their results suspect. The remaining seven studies showed no age differences in retention. In those studies the longest retention interval considered was five minutes (Barnett, Ellis, & Pryer, 1959), with retention intervals of less than 15 seconds used in most. None of those seven studies used verbal material. The reviewers conclude that, "None of the studies gave any but highly questionable evidence that children mature in retention ability." (Belmont & Butterfield, 1969, p. 52)

An earlier study not reviewed by Belmont and Butterfield (Mishima & Inone, 1966) examined both immediate and longer term (up to six hours) recall. In that experiment, seven Japanese nonsense syllables were learned to a criterion of one correct trial by children 9, 11, 13, 15, and 17 years of age. Since rate of acquisition varied with age, different numbers of trials were given the various age groups. Immediate recall (the precise interval being undefined) increased monotonically with age, and was significantly greater for the two older than for the two younger groups. In contrast, free recall after two, four, and six hours was better for the younger Ss.

A recent study by Walen (1970) also examined age differences in retention after short (30 seconds) and long (one week) intervals.

The Ss, fifth-grade children and university students, were given free recall (FR) and backward serial recall (BSR) training, using high and medium frequency nouns, to a criterion of 90 percent correct responding. Although acquisition was more rapid for both tasks by the older Ss, no differences were observed on the 30-second retention tests. After one week, the children were superior in BSR, with no differences in FR.

To summarize, (a) few interpretable data concerning developmental differences in rate of forgetting are available, (b) no such data evidently exist with respect to retention intervals exceeding one week, and (c) no such data are available for retention intervals exceeding a few minutes and for age ranges extending lower than nine years. The present experiment was designed to begin to furnish data to fill this gap.

Two conflicting hypotheses are of interest to the questions being examined here. The first is based on interference theory of forgetting, and assumes that forgetting is largely a function of proactive interference, i.e., a result of interference by previously learned material. According to this position, retention ought to be an inverse function of age, since the younger child has fewer sources of such interference. The opposite prediction is suggested in a recent paper by Campbell and Spear (1972). These authors reviewed a number of animal studies that appear to indicate substantial improvement in memory over the early portion (the first few months in the rat) of life. A number of mechanisms that might account for such an improvement were proposed, and the authors concluded by suggesting that similar

mechanisms may operate to produce marked increases in retentive abilities over the first few years of life in the child.

Method

Subjects

The subjects in the present experiment were 45 kindergarteners and 45 third-graders randomly selected from a public school in Evanston, Illinois. The choice of these grade levels was based on pilot work which indicated that children younger than kindergarten age found the learning task too difficult to accomplish in a reasonable length of time, and that older children found the task too simple to be meaningful. The age levels were chosen, then, in order to extend previous findings in this area and to try to avoid both a basement and a ceiling effect in the results. The mean age of the younger children was 5 years 7 months and the mean age of the older group was 8 years 10 months. The sample consisted of 41 females and 49 males.

Procedure

At each age level, the Ss were assigned randomly (except to insure equal numbers in the conditions) to three experimental conditions. The experimental conditions varied the amount of retention time between the original learning task and the retention tests. The three retention intervals were 6 minutes, 48 hours, and 4 weeks. The learning task was a list of 4 paired-associates, a number suggested by pilot research. In each pair, the response term was a very high frequency one-syllable English noun and the stimulus term was the Latin equivalent (all the Latin words were two-syllable and easily-pronounced). The specific items employed

for the PA learning were: ARCA-BOX, LIBUM-CAKE, CANIS-DOG, and SELLA-CHAIR. The learning task and the retention tests were all conducted orally.

Each child was administered the PA learning task by one of two experimenters, using a modification of the drop-out procedure described by Amster, Keppel, and Meyer (1970). Each child was told that he was to learn some new words that mean the same thing as some words that he already knew. Each S was then given a single study trial in which each pair was presented by the E, and the S was told to state the response term each time the E stated the stimulus term. After this study trial, an anticipation trial was given which included all the pairs. An incorrect response resulted in the E's correcting the error by stating the correct pair and having the S re-state the correct response term. A correct response resulted in positive feedback, and the omission of that pair on subsequent trials. When all items were given correctly by the S, a complete anticipation trial including all pairs was administered. For each complete anticipation trial, the pairs were presented in a different pre-determined random order than that of the previous trial. These steps were repeated until two perfect recitations on complete consecutive anticipation trials were accomplished. If that criterion was not reached before 10 complete anticipation trials were administered, the S was dropped from the sample and replaced by a child from the same age pool. Fifteen kindergarteners and one third-grader were unable to reach criterion in a single session. The mean number of trials to criterion for the Ss included in the final sample was 7.73 for the kindergarteners and 5.98 for the third-graders.

Immediately following the learning phase, every S was kept occupied by a 6-minute period of drawing activity. Following this period, those Ss in the 6-minute retention condition were administered the retention tests, and for the other Ss the session was ended. Each S was administered the retention tests by the same E who conducted the learning phase with him.

Retention testing consisted of three steps. First, a standard PA test was given in which the stimulus items were read in a predetermined random order with the S instructed to give the correct response term for each. In cases where performance on this task was less than perfect, a second step required the S to recall any additional response terms that he had not already mentioned. The third measure was a recognition test in which the four response words were randomly intermixed with four other unrelated high frequency one-syllable English nouns. The Ss were instructed to decide for each word whether or not a new word was learned for it.

Results and Discussion

The number of items correct on the three retention tests act as the dependent measures for analysis. The independent measures are chronological age and retention interval. The mean number of correct items in each condition are reported below. The total possible correct were 4.00 for PA, 4.00 for recall, and 8.00 for recognition.

	6 mins.		48 hrs.		4 wks.	
	K	3rd	K	3rd	K	3rd
PA	2.60	3.13	3.06	3.20	1.86	1.46
Recall	3.93	4.00	3.73	3.86	3.40	3.06
Recognition	7.80	8.00	7.53	8.00	7.73	7.86

Due to a very high degree of performance (a ceiling effect) on the recognition test in all conditions, this measure was not analyzed further. For each of the remaining two dependent measures, an arcsin transformation was performed on the data and a 2 X 3 analysis of variance was conducted. In each of these analyses, the main effects of age and retention interval, and the interaction between these variables, were examined.

The main effect of retention interval was found to be significant ($p < .01$) for both dependent measures analyzed. The main effect of age did not approach significance in either case, nor did either interaction approach significance ($F \leq 1$ in each case).

Although the high level of performance by both age groups in the 6 min. and 48 hr. retention interval conditions may obscure possible age differences, previous research (discussed earlier) suggests that this is not true. Furthermore, the point of central interest here is the performance of the two age groups after the longest retention interval. The data in the 4 wk. condition are clearly unaffected by either a ceiling or a basement effect, indicating without a doubt that the two age groups exhibited equivalent degrees of long-term retention.

The data of the 48 hr. condition may reflect a problem which was encountered during the study. The problem was that of differential rehearsal resulting from some of the children communicating with one another about the task. This factor may be the reason for the performance of the kindergarteners in the PA retention test being superior after 48 hours than after 6 minutes

retention time. However, when the children in the longer retention conditions were informally questioned whether they had "thought about or talked to anyone about" the words they had learned, equivalent numbers from each grade level and retention condition gave affirmative answers. Moreover, it is doubtful whether the problem would have an effect past the 48-hour retention interval. Therefore, the differences found between the 48-hour and the 4-week retention intervals for both age groups may be assumed to be unaffected by any unusual rehearsal.

Interpretation of the present findings in terms of the two hypotheses mentioned earlier must be only speculative, since neither hypothesis concerns itself with specific age level. With regard to the hypothesis based on interference theory, one might expect the commencement of schooling (around age five) to be that point before which significantly fewer sources of interference would exist for the younger child. This study was conducted midway through the school year, so the kindergarten Ss had had at least that much school experience. The data of the 4-week retention interval condition for the PA and recall retention tasks do indicate a trend in favor of the kindergarteners, suggesting that future research must tap the memories of preschool children to investigate whether interference theory lends meaning to the question of long-term retention. Similarly, it is highly possible that the age differences hypothesized by Campbell and Spear (1972) are confined to the years prior to age five. Clearly, then, this study indicates a need to examine a wider age spread extended to younger ages (although the procedural difficulties are great) and even longer retention

intervals. Nevertheless, the finding that children as young as five years of age can remember material as well as third-graders over a retention interval as long as four weeks, when the degree of original learning is equated, is certainly significant to our understanding of memory capabilities and extends previous findings regarding this question.

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