

Verbal Mediation in Paired-Associate and Serial Learning^{1,2}

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The experiments reported here are a further attempt to investigate the psychological differences between paired-associate and serial learning. Recent research has revealed what appear to be quite profound differences between these two well-known forms of rote learning (e.g., Young, 1959, 1961, 1962; Jensen, 1962). The typical finding is that the amount of transfer is surprisingly small when Ss go from a serial list (learned to a criterion of mastery) to a list of paired-associates derived from adjacent items of the serial list. Somewhat greater transfer occurs when the paired-associate (PA) list is learned first and the S is then required to learn a serial list composed of the same pairs strung together in a series. But even here the amount of transfer is much less than would be expected if both tasks involved essentially the same learning processes.

A number of informal observations have fallen together to suggest the hypothesis underlying the present experiments, *viz.* that one of the major differences between PA and serial learning consists of the degree to which verbal mediation plays a role. It has been found, for example, that the rate of

learning color-forms (triangles, squares, and circles, colored red, yellow, and blue) is much slower when they are presented as paired-associates than when they are presented as a serial list, and the differences in difficulty between PA and serial learning is much greater for color-forms than for verbal materials. The Ss report using verbal mediators in learning the PAs but not in learning the serial list. One reason the color-form PAs are so difficult to learn is probably that the color-forms do not readily elicit verbal mediators. Similar detailed reports of Ss' use of verbal mediators in learning letter-numeral pairs have been provided by Clark, Lansford, and Dallenbach (1960, p. 33). Their Ss often had to invent bizarre and far-fetched mediators in order to form associations between these relatively meaningless items.

Other suggestive evidence for the present hypothesis derives from the fact that various measures of "meaningfulness," such as associative frequency, are positively related to the speed of acquisition in both PA and serial learning [the evidence is comprehensively reviewed by Underwood and Schulz (1960, pp. 27-42)]. But how much of this facilitation is due merely to the factor of response availability and ease of recall, and how much is due to the elicitation of mediating associations between the S and R terms in rote learning, is difficult to say. If these two highly correlated aspects of facilitation—response availability and associative probability—could be manipulated independently in verbal learning experiments, it might be

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found that they would have different effects in PA than in serial learning. Response availability would most likely be facilitative in both PA and serial learning, while associative probability *per se* might be highly facilitative only in PA learning and might make little difference, if any, in serial learning. This point is not answered by the present literature, but there are two apparently conflicting experiments which, viewed together, are rather suggestive.

Mandler and Huttenlocher (1956) found a positive correlation between speed of PA learning and individual differences in ability to give verbal associations to the stimulus and response items of the PA list. Scheible (1954) performed a similar experiment. She grouped Ss on the basis of their ability to give associations to nonsense syllables, using the Glaze technique. But rather than using PA lists as Mandler and Huttenlocher had done, she used *serial* lists. She found *no* difference between the groups in the speed of learning the lists. It is interesting, however, that there was still a positive relationship between the associative frequency of the syllables composing the list and the speed with which the list was learned. This effect might have been due to the factor of response availability or ease of recall, which is highly correlated with associative frequency. Individual differences in associative ability *per se*, however, may not have shown up perhaps because serial learning does not depend upon verbally mediated associations, or at least not in the same degree as PA learning.

Investigation of this problem would pose considerable difficulties if Ss were selected from a population of normal adults, especially college students, in whom verbal associations are practically impossible to suppress. Ideal Ss for this investigation would not spontaneously form verbal mediators in rote learning so that verbal associations and mediators could be implanted by the *E*, as it were, on a *tabula rasa*. With such "ideal"

Ss, verbal mediation could be manipulated as an independent variable in experiments on PA and serial learning.

Thus, mentally deficient adult Ss were sought for the present experiments. A pilot study with a few of these Ss made it clear that the experimental procedures traditionally used with college students would have to be radically changed in order to be appropriate for the meager intellectual capabilities of these retarded Ss. It was reasoned that if their performance in simple rote learning tasks was markedly facilitated when they were given explicit *instructions* to form verbal associations between the S and R elements, it could be presumed that it was not habitually their tendency spontaneously to use such mediating associations in attempting to learn S-R connections.

Experiment I attempted to produce facilitation in PA learning by directly instructing the *S* to use verbal mediators. When it became apparent that retarded Ss did not seem to use verbal mediators spontaneously, but only when instructed to do so, Experiment II was planned, in which comparable but completely naive Ss would be used, to test our main hypothesis—that verbal mediation plays a more prominent role in PA learning than in serial learning.

EXPERIMENT I

Method

Subjects. The 20 Ss (16 men and 4 women) in Exp. I were selected from a sheltered workshop for the mentally retarded. Their ages ranged from 20 to 43 years, with a mean of 27.58 ($SD = 5.86$). Their Full Scale IQs on the Wechsler Adult Intelligence Scale ranged from 41 to 78, with a mean of 54.90 ($SD = 12.54$). None of the Ss had sensorimotor handicaps.

Learning tasks. Because most of the Ss in these experiments were unable to read, the stimulus materials had to consist of pictures of common objects. The items used in the first and third weeks consisted of 24 pictures from the Picture Vocabulary and Pictorial Naming subtests of the Stanford-Binet Tests of Intelligence. According to the Stanford-Binet norms, all these—simple black-and-white line

drawings—are nameable in the mental-age range from two to four. Each picture was mounted on heavy, white cardboard, 4 in. square. The materials used in the fifth and seventh weeks were pictures of common objects cut out of a pre-primer workbook³ and also mounted on 4-in. square cardboards. These pictures are colored but are otherwise similar in type to those of the Stanford-Binet. They seemed to be as easy for our Ss to name as those of the Stanford-Binet. The Stanford-Binet pictures and the colored pre-primer pictures were not of the same objects, and pictures from the different sets were never used in the same learning task.

Paired associates were made up from these pictures more or less at random. However, there was an attempt to avoid obvious relations of sound or meaning between the members of each pair.

Instructions. Two conditions of instructions were used, referred to as *mediation* and *non-mediation*. In the non-mediation condition *E* asked *S* on the first trial only to *name* the stimulus and response terms. In the mediation condition the *S* was asked on the first trial to make up a sentence or phrase linking the two items. The Ss generally made up very simple phrases, such as “the *hat* is on the *table*.” A few Ss apparently could not think of any phrases for certain pairs, in which case *E* supplied a simple phrase, such as the example above. The *S* had to use the mediating phrase overtly on the first trial; if he continued to say it aloud after the third trial, he was told he no longer had to say more than the response term. Thus, after the first trial, the procedure was essentially the same for both conditions.

Procedure. The method of presenting the task was the same for the mediation and non-mediation conditions, with one exception. For both conditions *E* first placed the cards bearing the response terms in a row on the table before the *S*, who was asked to name the pictures. Then *E* covered each picture with the card bearing the stimulus item. In the non-mediation condition Ss merely had to name these. In the mediation condition, on the other hand, the *S* was asked to form a phrase connecting the names of the two pictures. After this, the procedure was the same for both conditions. Pointing to each picture in turn, *E* asked *S* what picture was underneath. On each trial, as soon as *S* responded, *E* removed the top card to permit the *S* to see the picture underneath. In order to rule out position cues, *E* randomly changed the positions of the pairs of cards on every trial. All tasks were subject-paced.

Sequence of Tests. The testing was conducted at

³ Monroe, M., Nichols, R. G., Greet, W. C., and Gray, W. S. *Learn to listen, speak, and write*, Book 1. Chicago: Scott, Foresman, 1960.

two-week intervals over a period of five weeks. The same 20 Ss were used throughout.

First week: All Ss were given non-mediation instructions. Six sets of paired-associate (PA) tasks were made up from the Stanford-Binet pictures. Each set consisted of four PAs. The six sets had no PAs in common, and no picture was duplicated within one set. All six sets were used an equal number of times, but each *S* was given only three of the PA tasks. They were administered in one session, taking on the average about 30 min. The Ss were required to learn to a criterion of one errorless trial.

Third week: All Ss were given *mediation* instructions. Each *S* learned three sets of the 4-PA task; the same six sets were used as before, but in no case was the *S* given the same set he had learned previously. As before, the three tasks were administered in one session. The Ss learned to a criterion of one errorless trial.

Fifth week: By now all Ss were familiar with *E* and with the requirements of the PA task, and all had learned under both mediation and non-mediation conditions. In the fifth week the Ss were divided into two equal groups in learning ability, as determined from the first week's tests. One group learned under the non-mediation condition, the other under the mediation condition. Two sets of PA tasks, each consisting of eight PAs, were made up of the colored, pre-primer pictures. Each set was used on an equal number of Ss in each group. The two groups of 10 Ss each were formed in a manner to equate their mean errors on the first week's test. These means were 22.4 ($SD = 16.6$) for the non-mediation group, and 22.7 ($SD = 20.6$) for the mediation group. All Ss were given 10 trials.

Results

The learning scores are expressed either in terms of number of trials to criterion or total number of errors. A preliminary analysis revealed no significant differences (or interactions with treatments) between the various sets of PAs made up of the Stanford-Binet pictures or between the sets made up of the pre-primer pictures; nor were there significant practice effects, either in the first or third week, among the three PA tasks given to each *S* (in all cases $F < 1.00$). Therefore, the different forms of the PA task were considered as equivalent forms for the purposes of the present experiment, and were not treated separately in the subsequent analyses.

The essential findings are as follows:

(a) Mean trials to a criterion of mastery of 4 PAs for the Non-Mediation Condition (Week 1) was 10.85 ($SD = 7.72$); for the Mediation Condition (Week 3) $M = 1.84$ ($SD = 1.71$). The t -test for correlated means shows the difference to be highly significant ($t = 6.23$, $df = 19$, $P < .001$). (b) The difference between the two equated groups of Week 5 is highly significant, again with the Mediation Condition markedly superior. Mean errors in 10 trials on 8 PAs for the Non-Mediation Group was 43.7 ($SD = 18.07$); for the Mediation Group $M = 13.9$ ($SD = 10.67$); ($t = 4.26$, $df = 18$, $P < .001$).

The fact that the mediation instructions had such a dramatically facilitating effect on PA learning in the present experiment strongly suggests that mentally retarded Ss of the type seen here do not *spontaneously* use verbal mediators in PA learning.

EXPERIMENT II

The design of this experiment is simple: There were four groups of 10 Ss each, matched on the basis of IQ. The groups were assigned to the conditions of a 2×2 design, the independent variables being type of *Instructions* (mediation versus non-mediation) and type of learning *Task* (PA versus serial).

Method

Subjects. The 40 Ss (23 men and 17 women) in Exp. II were selected from a large state institution for the mentally retarded. Their ages ranged from 18 to 40 years, with a mean of 24.1 ($SD = 4.87$). Their Stanford-Binet IQs ranged from 50 to 72, with a mean of 58.2 ($SD = 5.85$). In addition to age and IQ, three other criteria for selection were (a) absence of pronounced emotional instability of psychotic symptoms, (b) absence of sensorimotor handicaps, and (c) absence of any gross speech defect.

In order to match the four experimental groups on tested intelligence, the 40 Ss were ranked from highest to lowest in IQ; each of the first four Ss was assigned at random to one of the four experimental conditions; each of the second four Ss was assigned in the same manner, and so on. The means and SD s of the groups' IQs are as follows: PA

Mediation: $M = 58.3$, $SD = 5.81$; PA Non-Mediation: $M = 58.2$, $SD = 6.13$; Serial Mediation: $M = 58.4$, $SD = 6.05$; Serial Non-Mediation: $M = 58.2$, $SD = 6.13$. The differences between the groups are, of course, nonsignificant ($F < 1$). Neither did the groups differ significantly in age ($F < 1$); the mean age in years for the four groups (listed in the same order as above) were: 24.8, 22.0, 24.4, and 25.2.

Learning Tasks. Two sets, each consisting of eight PAs, were made up of the same colored, pre-primer pictures used in Exp. I. Each form was given to half the Ss in each PA condition. The response terms of the two PA sets were used to form two 8-item serial lists, each of which was used for half the Ss in each of the serial-learning conditions.

Procedure. The instructions and procedure for PA learning in the non-mediation condition were the same as in Exp. I. For the mediation condition, however, a standard set of mediating verbalizations was provided by *E* upon initial presentation of the pairs. These mediators were not repeated by *E* after the first trial, and if *S* continued to say them aloud after the third trial, he was told he should only name the response term in each pair. The intellectual capabilities of these Ss suggested that some of them might not have been able to invent mediating phrases of their own. Providing a standard set of phrases for all Ss seemed preferable to selecting Ss for their ability in this respect or supplying mediators for some Ss and not for others.

The mediating verbalizations given by *E* for the first set of PAs were: (1) I threw the SHOE with the CLOCK. (2) I smashed the TELEPHONE with the HAMMER. (3) I bounced the BALL against the HOUSE. (4) I spilled the MILK on my FOOT. (5) I SAWed the handle off the BROOM. (6) The TOASTER fell into the BED. (7) I washed the BIRD with SOAP. (8) The CUP was hanging on the TREE.

The phrases for the second set were: (1) I stuck the CORN in the SHOE. (2) I smashed the CRAYON with the HAMMER. (3) The COW played with the BALL. (4) I cleaned up the spilled MILK with the BRUSH. (5) I MOPPED up the TOMATO. (6) The CAT popped out of the TOASTER. (7) I washed the FORK with the SOAP. (8) I carried the TREE in the WAGON.

The non-mediation condition of serial learning was conducted as in Exp. I; the Ss merely named the pictures on the first trial and anticipated each picture on subsequent trials. Since a different order of the pictures was used for every *S*, a standard set of mediators was not possible in the mediation condition. Therefore, *E* made up mediating phrases linking each item to the one following; the phrases were similar to those used in PA mediation. These phrases

were given only on the first trial, and Ss were discouraged from saying them aloud after the third trial. Thus, for both PA and serial learning, *E*'s procedure after the first trial was the same in both the mediation and non-mediation conditions. All the tasks were subject-paced and *E* recorded the total time; the stop-watch was started at the beginning of the initial trial. An attempt was made to spend as much time displaying the picture cards during Trial 1 for the non-mediation as for the mediation condition. All Ss in each condition were given 20 trials.

Results

Learning was measured in terms of total errors in 20 trials and the total time required. An analysis of variance revealed no significant differences (or interactions with treatments) between the two sets of the PA and serial tasks, either for errors or for time (in all cases $F < 1$). The two forms, therefore, were regarded as equivalent and were not treated separately in the subsequent analysis.

The main results, shown in Table 1, are quite unequivocal. Only PA learning was facilitated by the mediation instructions. In serial learning the mediation instructions had no apparent effect whatsoever. The error scores were subjected to analysis of variance following the Freeman-Tukey square-root transformation ($\sqrt{X} + \sqrt{X + 1}$), which was applied to achieve homogeneity of variance. The Tasks (PA versus Serial) main effect was nonsignificant ($F < 1$); the Instructions (Mediation versus Non-mediation) main effect was significant ($F = 13.80$, $df = 1/36$, $P < .001$); and the interaction of Tasks \times Instructions was significant ($F = 9.79$, $df = 1/36$, $P < .01$).

While one might have expected verbal mediation to require more time than merely naming the pictures, it is interesting to note that the contrary is true, especially for PA learning. The non-mediated PA learning required more than twice as much time, for the same number of trials, as the mediated learning. The time required for serial learning was about the same for the two types of instructions. In difficulty, serial learning, with or without mediation, seemed to be intermediate between mediated and non-mediated PA learning. For the time scores, which did not require transformation, analysis of variance shows no significant main effect for Tasks, a significant effect for Instructions ($F = 10.73$, $df = 1/36$, $P < .01$), and a significant Tasks \times Instructions interaction ($F = 4.89$, $df = 1/36$, $P < .05$).

Test for Retention of the Mediation Set

In order to find out if these retarded Ss retained any benefit from the mediation instructions, it was decided to retest the two PA groups on "equivalent forms" of the PA task *without* mediation instructions for either group.

Since verbal mediation affected only PA learning, only the groups previously given the PA task were used in the retention test. Unfortunately, the lapse of 10 days resulted in the loss of 7 Ss—3 from the Mediation Group and 4 from the Non-Mediation Group. These Ss had been released from the institution temporarily for summer farm work.

The remaining 13 Ss were given the 8-PA test (made up of the pre-primer pictures) in the same manner as before, with non-

TABLE 1
MEANS AND STANDARD DEVIATIONS OF ERROR SCORES AND OF
TOTAL TIME (MIN.) FOR 20 TRIALS (EXP. II)

Instructions	Serial Learning				Paired-Associate Learning			
	Errors		Time		Errors		Time	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Mediation	33.1	29.33	14.37	7.16	14.7	25.30	12.75	5.32
Non-Mediation	33.1	11.85	16.89	7.50	72.7	44.89	25.73	2.57

mediation instructions. No *S* was given the same set of PAs he had learned previously. Every *S* had 20 trials. All were tested within 10 to 12 days after the first test.

Results. Because of the missing *Ss*, the two groups were no longer truly matched or truly random—an unfortunate condition which may have biased the retest results in some unknown degree. Nevertheless, with this limitation in mind, a *t*-test was performed, for whatever it might be worth, to compare the groups in mean error and time scores obtained on retest. The mean retest errors for the (previously) Non-Mediation and Mediation Groups were 90.83 ($SD = 39.60$) and 80.86 ($SD = 53.34$), respectively. The difference is nonsignificant ($t = 0.36$). The mean time in minutes on retest was 20.81 ($SD = 4.45$) for the Non-Mediation Group and 21.43 ($SD = 5.25$) for the Mediation Group. The difference is negligible.

In brief, the groups did not differ significantly from each other on retest. It at least appears that the mediation “set” was not retained to any marked extent. In the case of the Mediation Group, of course, these retest results further corroborate the earlier finding that verbal mediation drastically facilitates PA learning in mental defectives.

DISCUSSION

It has been found that instructions to use verbal mediators, among *Ss* who do not seem to do so spontaneously, had a greatly facilitative effect on PA learning but had no discernible effect on serial learning. Though the data are quite clear-cut, their interpretation and theoretical implications undoubtedly leave room for argument. Two obvious questions immediately arise.

First, since we are primarily interested in rote learning as it occurs in normal individuals, it may be asked whether findings derived from patently atypical *Ss*, such as the mentally deficient, can have any general

theoretical significance. The answer to this question would seem to depend ultimately upon whether the mentally deficient differ from the normal quantitatively or qualitatively. At present this question is basically unanswerable; indeed, posed in this simple manner the question is probably meaningless. But aside from this problem of the immediate generalizability of these findings, had they not borne out our hypothesis there would be less incentive to devise what will undoubtedly have to be more ingenious experiments in order to test the hypothesis with normal *Ss*, in whom attempts to manipulate mediating processes experimentally could present formidable problems.

There is a second obvious question: Instead of there being an *absence* of mediation in serial learning, could it be that there is mediation, only of a quite different sort than seems to occur in PA learning? If so, and if we had provided the retarded *Ss* with the kind of mediators appropriate for *serial* learning, we might have obtained facilitation there as well. But what would these mediators consist of? Obviously all one can conclude at present is that if serial learning normally involves mediational processes, these would seem to have little in common with the kind of mediation that apparently operates in PA learning. Perhaps serial position itself serves as a mediator in serial learning (Young, 1962). This hypothesis calls for further experiments in which positional and spatial mediators are systematically manipulated in serial learning.

SUMMARY

On the basis of circumstantial evidence gleaned largely from the recent literature on transfer between paired-associate (PA) and serial learning, it was hypothesized that one difference between PA and serial learning involves the relative importance of verbal mediational processes. It was suggested that mediated associative processes play a more

prominent role in PA learning than in serial learning.

The Ss used to investigate this hypothesis were mentally retarded adults, in whom the tendency spontaneously to use verbal mediators seemed to be minimal. In Exp. I 20 Ss learned PA tasks composed of pictures of common objects; they learned either with or without instructions intended to prompt the use of verbal mediation. Under mediation instructions the Ss learned PA lists much faster than they did without such instructions. In Exp. II four groups of retarded Ss (total $N = 40$), matched for IQ, were divided into four experimental conditions: (1) serial task with mediation instructions; (2) serial task without mediation instructions; (3) PA task with mediation instructions; and (4) PA task without mediation instructions. It was found that the mediation instructions greatly facilitated PA learning but had no effect whatsoever on serial learning. Retest of the same Ss approximately 10 days later, without mediation instructions and using equivalent forms of the PA learning task, revealed little if any tendency for the retarded Ss to retain

the technique of using verbal mediation in PA learning.

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