

The Effect of Awareness on Three-Stage Mediated Association

SEONG SOO LEE AND ARTHUR R. JENSEN

University of California, Berkeley, California 94720

In order to evaluate the effect of Ss' "awareness" on three-stage mediated paired-associate learning, two experiments were conducted in which a chaining paradigm, A-B, B-C, A-C, was compared with a baseline condition of A-B, D-C, A-C. The Ss' awareness was induced by instructions as to the composition of the three lists prior to learning the A-C list. Thus, two variables were manipulated, both of them having two levels: mediation vs. control paradigm and instructions vs. no instruction.

Seventy-two Ss were assigned to the four treatment conditions for Exp. 1 and 120 Ss to the four for Exp. 2, the former being essentially replicated in Exp. 2. Performance data indicate that Ss' awareness facilitated mediated associations. Furthermore, postexperimental interview data show that the uninstructed Ss who became spontaneously aware of mediators learned the A-C test list faster than others in the uninstructed group and performed at least as well as the instructed Ss. The findings were essentially consistent across the two experiments, which are interpreted as indicating that the mediational paradigm and Ss' awareness of mediators are additive in facilitating the acquisition of the A-C list and that the magnitude of the facilitative effect is closely linked with the Ss' degree of awareness of the relationships between the A-B, B-C, and A-C lists.

Most of the experimental studies of three-stage mediated paired-associate learning (e.g., A-B, B-C, A-C) have shown facilitation of the learning of a test list (i.e., A-C) as compared with a control treatment (e.g., A-B, D-C, A-C). On the other hand, there have also been rather puzzling exceptions (Jenkins, 1963, pp. 216-217; Peterson *et al.*, 1964) which remained unexplained. Also, four-stage paradigms, in which all the associations were acquired by a typical paired-associate learning procedure in the laboratory, have consistently failed to show any significant mediated facilitation (see Jenkins, 1963), with the exception of three studies which employed unconventional PA procedures involving unpaced presentation and alternating practice and test trials. These procedures are not comparable with the conventional PA mediation paradigm used in the present study (James and Hakes, 1965; Hakes, James, and Lloyd, 1965; Martin and Parrot, 1966).

It has been noted in these experiments that some Ss show the mediated facilitation while

others do not. A question immediately arises as to whether or not the S must "catch on" to the possibility of mediation for the facilitative effect to occur. In connection with this question some investigators have claimed that mediation occurs without S's awareness of interlist item relationships involved in a mediation paradigm. Since this assertion is mostly based upon postexperimental interview data, its validity can still be questioned.

Horton (1964) tried to clarify this issue by analyzing postexperimental interview data with reference to S's performance. He observed that significant increases in mediation score accompanied increases in awareness as expressed by Ss. He interpreted this as an indication that mediation occurs prior to awareness and contributes to arousing it. He also noted that the relationship between the mediation effect and awareness depends on the conditions under which the experiment is carried out. For example, the observed relationship between the mediation effect and awareness holds only for items of high

meaningfulness. From Horton's data, however, it is not clear whether the mediation effect is responsible for awareness or vice versa. In Hartman's study (cited in Horton, 1964) *Ss* instructed as to the composition of the test list showed no greater mediation effect than an uninstructed group. This finding does not appear definitive, since it can be argued that the instruction as to the test list alone might have resulted in interference for the instructed group, especially if the previously learned A-B, B-C associations were not highly available just prior to learning the test list, A-C. In view of the unclarified nature of the relationship between the mediation effect and awareness, what is needed is an experiment in which *Ss*' awareness of the interlist relationships in a three-stage mediation paradigm can be experimentally manipulated.

Thus, the question is: Does the prior acquisition of associations A-B and B-C in and of itself result in the mediated facilitation of A-C, or must some additional mediational process (e.g., *S*'s ability to verbalize the relationship between A-B and B-C) also occur for the acquisition of the A-C association to be facilitated? The striking difference between the success of the three-stage and four-stage paradigms might be due to the lesser tendency of the latter to elicit such an additional mediational process as *S*'s awareness. The purpose of the present study is to evaluate the effect of awareness on mediation by experimentally manipulating *S*'s awareness in the manner suggested by Jenkins (1963, p. 238), i.e., informing *Ss* of the composition of three lists prior to first-list learning. Two experiments were conducted to evaluate the effect of *Ss*' awareness; the second experiment was a replication of the first with a slight variation in procedure.

METHOD

Experiment I

Design. Two variables were manipulated: paradigm and instructions. The paradigmatic variable was manipulated by having *Ss* learn either two-paired-associate (PA) lists A-B, B-C (hereafter denoted by E) or two

control lists A-B, D-C (hereafter denoted by C) and then by giving all *Ss* a common transfer test list A-C. The instructional variable consisted of giving *Ss* either instructions as to the composition of the three lists prior to first-list learning (denoted by I) or no such instruction (denoted by N). Two levels of each of the two variables were factorially combined in a 2 (E vs. C) \times 2 (N vs. I) design, yielding four treatment conditions: EN, EI, CN, and CI. Treatment CI was included to estimate the effect of awareness in the absence of the mediation paradigm. An attempt was made to minimize *Ss*' voluntary awareness of, or tendency to search for, interlist relationships during the course of learning the three lists, because the expected effect of awareness to be induced by instruction in EI largely depends on the extent to which *Ss* in EN become aware of the precise relationship among the three lists. In addition, there is usually great between-subject variability in PA learning among naive *Ss*. In order to reduce these sources of variance as much as possible, all *Ss* were given practice on three different PA lists, E-F, G-H, I-J, prior to the main experimental treatments on Day 1, and then exactly 24 hr later each *S* was subjected to one of the four treatment conditions on Day 2. The manipulation of the instructional variable was introduced immediately before first-learning on Day 2.

Subjects. Seventy-two students (16 men and 56 women) enrolled in introductory educational psychology served as *Ss*. Each *S* was randomly assigned to one of the four treatment conditions. Thus, 18 *Ss* (4 men and 14 women) were in each condition.

Stimulus Materials. The stimulus terms for the three 12-pair practice lists were always bigrams from the total count range of 500 to 1,000 in the Underwood and Schulz table (1960). The bigrams within a given list differed among themselves with respect to the first letter of each, and none of the bigrams as stimulus terms was identical to the first pair of letters in their corresponding response terms. The response terms were always CVC trigrams selected from Archer's table (1960) with association values ranging from 49 to 52%.

The stimulus terms (A) in the first and third lists (i.e., A-B, A-C) for the experiment proper were letters selected from a pool of 20, excluding the five vowels and the letter Y; the 12 letters selected were non-adjacent in alphabetical order. The presumed mediators in a chaining paradigm, B, and the nonmediators, D, were common adjectives with a familiarity rating on a 5-point scale of 0.6. Every effort was made to minimize synonymy between items of B and D in terms of their M values (Hagen, 1949). All the items representing the response term, C, were one-syllable four-letter high-frequency common nouns (AA in the Thorndike-Lorge G count). In constructing the 12-pair lists, caution was taken to minimize formal and semantic similarity, both within and between lists.

In the present study, of course, primary interest was in evaluation of the mediation effect involved in the associative learning rather than in response learning. The reason for using letters, adjectives, and common nouns as A, B, and D, and C terms, respectively, was twofold: (a) to reduce interference effects from item indiscriminability as well as backward associations so that, for example, A can be easily discriminated from B and C, and (b) to minimize the role of response learning *per se*, thereby emphasizing the associative aspect of PA learning.

Procedure. All the letters representing stimulus and response terms were typed in capitals. Learning of a new list began with a study trial which is a complete presentation of 12 pairs of both stimulus and response terms by a Lafayette memory drum at a 2-sec rate, and from then on the list of 12 pairs was presented by a PA anticipation method at 2:2-sec rate in five random orders. At the outset, Ss were given general instructions in the conventional PA anticipation method for learning and were asked to respond by pronouncing each response term, as if it were a whole word in case it was a CVC trigram. Learning trials continued up to a criterion of two perfect errorless trials or 20 trials for Day 1 practice, a criterion of two perfect errorless trials for A-B, and B-C list learning, and a criterion of either two errorless trials or a total of eight trials, whichever occurred first, for the A-C test-list learning. After the last list, Ss in the EN treatment were presented a sheet of paper with the question of whether they had used any mnemonic "trick" which might have made it easier for them to learn the three different lists; they were asked to write their answers.

Manipulation of Awareness. The Ss in the EI and CI treatments were shown a chart of 8 1/2 x 11 in. cardboard, in which either the paradigm A-B, B-C, A-C or the paradigm A-B, B-C, A-C was illustrated by four different families of geometrical figures, each representing items A, B, D, and C. Each of the visual aids had its own legend on the top, as follows: "The composition of the three lists of 12 pairs you are going to learn today are of the nature as shown below." The Ss were asked to look carefully at the visual aid for 4 to 5 min and were implicitly encouraged to utilize their knowledge of the three lists for the PA learning to follow. The Ss in both the EN and CN treatments were given only the conventional instructions for PA learning by the anticipation method.

Experiment II

Although the experimental effects observed in Exp. I showed a definite trend, their significance was not as clear-cut as one would desire as the basis for a conclusion. Therefore, Exp. I was replicated with a larger sample size. Experiment II was carried out in the same manner as Exp. I except that in Exp. II a total of 120 students (16 men and 104 women) enrolled in intro-

ductory educational psychology served as Ss, 30 Ss (4 men and 26 women) being assigned to each of the four treatment conditions; the Day 1 training on the three practice lists given to all the Ss in Exp. I was entirely omitted in Exp. II.

RESULTS AND DISCUSSION

In order to determine whether Ss' initial capabilities in the PA learning task differed among the four treatment groups, the mean numbers of errors made in 20 trials during the learning of the three practice lists on Day 1 in Exp. I were computed. No significant differences were found among the four groups in initial learning ability.

The main analyses of the data focus on the performance of the four treatment groups on the A-C test list in both Exps. I and II. The criterion measure is the total number of errors (i.e., overt errors and omissions) in the first eight trials. The Ss who reached the criterion of two errorless trials before the eighth trial (4 Ss in Exp. I and 7 in Exp. II) were conceded perfect scores on trials following the two errorless trials. In view of the small number of such Ss (about 6% of all Ss in both Exps. I and II) and the stringent nature of the performance criterion (two perfect trials), this would seem a reasonable procedure.

Analyses of Performance Data. The results of the two experiments do not differ appreciably in any respect, as can be seen in Table 1. The grand means, also, are practically identical

TABLE 1
MEAN ERRORS IN THE FIRST EIGHT TRIALS FOR THE FOUR TREATMENTS IN EXPS. I AND II

Treatment	EN ^a	EI	CN	CI	MS error
Exp. I (N = 72)	46.11	40.39	52.56	48.94	213.43
Exp. II (N = 120)	41.97	40.30	54.37	51.67	236.71

^a Ss in EN were categorized into three subgroups as follows:

Exp. I—18 Ss in EN: 9 in EN-0, 2 in EN-1, and 7 in EN-2.

Exp. II—30 Ss in EN: 16 in EN-0, 3 in EN-1, and 11 in EN-2.

and the mean square error variance is similar in both experiments. A separate analysis of variance was performed on each experiment.

In both experiments, the main effect due to the paradigmatic variable, E vs. C, was significant: $F(1, 68) = 4.74, p < .05$, and $F(1, 116) = 17.89, p < .001$ for Exp. I and Exp. II, respectively. Thus, the mediation paradigm was clearly facilitative. In both experiments the main effect due to the instructional variable, N vs. I, was nonsignificant: $F(1, 68) = 1.55, p > .05$, and $F(1, 116) < 1.00$ for Exp. I and Exp. II, respectively. The interaction between instructions and paradigms is also nonsignificant, with $F < 1.00$ for the interaction term in both Exp. I and Exp. II.

As can be seen in Table 1, however, the effect of instructions (i.e., experimenter-induced awareness) is consistently facilitative with an exception of the minimal difference between EI and EN in Exp. II. The observed minimal difference may be attributable to the fact that the EN Ss in Exp. II did not receive the Day 1 training, the absence of which might have left the Ss freer to search for mediators than the EN Ss in Exp. I so that the EN Ss could have capitalized on the presumably identified mediators and thereby performed better on the A-C list. Nevertheless, the means in Table 1 form a roughly linear trend when plotted in the order CN, CI, EN, EI: $F(1, 68) = 6.59, p < .025$, and $F(1, 116) = 17.13, p < .005$ for Exp. I and Exp. II, respectively. This fact is consistent with the hypothesis that the facilitative effects of instructions and mediation paradigm are additive, although the additive effect of instructions is very weak in Exp. II for the reason explained above.

Furthermore, the effect of the instructional variable in these experiments may be greatly attenuated by the impossibility of completely controlling the awareness of the mediation paradigm by all Ss in the noninstructed group. To examine the effects of spontaneous awareness of the mediation paradigm, the interview data regarding whether the EN Ss had used any particular "trick," strategy, or mnemonic

device to aid their learning of the A-C list were analyzed.

Analyses of Postexperimental Interview Data. The Ss' protocols were classified into one of three categories: (a) EN-0 Ss who reported no indication of awareness of the relationships in the mediation paradigm, (b) EN-1 Ss who indicated some suspicion of the relationships in the mediation paradigm but claimed not to have used the relationships in learning the A-C list, and (c) EN-2 Ss who reported awareness of the paradigm and were able to mention specific examples of mediators. The mean numbers of errors for EN-0, EN-1, and EN-2 are 48.44, 70.50, and 36.14; and 46.75, 53.33, and 31.91 for Exps. I and II, respectively.

This analysis is quite revealing. Note that the EN-2 Ss who became spontaneously aware of the possibility for mediation performed on the A-C list better than EN-0 Ss who remained unaware and even better than the instructed Ss (EI). Also, there appears to be no appreciable or consistent difference in performance between the EN-0 Ss and Ss in CN and CI. Thus, the means for EN-0, EI, and EN-2 show a linear trend in that order: $F(1, 31) = 3.13, .05 < p < .01$, and $F(1, 54) = 6.41, p < .025$ for Exp. I and Exp. II, respectively. This observed fact indicates that induced as well as spontaneous awareness facilitates the acquisition of the A-C list. Studies reported by Martin and Dean (1964) and James and Hakes (1965) seem to support the above interpretation of our data despite the wide variations involved in their studies in terms of paradigms, materials, and procedures used.

In brief, there is no evidence in these experiments that the main facilitative effect of the mediation paradigm occurs in the absence of awareness of the paradigm, defined as the S's ability to explicitly verbalize the relationship between the A-B, B-C, and A-C lists. The mediation effect, therefore, does not appear to be "automatic," but depends upon more than just the prior acquisition of associations A-B and B-C. Some additional mediational process, viz., the S's ability to verbalize the relation-

ships between A-B, B-C, and A-C, apparently is needed for facilitation of A-C learning to occur.

REFERENCES

- ARCHER, E. J. A re-evaluation of the meaningfulness of all possible CVC trigrams. *Psychol. Monogr.*, 1960, 74 (10, Whole No. 497).
- HAGGEN, C. H. Synonymity, vividness, familiarity, and association value ratings of 400 pairs of common adjectives. *J. Psychol.*, 1949, 27, 453-463.
- HAKES, D. T., JAMES, C. T., AND LLOYD, R. H. Grammatical frames as stimuli in a four-stage stimulus-equivalence paradigm. *Psychon. Sci.*, 1965, 2, 383-384.
- HORTON, D. L. The effects of meaningfulness, awareness, and type of design in verbal mediation. *J. verb. Learn. verb. Behav.*, 1964, 3, 187-194.
- JENKINS, J. J. Mediated association: Paradigms and situations. In C. N. Cofer and Barbara S. Musgrave (Eds.), *Verbal behavior and verbal learning*. New York: McGraw-Hill, 1963. Pp. 210-245.
- MARTIN, R. B., AND DEAN, S. J. Implicit and explicit mediation in paired-associate learning. *J. exp. Psychol.*, 1964, 68, 21-27.
- MARTIN, R. B., AND PARROT, G. L. Mediation and inference in verbal chaining. *J. exp. Psychol.*, 1966, 72, 439-442.
- PETERSON, M. J., COLVINTA, F. B., SCHEAHAM, D. B., AND BLATTNER, K. C. Verbal mediating chains and response availability as a function of the acquisition paradigm. *J. verb. Learn. verb. Behav.*, 1964, 3, 11-18.
- THORNDIKE, E. L., AND LORGE, I. *The teacher's word book of 30,000 words*. New York: Bureau of Publications, Teachers College, Columbia University, 1952.
- UNDERWOOD, E. J., AND SCHULZ, R. W. *Meaningfulness and verbal learning*. Philadelphia: Lippincott, 1960.

(Received January 15, 1968)