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Incidentally learned associations and imagery in verbal discrimination transfer

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The effects of imagery (I) of List 2 right (R) items on verbal discrimination (VD) transfer were examined. Two levels of I were crossed with the experimental (E) paradigm of W_1-R_1, W_1-R_2 and the control (C) paradigm of W_1-R_1, W_2-R_2. Significant negative transfer was obtained with the E paradigm when low I was employed; however, List 2 R item high I eliminated the negative transfer effect on List 2 acquisition in the E paradigm. The results were discussed in terms of the frequency theory of verbal discrimination and an incidental associative interference hypothesis.

The frequency theory of verbal discrimination (VD) learning (Ekstrand, Wallace, & Underwood, 1966) predicts initial positive transfer during the early trials of List 2 practice, followed by negative transfer during the later trials when List 2 contains the wrong (W) items of List 1 paired with new right items (designated as the W_1-R_1, W_1-R_2 transfer paradigm), relative to a nonspecific control condition containing both new W and R items in List 2 (the W_1-R_1, W_2-R_2 paradigm). Frequency theory assumes that the basic mechanism involved in learning a VD list is the differential subjective frequency unit accrual to W and R items. List 1 of a transfer situation is assumed to be learned via the application of a Rule 1 strategy of selecting the most frequent item. In the W_1-R_2 paradigm, W items have the highest situational frequency following List 1 learning and the appropriate strategy would be to adopt Rule 2: "Select the *least* frequent item" leading to positive transfer relative to the W_2-R_2 control in the early trials. As List 2 learning progresses, however, R items build up subjective frequency at a faster rate than W items and a point will be reached in which the Rule 2 strategy breaks down and negative transfer should be demonstrated until a Rule 1 strategy becomes effective.

Underwood, Jesse, and Ekstrand (1964) have reported results supporting these predictions from frequency theory when subjects were informed of the interlist relationships of the items. Subsequent studies reported by others using uninformed subjects (e.g., Eschenbrenner & Kausler, 1968; Kanak & Dean, Experiment I, 1969; Kausler & Dean, 1967; Kausler, Fulkerson, & Eschenbrenner, 1967), however, found negative transfer throughout List 2 practice rather than only during the later trials. Kanak and Dean and Kausler and his associates interpreted their results in terms of associative interference produced by the incidentally learned associations between the W and R items of List 1 and List 2, a type of competition analogous to the intentionally learned associations of an A-B, A-C paired associate transfer paradigm. Further support for the incidental associative interference interpretation has been reported by Kanak and Dean (Experiment II, 1969) and Kanak and Knight (1974). In both of the latter investigations, negative transfer was obtained when List 2 involved a re-pairing of the W and R items of List 1, relative to a control condition requiring continuation of practice on the same pairs. Such results cannot be explained by frequency theory since both conditions allow the ready application and continuation of the use of a Rule 1 mode of responding. An incidental associative interference interpretation, however, would suggest that the W-R and R-W associations of List 1 enter into competition with their re-paired counterparts in List 2 in a manner analogous to the bidirectional associative interference from intentionally learned associations in the A-B, A-Br paradigm of paired associative learning.

The present experiment was designed to test whether the introduction of a variable (imagery) known to facilitate VD intentional learning would produce a reduction in the potency of incidental associative interference in the W_1-R_2 paradigm. Paivio and Rowe (1970) have presented evidence regarding the facilitatory effect of imagery (I) on VD learning. Subsequent research has demonstrated that the effect of I is more potent than frequency (Rowe & Paivio, 1971a, b) and that the two variables are independent of each other (Rowe, 1972). Rowe & Paivio (1971a) have suggested that high I words facilitate VD acquisition by allowing the subject to utilize the image evoked as a "tag" or a conceptual peg. In the present experiment, I was varied in a between-subject design at high and low levels on the R item of List 2 for the W_1-R_2 and W_2-R_2 paradigms, while all W items involved low imagery. It was anticipated that the W_1-R_2 paradigm would yield negative transfer under conditions of low I, relative to

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the low I control, but that high I would provide a compensatory cue potentially useful in overcoming incidental associative interference and its consequent negative transfer effect.

METHOD

Design

The design of the experiment was 2 by 2 factorial with two transfer paradigms, W_1-R_1, W_1-R_2 (E) and W_1-R_1, W_2-R_2 (C) crossed with two levels of imagery of R items of the second list, low (L) and high (H), resulting in the four conditions of E-L, C-L, E-H, and C-H.

Subjects

Sixty-four undergraduate students enrolled in introductory psychology classes at the University of Oklahoma participated in the experiment as a part of an option among requirements of the course. All subjects were naive to verbal discrimination learning. Each subject was randomly assigned to one of the four treatment conditions (N = 16) upon appearance at the laboratory within the restriction of achieving equal cell Ns.

Lists

Forty-eight low-I ($\bar{X}$ = 2.98) and 12 high-I ($\bar{X}$ = 6.57) nouns were selected from the Paivio, Yuille, and Madigan (1968) norms. All words had a frequency count of A or AA on the Thorndike and Lorge (1944) G scale with the exception of one word which had a frequency of 48/million on the same scale. The words were roughly equated on meaningfulness ($\bar{X}$ = 5.38 for low-I items and $\bar{X}$ = 5.94 for high-I items) on the basis of the same norms, and all the words were associatively unrelated.

The low-I nouns were randomly divided into two sets of 24 items each. From each set, a 12-pair list was constructed by randomly pairing the items and R and W item function was randomly assigned. The two lists constituted the first and the second lists for the C-L condition. List 1 for the E-L condition was constructed by random pairing of the W items of the second list of the C-L condition with the R items of the first list of the C-L condition. List 2 of the E-L condition was the same as that of the C-L condition. List 2 for the E-H and C-H conditions was formed by random pairing of the 12 high-I nouns with the W items of the second lists of the E-L and C-L conditions, respectively. In these two lists, the high-I nouns were always designated as the R items. The first lists of the E-H and C-H conditions were the same as that of the E-L and C-L conditions, respectively. It should be noted that within each level of imagery the manipulations necessary for defining the different transfer paradigms were performed on the first lists and the second lists were identical. Care was taken to insure that no interlist or intralist associative relationships existed. In addition, two random pairings of the R and W items were derived for each list to control for possible idiosyncratic associative relationships and for purposes of generality. Four random serial orders were employed for each list and four random orders of left-right spatial position of the R and W items across serial orders were utilized.

Procedure

The lists were presented by the anticipation method on a Lafayette memory drum. The rate of presentation was 2:2 sec with a 4-sec intertrial interval. All subjects were given standard VD instructions before the onset of List 1 practice. The words were presented in horizontal juxtaposition with the subject instructed to pronounce the item he believed was correct during the anticipation interval. The pair reappeared in the feedback interval with the correct item underlined. Both List 1 and List 2 were learned to a criterion of two successive errorless trials, with the first trial of each list conducted as a guessing trial. Following attainment of criterion on List 1, subjects were told that they would be presented a second list involving the same learning procedure as the first list. No information on the nature of the interlist relationship of the two lists was given. After completion of learning of List 2, all subjects were given a variation of the MMFR (Barnes & Underwood, 1959) recall test. The subjects in the E conditions were presented with the 12 items common in both List 1 and List 2 and were asked to write the R items of both lists for each W item in the order that they remembered them. The subjects in the C conditions were presented with the 24 W items of the first and second lists and were instructed to write the R item which had been paired with each. After writing all the items they remembered, subjects were instructed to designate the list in which each of the pairs appeared.

RESULTS

List 1 Acquisition

A 2 by 2 by 2 analysis of variance for paradigms, imagery, and lists was performed on number of trials to criterion for List 1. None of the main effects or their interactions was found to be significant (all $ps > .10$). An analysis on total errors to criterion provided similar results. Since these results indicated that the forms of pairing of lists were equal in terms of difficulty, subsequent analyses omitted list form as a factor.

List 2 Acquisition

Table 1 presents the cell means and standard deviations of number of trials and total number of errors to the criterion of two perfect trials on List 2. The analysis of the number of List 2 trials to criterion resulted in significant imagery main effect, $F(1,60) = 18.37$, $p < .001$, a significant paradigm main effect, $F(1,60) = 3.80$, $p < .05$ and a significant interaction of the two variables, $F(1,60)$ 5.26, $p < .02$. The means and standard deviations, respectively, for levels of imagery were 7.59, 3.96 (low), and 4.50, 1.32 (high). The mean and standard deviations, respectively, for paradigms were 6.75, 3.81 (E) and 5.34, 1.88 (C).

Simple main effects tests on the interaction revealed that, as expected, the E-L group required significantly more trials than the C-L group, $F(1,60) = 9.00$, $p < .005$, while the E-H and C-H groups did not differ, $F < 1$. The E-H group, however, took significantly fewer trials than the E-L group, as predicted, $F(1,60) = 21.65$, $p < .005$, while I was not a potent factor for the C groups, $F(1,60) = 1.98$, $p > .10$. The E-H group showed a slight trend toward significantly fewer trials than the C-L group, $F(1,60) = 2.73$, $p = .12$. The E-L group, more importantly, was significantly inferior to the C-H group, $F(1,60) = 19.13$, $p < .005$.

The analysis of total errors to criterion revealed similar effects, although not as potent as those obtained with the trials to criterion measure. The main effect of imagery was highly significant, $F(1,60) = 10.78$, $p < .001$, but the paradigm effect only approached significance, $F(1,60) = 2.87$, $p < .10$. The interaction between the two variables achieved marginal significance, $F(1,60) = 3.43$, $p > .06$. The means and standard deviations, respectively, for levels of imagery, were 16.13, 10.26 (low) and 9.53, 4.91 (high). Comparable statistics for paradigms were 14.53, 10.71 (E) and 11.13, 5.47 (C). Simple main effects tests on the interaction confirmed that E-L made significantly more errors than the C-L group, $F(1,60) = 154.80$, $p < .001$, while the E-H and C-H groups again did not differ, $F < 1$. The E-H group again was superior to the E-L group, $F(1,60) = 34.97$, $p < .001$, but imagery was not a significant variable for the C groups, $F < 1$. The E-L group was also inferior to the C-H group, $F(1,60) = 12.39$, $p < .001$, but the difference between the E-H and C-L groups was nonsignificant, $F(1,60) = 1.26$.

An investigation of the errors across trials produced no support for the prediction from frequency theory of initial positive transfer and later negative transfer for W_1-R_2 condition. Figure 1 presents the total number of errors on each of the practice trials of List 2. As shown in Figure 1, subjects in the E-L condition made more errors than those in the C-L condition on all trials except the first which was a guessing trial. By contrast, subjects in the E-H and C-H conditions had an almost identical number of errors on each trial.

Recall

Three different measures were derived from the data of the MMFR test. On the stringent measure, only those responses which were correctly matched and were correctly assigned to the appropriate list were included in the analyses. For an associative measure, all responses which were correctly matched, regardless of list assignment, were included. For an availability measure, all recalled List 1 or List 2 R items were included in the analyses. Since all analyses yielded similar conclusions, only the analyses of stringent scoring will be reported. For List 1 recall, subjects in the List 2 high-imagery conditions ($\bar{X} = 2.63$) recalled and correctly designated more correct associations than those in the low-imagery condition ($\bar{X} = 1.19$), $F(1,60) = 8.50$, $p < .005$. This result suggests that List 2 high imagery may produce a release from retroactive inhibition when List 1 items are

Table 1
Cell Means and Standard Deviations of Number of Trials and Total Errors to Criterion on List 2

	Condition			
	Experimental		Control	
Measure	Trials	Errors	Trials	Errors
Low Imagery				
Mean	9.13	19.69	6.06	12.56
SD	4.72	12.49	2.33	6.02
High Imagery				
Mean	4.38	9.38	4.63	9.69
SD	1.46	5.33	1.16	4.63

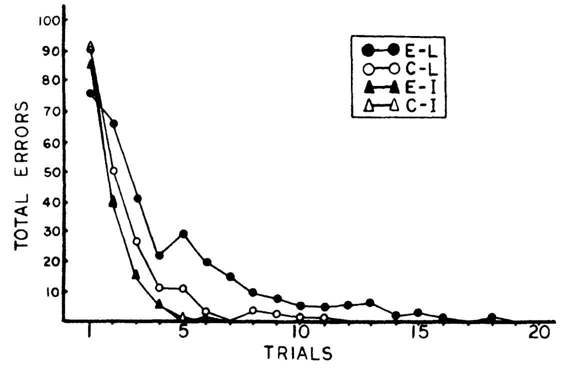

Figure 1. Total number of errors for each treatment condition on each List 2 trial.

low in imagery. In agreement with an incidental associative interference hypothesis and previously reported data (e.g., Eschenbrenner & Kausler, 1968), subjects in the E groups ($\bar{X} = 1.19$) recalled fewer correct pairings than those in the C groups ($\bar{X} = 2.63$), $F(1,60) = 8.50$, $p < .005$. The interaction was nonsignificant ($F < 1$).

In the analyses of List 2 stringent recall, only the imagery effect was significant with high imagery ($\bar{X} = 4.00$) producing superior recall over low imagery ($\bar{X} = 2.65$), $F(1,60) = 4.91$, $p < .03$.

DISCUSSION

Both the analyses of trials to criterion and errors to criterion for low-imagery items confirm the negative transfer reported for the W_1-R_2 paradigm by others earlier cited. The results with the high-imagery conditions, however, indicated that this interference can be substantially reduced by an attribute such as imagery. The E-H condition was superior to the E-L condition in both analyses of List 2 transfer and the E-L condition was inferior to the C-H condition. Since imagery did not produce significance within the C condition, it would appear that, contrary to single-list learning, imagery does not produce an advantage in List 2 learning in this condition above those effects accruing from learning-to-learn phenomena presumably based on frequency mechanisms. In the E condition, on the other hand, high-imagery subjects have two potential cues on which to base their responses: (a) the contrast of an old vs. a new item, and (b) the contrast of a concrete R item vs. a relatively abstract R item in List 1. The first source of contrast is also available to low-imagery subjects of the E condition, but, as was seen, these subjects failed to perform like frequency learners and showed negative transfer throughout List 2 practice, relative to low-imagery-condition subjects. It seems likely, therefore, that the superior performance of high-imagery subjects in the E condition, relative to low-imagery subjects of the E condition, was based on the cue provided by concrete image-evoking items. This "release" from contextual associative interference (Kanak & Curtis, 1970) in the case of high-imagery C condition, and from the additional interference factor of competition between incidentally learned associations in the high-imagery E condition, is further supported by the List 1 MMFR data which showed both high-imagery conditions producing better recall than their low-imagery counterparts even though imagery was held constant on List 1. This result has some similarity to the reduced retroactive inhibition observed in the A-B, A-C paired associate transfer paradigm when interlist grammatical class of the responses is varied (Postman, Keppel, & Stark, 1965).

The results of the present experiment would suggest that incidental associative interference in the W_1-R_2 paradigm could be reduced by any variable which increases list differentiation. The role of instructions regarding the interlist relationships of the materials has already been suggested as one such factor in accounting for the discrepant results between Underwood, Jesse, and Ekstrand (1964) and those earlier cited studies finding negative transfer with uninformed subjects. In addition to the presence or absence of instructions and interlist variations of imagery, other variables which may be potentially important in reducing the influence of incidentally learned associations in VD transfer include varying the objective frequency of the R items, their orthographic distinctiveness, and the degree of List 1 practice.

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