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Abstract

Transfer from prior intentional (INT) and incidental (INC) learning tasks was studied on A-Br and C-D paired-associate (PA) second lists learned intentionally. Transferred INC associations were learned as an intrinsic component of a first list verbal-discrimination (VD) task. The same 12-pair first list of high meaningful words was learned under INC and INT conditions. Moreover, the amount of INC and INT acquisition was comparable in that PA first list learning was limited according to a yoked criterion based on the level of INC associative recall for an S learning the VD list. Percentage of transfer measures showed that INC interference was less potent than INT. Recall of List 1 following List 2 mastery showed a greater loss of INC associations relative to INT. The results were interpreted within the framework of Craik and Lockhart's (1972) proposal that implicit processing activities differ between usual INC and INT learning tasks with only the later including semantic processing that results in a more durable memory trace.

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In a verbal discrimination (VD) task using the anticipation method, the S is shown a pair of verbal items and asked to choose and, usually, pronounce out loud the item arbitrarily designated by E as correct. During the immediately following feedback interval, the correct item is indicated (e.g., underlined) to inform the S of the correctness of his prior response. Empirical support is available for the notion that bidirectional intrapair associations between wrong (W) and right (R) items (i.e., W-R and R-W associations) are learned as an intrinsic incidental (INC) component of intentional (INT) practice in VD learning. When measured by using a modified free recall task (MFR; Briggs, 1954), in which Ss are given a list of W (or R) items and asked to recall the corresponding R (or W) items, the level of INC associative learning is expected to be about 50% complete for high meaningful pairs after perfect intentional learning (Kanak, 1968). When measured by an associative matching task (AM; McGovern, 1964), in which Ss are given both the W and R items and are asked to match them correctly, the level of INC associative learning for high meaningful pairs is also about 50% complete (Kanak and Curtis, 1970; Keppel, 1966). Performance on the AM task is not restricted by limited item learning (Keppel, 1966), as on an MFR task. Accordingly, item availability following VD list mastery is about 50% for W items and at least 50% for R items for lists of high meaningful pairs (Kausler and Sardello, 1967).

The interference potential of INC associations learned during VD practice has previously been demonstrated (Kanak and Dean, 1969; Kausler, Fulkerson, and Eschenbrenner, 1967). The purpose of the present study was to extend these findings by comparing the interference effects of these INC associations with that from INT associations on (a) List 2 intentional paired-associate (PA) learning of an A-Br transfer list and (b) subsequent recall of List 1 associations. Even when yielding equivalent amounts of acquisition, INC and INT conditions may lead to different implicit processing activities (Craik and Lockhart, 1972). The qualitative differences in implicit behaviors occurring under INC and INT acquisition conditions may be expected to produce an INC versus INT transfer and/or recall difference.

On a typical paired-associate A-Br list, B items are re-paired relative to first list A-B pairings. For Ss transferring from first list VD acquisition in the present study, B items on the A-Br transfer list were re-paired first list R items, and second list A items were first list W items. Interference on an A-Br list is believed to arise from competition from first list forward, A-B (or W-R), and backward, B-A (or R-W), associations (Martin, 1965). In the present study, performance comparisons were made between a group transferring INC associations (VD group) and a yoked, INT group (Yoked-PA) transferring intentionally learned associations. The INT associative learning was assured by use of a PA first task, and INC associative learning was measured by an AM task given after VD list mastery in a Control-VD group. A yoked-limit to PA first list learning was placed on Ss in the Yoked-PA group according to the AM score of a corresponding S in the Control-VD group. The amount of potential interference arising from List 1 associative learning was assumed comparable, therefore, on List 2. Consequently, differences in performance on the A-Br transfer list between the groups learning List 1 as a PA task (the INT paradigm) or as a VD task (the INC paradigm) would arise from differences in the way INC and INT interference occurs. The present study thereby provides a framework to investigate qualitative effects of INC and INT conditions.

Although quantitatively the same, the INC and INT associations of the present study are learned while performing tasks that are likely to induce different levels of associative-semantic processing. Craik and Lockhart (1972) suggested that the durability of memory traces is determined by the original "level of processing" at acquisition. These authors implied that a so-called INT learning task merely imposes performance requirements that employ the high level of associative-semantic processing. This model assumes a hierarchy of processing activities with the highest level occurring at the associative-semantic stage in which a stimulus is enriched by "extracting meaning" (Craik and Lockhart, 1972). In the PA task, for example, the S performs his task by use of an association process. The response learning stage of PA learning may require a "selector mechanism" (Underwood and Schulz, 1960) involving a "retrieval rule" that is clearly semantic (Baddeley, 1972). The "selector mechanism" is activated when the S uses a "rule" to restrict response retrievals within the limits of a semantic set of responses available for recall.

In performing many INC tasks, however, Ss are required merely to repeat or rehearse information and thereby use a low level of processing. The frequency theory of VD learning (Ekstrand, Wallace, and Underwood, 1966) assumes that INT learning in the VD task is a result of S's rule in selecting the most frequently experienced item of a pair. Frequency accrues in favor of R items as a result of correct rehearsals which may be seen as a type of low level processing. On the typical VD task, the S uses a frequency based discrimination rule rather than associative formation in performing the INT task. The recognition nature of VD learning also eliminates the performance of retrievals as in a PA task.

However, the pronunciation responses, given mainly to R items on a typical VD task, emphasize their phoenemic features and increase the likelihood of semantic processing. These pronunciation responses may induce an intermediate level of processing and a relatively weak "selector mechanism" creating a set of R items. Since the associative-semantic properties of pairs are not assumed to be intentionally processed, however, during typical VD learning the intrapair associative learning that occurs can be regarded as an example of incidental learning by contiguity (Spear, Ekstrand, and Underwood, 1964).

Insofar as INC associations learned during VD practice are the product of low level processing, their subsequent interference potential may not be as strong as for INT associations. As a function of the INC versus INT differences in associative interference potency, differential unlearning of List 1 associations during second list A-Br practice may also be expected. Unlearning is affected, however, by variable other than interference. A direct relation between strength of interference and unlearning may not occur, for example, when response-suppression of List 1 occurs during List 2. Response-suppression based on the operation of a List 1 "selector mechanism" may eventually "break down" on an A-Br transfer list (Postman and Underwood, 1973). To the extent that the "selector mechanism" is available, however, it makes possible, even in A-Br, an effort to differentiate the responses associated with Lists 1 and 2 pairs and, thus, a basis for mitigating unlearning. The relatively weaker "selector mechanism" available after VD practice on List 1 would provide less opportunity for list differentiation.

Since S's implicit processing activities are controlled by instructions (Sutcliffe, 1972), this variable was further manipulated in the present study. Prior to List 2 practice, one-half of the Ss were instructed (I) concerning the relationship in list content between Lists 1 and 2 while the remainder were not so instructed (NI). Under the assumption that INC associations are less semantically distinctive and, therefore, less interfering than INT associations, instructions may offset this difference and augment INC interference by giving salience to the List 1 associations. For INT learned associations, instructions may provide a basis for increased list differentiation since the pairs are already semantically distinctive and, thus, reduce interference on List 2 relative to no instructions.

Transfer differences can result, of course, from nonspecific sources since learning sets transferred in the INC and INT paradigms differ. Nonspecific transfer effects are facilitative in the INT paradigm but are likely to be negative or less positive for the INC paradigm in which the second, PA task introduces a new requirement. The new task requirement, i.e., "recall" of B items as opposed to previous "recognition" of R items, should make the List 1 learning set less effective on List 2 for the INC paradigm. For the INT paradigm, however, the task requirements of Lists 1 and 2 are the same and, thus, greater ease of List 2 learning, relative to the INC paradigm, may be expected. Therefore, even if INC and INT interference in A-Br transfer were equal, the A-Br list may be easier in the INT groups. As a result of a differential effect from learning set, equivalent List 2 performance in A-Br for INC and INT groups, or greater difficulty for the INT group, could indicate that actual INC associative interference is less strong. Performance comparison on a second list learned as a C-D, nonspecific PA control task allow a means for assessing learning set differences between the INC and INT groups.

Method

Subjects.--The Ss were 128 students enrolled in General Psychology classes at Southwestern Oklahoma State University who were naive to verbal learning studies. Each S was run individually and volunteered although given bonus course credit for participation.

Materials.--A pool of 48 common words (Thorndike-Lorge A or AA) were selected and were determined to be unrelated in the Palermo and Jenkins (1964) norms. From this pool, two sets of 24 words were formed with each set containing 16 nouns and 8 other words (viz., adjectives, adverbs, and one preposition in one set). For each set, 12 pairs of words were formed making up the two 12 pair lists (A and B) second lists of the present study. Each 12 pair list contained eight noun pairs and four other pairs. All pairs were formed in such a way as to avoid natural language habits. In forming the A-Br variation for each list, the response items within each set were re-paired within the set of noun pairs and within the other pairs. Of course no response term of the A-B list appeared with the same A item on the A-Br list variation.

Paradigmatic variation was accomplished at List 1 so that Ss in either the A-B; C-D nonspecific transfer control or A-Br condition learned a common second list. Half of the Ss who learned the A list as the common second list, had learned its A-Br variation (A-Br group), and half had learned the A-Br variation of the B list (C-D group). Since the two lists (A and B) were used to provide greater generality of the results, the lists were counterbalanced so that the C-D and A-Br first list variations for half of the Ss (having A List 2) were, respectively, the A-Br and C-D lists for the other half (having B List 2). The (A and B) list division combined with two E's who concurrently conducted the experiment yielded four control variables that were completely balanced across treatment groups.

The W and R items of each pair in a VD List 1 were, respectively, the A and B items of the corresponding PA list. During acquisition and transfer, four random orders were used in presenting the 12 pairs. On the VD lists, the left and right spatial positions of an R item were randomly alternated within the restriction that across the four orders an item appear equally often on both sides. The successive occurrence of an R item on the same side was restricted to three within any order. Both Lists 1 and 2 were presented on a Lafayette (model 23011) memory drum using the anticipation procedure at a 2:2 sec rate with a 4 sec intertrial interval. On VD acquisition lists, the W and R items appeared contiguously during both the anticipation and feedback intervals with the R item underlined during the later. On PA acquitition lists only the stimulus item appeared on anticipation intervals with both the stimulus and response items appearing together during the feedback intervals.

Procedure.--Four acquisition groups were used, including two INC groups, VD and Control-VD, and two INT groups, Yoked-PA and Mastery-PA. The Ss assigned to either INC group were given standard VD instructions and learned List 1 as a VD list to the criterion of one perfect trial. The first trial was a study trial, and Ss were told to study the pairs silently on Trial 1. Following List 1 acquisition, Ss in either INC group were then given standard PA instructions and learned List 2. The Ss in the Control-VD group were also given an unpaced AM task prior to being given List 2 instructions. For the AM task, Ss were given a sheet of paper with the W and R items typed in two columns in new random orders. The Ss were asked to match each R item in the right column with the W item in the left column with which it was paired during acquisition. The AM measure of INC associative learning is not restricted by limited item availability (Keppel, 1966) since all W and R items are presented. The number of correctly paired W and R items on the AM task in the Control-VD group thus served as a measure of INC associative learning following List 1 VD practice and made possible the use of a yoking criterion for INT associative learning for a corresponding S in the Yoked-PA group.

In the Yoked-PA group, Ss were given standard PA instructions and practiced List 1 until the predetermined (yoked) number of correct responses was given on a particular trial. If an S gave the criterion number of correct responses before finishing a trial, the trial was stopped at that criterion. The Mastery-PA group practiced List 1 to the criterion of one perfect trial and thus provided a comparison group for assessing the treatment conditions of the present study at relatively higher levels of List 1 INT associative learning. In both PA groups, Ss studied the pairs silently on Trial 1.

Within each of the above 4 (Acquisition Groups) x 2 (Paradigms) transfer groups, half of the Ss were given either specific instructions regarding the interlist relationships in addition to standard List 2 instructions (I) or were merely given standard List 2 instructions (NI). Thus, in the I condition, Ss given the A-Br task were informed that the words on List 2 were the same but re-paired relative to List 1. Those Ss in the I condition given the C-D task were told that List 2 items were entirely new. All Ss transferring from a VD List 1 were given standard PA instructions prior to List 2. All Ss in the INT paradigms (given a PA List 1) were told simply that they would learn another list by the same procedure. For all transfer groups, Trial 1 on List 2 was also a study trial for silent study of all pairs. All Ss practiced List 2 to the criterion of one perfect trial.

Within each treatment combination of acquisition groups, transfer paradigms, and instructions, half of the Ss were given, following List 2 practice, an MFR recall task requiring recall of List 1 R or B items to given W or A items, followed by recall of List 1 W or A items to given R or B items (Order 1). The remaining half were given the reverse sequence (Order 2). The set of W or A and R or B items were each typed on individual sheets of paper with each set typed in a new random order. The Ss were unpaced and, thus, given as much time as needed for each (W-R and R-W) recall task.

The treatment conditions provided a complete 4 (Acquisition Groups) x 2 (Paradigms) x 2 (Instructions) design for the main analyses of transfer data. Analysis of Order in the MFR data further provided a 4 x 2 x 2 x 2 design with 32 conditions. However, for the purpose of assignments, Ss were given one of 24, 3 (VD, Control-VD, Mastery-PA) x 2 x 2 x 2, randomly sequenced treatment combinations in order of their appearance at the laboratory. Although a random sequence of 24 combination was used, squads of 32 Ss were run successively with lists (A or B) assigned randomly to one of each S within the two squads run by each E. Thus after a S from the Control-VD group completed an experimental session, the following S to appear at the laboratory, not one of the random sequence of 24 assignments, was given a Yoked-PA treatment combination corresponding to that given the immediately prior Control-VD S.

Results and Discussion

List 1 Acquisition.--The number of trials of List 1 practice for both PA acquisition groups (Yoked-PA and Mastery-PA) was cast into a 2 (Acquisition Groups) x 2 (Paradigms) x 2 (Instructions) analysis of variance. This analysis showed that only the effect from Acquisition Groups was significant, $F(1,56) = 29.03$, $p < .001$. Means and (standard deviations) for trials of List 1 acquisition practice were 6.06 (3.49) and 10.78 (3.46) for the Yoked-PA and Mastery-PA groups, respectively. The grand mean and standard deviation were 8.42 and 4.19. List 2 differences arising from Instruction or Paradigm are not attributable to differential rates of List 1 learning since other F values were either less than one or associated with $p > .20$.

The number of trials of List 1 practice for both VD acquisition groups (VD and Control-VD) was cast into a 2 x 2 x 2 analysis of variance. This analysis yielded no significant F values. The grand mean and standard deviation were 7.73 and 3.50. Transfer differences occurring among any of the INC groups therefore are not confounded by differences in first list rate of intentional VD learning.

Associative learning in Control-VD.-- The AM task given to Ss in the Control-VD group following List 1 learning provided a measure of INC bidirectional associative learning. The number of correctly paired items on the AM task was cast into a 2 (Paradigms) x 2 (Instructions) analysis of variance yielding Fs less than one for each main effect and the Paradigm x Instruction interaction. In C-D, mean correct matchings and (standard deviations) were 6.62 (2.50) and 6.62 (2.50) in the I and NI conditions, respectively. The corresponding values in A-Br were 6.62 (4.74) and 5.88 (3.44). Thus, INC associative learning following VD list mastery of highly meaningful words was approximately 50% complete, as expected. It may be concluded that the transfer groups in the Control-VD condition learned comparable levels of List 1 INC associations. This conclusion also holds for the Yoked-PA group learning INT associations since Ss in this group were identical to those of the Control-VD group in that yoking controlled the amount of List 1 associative learning. Moreover, associative learning in the VD group is assumed equal to that in the Control-VD group. The later assumption that the VD and Control-VD groups incidentally learned a comparable number of List 1 associations is given support by the joint findings of no difference in acquisitions trials between the two VD groups of the present study and the finding of 50% associative learning in the Control-VD condition. This later finding, that is, suggests that the population of Ss and materials of the present study yielded a level of INC associative learning consistent with that found under similar conditions by earlier researchers (e.g. Kanak and Curtis, 1970).

Rate of List 2 learning.--A 3 (Acquisition Groups; VD, Control-VD, Yoked-PA) x 2 (Paradigms) x 2 (Instructions) analysis of variance was performed on the number of trials of List 2 practice to the criterion of one perfect trial. The only significant F value occurred for Paradigm, $F(1,84) = 13.60$, $p < .001$. The A-Br list required, as expected, more trials to learn than the C-D list; respective means and (standard deviations) were 14.10 (4.79) and 10.54 (3.43). The Acquisition Groups x Paradigm effect was not significant, $F(2,84) = 1.52$, $p > .20$. For C-D, means and (standard deviations) were 11.13 (5.17), 11.00 (3.74), and 9.50 (3.97) for the VD, Control-VD, and Yoked-PA groups respectively. These means show an absolute greater ease of List 2, PA learning in the INT group relative to the INC groups and suggest that learning set was more facilitative in the INT paradigm. Conversely, nonspecific transfer effects were apparently not as facilitative in the INC groups as a result of a change in task requirements occurring on List 2. In A-Br, means and (standard deviations) were 13.63 (4.99), 13.25 (3.77), and 15.44 (6.00) for the VD, Control-VD, Yoked-PA groups, respectively. These means show that on A-Br, the absolute level of List 2 difficulty was less for the INC groups than for the INT group even though the later probably benefited from the facilitation of learning set. Although the interaction of Acquisition Group x Paradigm was not significant, its direction is consistent with the hypothesis that INC interference is less potent than INT. The

Acquisition Group x Paradigm x Instruction effect was not significant, $F(2,84) = 2.27 p > .10$, suggesting that instructions did not differentially affect the salience of INC and INT associations.

In order to highlight the A-Br versus C-D comparisons, a percentage of transfer measure, defined as the mean in C-D minus the mean in A-Br, divided by the sum of the two means and then multiplied by 100, was computed for each acquisition group. Using this measure, the VD, Control-VD, and Yoked-PA groups, respectively, showed amounts of transfer of -10.89%, -9.28%, and -23.82%. It is apparent that INT interference resulted in about twice as much negative transfer than INC interference.

A 2 (Paradigms) x 2 (Instructions) analysis of variance of trials to List 2 criterion in the Mastery-PA condition showed only a significant effect from the paradigm variable, $F(1,28) = 35.64$, $p < .001$, with means and (standard deviations) of 7.18 (2.32) and 15.62 (5.38) for the C-D and A-Br lists, respectively. The close similarity in mean trials to criterion on the A-Br list for the Yoked-PA group (15.44) and Mastery-PA group (15.62) yielded $t < 1$ but cannot be interpreted to mean that interference was equivalent. Postman (1962) also failed to find greater negative transfer as measured by the number of trials to criterion in the A-Br condition (with a 12 adjective pair list) as a function of degree of List 1 learning. Positive transfer from nonspecific sources, e.g., learning set, is also a function of degree of List 1 learning. Indeed, Postman (1962) did show a marked increment in negative transfer in A-Br as a function of degree of List 1 learning when transfer was measured as the difference between A-Br and C-D performance. Similarly, in the present study the nonspecific component showed a marked relationship to the degree of List 1 learning. In C-D, the difference between the mean of the Yoked-PA group (9.50) and the Mastery-PA group (7.18) was significant, $\underline{t}$ (30) = 2.02, one-tail $\underline{p}$ < .05. The percentage of transfer in the Mastery-PA group was -36.99%. The absence of a significant effect for the interaction of Instruction x Paradigm ($\underline{F}$ < 1) showed no support for the notion that the I condition facilitates list differentiation of associations in A-Br. Postman (1962) noted that in A-Br differentiation would develop slowly and, recently, suggested that it is probably limited to response differentiation (Postman and Underwood, 1973).

Confidence thresholds.--The average trial (across list pairs) on which a response is first given (FG) was used to estimate the response learning stage of List 2 acquisition although Ekstrand (1966) named this measure a "confidence threshold". The FG scores were analyzed via a 4 (Acquisition Groups) on x 2 (Paradigms) x 2 (Instructions) analysis of variance. The Paradigm effect was highly significant, $\underline{F}(1,112) = 13.76$, $\underline{p} <.001$. Means and (standard deviations) for the FG measure were 4.05 (1.27) and 4.96 (1.57) for C-D and A-Br, respectively. The mean FG was larger for A-Br than for C-D even though the later condition involved new response terms on List 2 thus confirming Ekstrand's (1966) notion that the FG measure is inflated by the degree of associative interference present. The FG measure is suited for reflecting a possible INC versus INT effect in the extent to which associative interference affects the S's tendency to respond on the early trials of transfer. If an effect is found, it may suggest that group effects were most evident early in transfer.

The analysis of FG scores did show a trend toward a significant

Acquisition Group x Paradigm effect, $\underline{F}(3,112) = 2.27$, $\underline{p} < .10$. In C-D, means and (standard deviations) were 4.60 (1.37), 4.22 (1.45), 3.91 (1.16), and 3.47 (.83) for the VD, Control-VD, Yoked-PA, and Mastery-PA groups, respectively. In A-Br, these means and (standard deviations) were 4.69 (.99), 4.71 (.92), 5.59 (2.46), 4.85 (1.38). Within the VD, Control-VD, Yoked-PA, and Mastery-PA groups, the amounts of transfer shown by the FG measure were, respectively, -.97%, -5.49%, -17.68%, and -16.59%. It is apparent that the above mentioned statistical trend reflects the differential effects of INC and INT transfer with the later producing relatively longer delays in first emitting a response. In considering the likely difficulty of response learning _per se_ in the INC groups, the conclusion that INC interference was less potent than INT is given further support. That is, to the extent that the FG score also reflects the length of the response learning stage, it is surprising that the INC groups showed relatively low FG scores in A-Br.

Response learning itself should be difficult in the A-Br lists of the INC groups since R item learning following List 1 is expected to be only about 50% complete (Kausler and Sardello, 1967). The analysis of FG scores revealed only one other large $\underline{F}$ value; a statistical trend occurred for the Instruction effect, $\underline{F}(1,112) = 3.52$, $p < .10$. In the I and NI conditions, respective means and (standard deviations) for the FG measure were 4.27 (1.65) and 4.47 (1.29), respectively. This finding may be interpreted according to Ekstrand's (1966) explanation of the FG measure; instructions, that is, tended to increase _Ss_' confidence in emitting a response.

Early Transfer.--A 4 (Acquisition Groups) x 2 (Paradigms) x 2

(Instructions) analysis of variance was performed on the number of correct responses given on Trials 1-5 of List 2. All Ss required at least five trials. As expected, there was a significant Paradigm effect, $F(1,112) = 27.53$, $p < .001$. Mean correct responses and (standard deviations) on Trials 1-5 were 24.06 (9.20) in C-D and 16.00 (8.10) in A-Br. This analysis also showed a significant Instruction effect, $F(1,112) = 4.82$, $p < .05$; mean correct responses and (standard deviations) were 21.72 (9.29) in I and 18.34 (9.54) in NI. Other effects were nonsignificant. The I condition did not interact with Paradigm or Acquisition Group in this or any other analysis performed. The facilitative effects of instructions in all conditions, including C-D, suggests that information concerning an interlist relationship may serve to activate a "selector mechanism" early in List 2 practice. This can also occur for the INC groups and for the A-Br transfer task. Even in these conditions, therefore, interlist differentiation apparently was possible although it is doubtful that the same type of "selector mechanism" is involved.

Further analyses include only the three acquisition groups (VD, Control-VD, Yoked-PA) having equivalent amounts of List 1 associative learning. A 3 (Acquisition Groups) x 2 (Paradigms) x 2 (Instructions) analysis of variance of the number of trials to reach a criterion of 6 out of 12 (50%) correct responses showed only a significant Paradigm effect, $F(1,84) = 7.20$, $p < .01$. Mean trials to achieve the 50% criterion and (standard deviations) were 4.08 (4.42) and 5.52 (9.70) in C-D and A-Br, respectively. Correct responses and omissions, converted to rates to the base of opportunities were then analyzed. Opportunities for each S were defined as 12 x the number of trials to reach the 50% criterion. This conversion provides paradigm comparability on trials to 50% criterion in analyzing the rate measures. Percentage of transfer scores were then computed for all A-Br Ss according to a formula provided by Read and Scarlett (1973). Accordingly, 100 x (C-E)/C+E) was used; C is the mean rate of each C-D group serving as a control for each corresponding A-Br group, and E is a given S's score in the A-Br group. For the measure of correct responses, the number of correct responses is directly related to ease of performance. For this measure, the above formula was therefore changed to 100 x (E-C)/(C+E).

A 3 (Acquisition Groups) x 2 (Instructions) analysis of variance of the percentage of transfer was performed using the measure of rate of correct responses up to and on the 50% criterion trial. This analysis showed a statistical trend for the effect of Acquisition Groups, $F(2,42) = 2.76$, $p < .10$. Means and (standard deviations) were -.93% (10.67), -6.18% (8.14), and -10.65% (15.43) for the VD, Control-VD, and Yoked-PA groups, respectively. Relative to Yoked-PA, the INC groups thus tended to show a higher rate of correct responses on the early trials of practice on A-Br relative to a corresponding rate on C-D.

An omission error may provide a more sensitive measure of the extent to which the S attempts to differentiate the pairs of Lists 1 and 2 by activating the List 1 "selector mechanism" to suppress responding. In A-Br, however, this "selector mechanism" may "break down" (Postman and Underwood, 1973) later in practice but should be evident early in List 2 practice. A 3 x 2 analysis of variance of the percentage of transfer, measured by the rate of omissions, showed a significant effect for only Acquisition Group, $F(2,42) = 4.19$, $p < .05$. Means and (standard deviations) were +2.92% (24.13), -5.74% (9.27), and -15.28% (18.19) for the VD, Control-VD, and Yoked-PA groups, respectively. Tukey's test showed that only the Yoked-PA and VD groups showed a reliable difference ($p < .05$). A basis for a List 1 "selector mechanism" may have been provided by the AM task given after List 1 in the Control-VD group.

Interlist intrusions, defined as associations correct in the first list but incorrect in the second (Postman, 1962), were possible only in A-Br. These errors provide a direct indication of interlist associative interference but are generally infrequent. Comparisons of the acquisition groups in the A-Br condition in rates of interlist intrusions yielded no evidence of an INC versus INT differences. However, these performance comparisons in the A-Br condition alone yield ambiguous findings influenced by acquisition group differences in nonspecific transfer effects.

Modified Free Recall.--A 3(Acquisition Groups) x 2 (Paradigms) x 2 (Instructions) x 2 (Orders of Administration) x 2 (Directions of Recall) analysis of variance, with repeated measures on the last factor, was performed on the MFR data. This analysis of course showed a significant Paradigm effect, $F(1,72) = 31.88$, $p < .001$ and one other significant effect, Acquisition Group, $F(2,72) = 15.12$, $p < .001$. Means and (standard deviations) for combined (A-B or W-R + B-A or R-W) recall were 3.28 (3.99), 4.97 (5.15), and 9.28 (6.32) for the VD, Control-VD, and Yoked-PA groups. Tukey's test showed that the two INC groups were equivalent but that the Yoked-PA group recalled more than the VD group ($p < .01$) and the Control-VD group ($p < .05$). In accord with Craik and Lockhart's (1972) notion that lower levels of processing yield less durable memory traces, the INC groups recalled significantly fewer List 1 associations. That is, the mere performance of recognitions and R item pronunciations during VD practice did not activate the associative-semantic levels of processing in the INC groups. In the PA task, however, a high level of processing was probably activated as a result of the performance of response retrievals made in association with each A item.

In C-D, means and (standard deviations) for combined recall were 4.94 (4.67), 7.19 (5.53), 13.19 (5.43), 20.69 (4.09) for VD, Control-VD, Yoked-PA, and Mastery-PA; in A-Br these values were 1.63 (2.31), 2.75 (3.72), 5.38 (4.51), and 11.75 (5.51). The percentages of mean recall in A-Br relative to C-D were 33%, 38%, and 41% in the VD, Control-VD, and Yoked-PA groups, respectively. These values are similar as reflected by the absence of a significant Acquisition Group x Paradigm effect, $F(2,72) = 2.17$, $p > .10$. The effectiveness of the A-Br condition in producing unlearning, relative to C-D, was apparently comparable for INT and INC paradigms despite the absence of a semantically based "selector mechanism" in the INC groups. In the INT paradigm, that is, a "selector mechanism" may enable suppression of responses associated with List 1 pairs during List 2 and thereby allow some interlist differentiation. A lower level "selector mechanism," based on List 1 pronunciation behavior, would not produce a durable basis for differentiation; however, interlist discrimination could result from intertask performance differences (e.g. recognition versus recall) in the INC paradigm.

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APPENDIX A

A REVIEW OF THE LITERATURE

Transfer Effects in Intentional and Incidental Learning Paradigms: A review of the Literature

Following his review of a large body of research in incidental (INC) learning, McLaughlin (1965) concluded that the term "incidental learning" is a misnomer. The usual operational definition of INC learning is that which occurs without formal instructions to learn (McLaughlin, 1965). Thus, the essential element of instructions given to the so-called "INC learning group" is merely the absence of information about a later test of retention. McLaughlin concluded that there is only one learning process and that, therefore, only quantitative differences between INC and intentional (INT) groups have been found as a function of instructions. However, the theoretical null hypothesis that no qualitative difference exists between INC and INT groups is credible to the extent that researchers make reasonable efforts to demonstrate the alternative. As McLaughlin noted, the logic of most studies on INC learning is based on a research design suited for showing only quantitative differences. The present study departs from this logic in an effort to demonstrate possible qualitative differences or, that is, in showing differences in <u>what</u> is learned under INC and INT conditions.

The tradition of human verbal learning research in INC learning has been limited to showing only <u>how much</u> is learned as a result of an excessive use of single (recall or recognition) retention tests to measure "amount learned." Recently Wolk (1974) observed that INC learning research is restricted by an excessive use of immediate retention tasks but failed to suggest alternative means of measuring what is learned in INC and INT groups. Transfer tasks, however, are generally more promising that retention tasks for determining what is learned (Postman, 1971). Moreover, transfer tasks have an additional advantage in being able to reflect acquisition effects arising from performance (nonspecific) as well as learning (specific) variables. Thus, the present study provides an analysis of a proposed INC learning paradigm based on a transfer model. In this way the proposed INC learning paradigm may optimize conditions for demonstrating that INC and INT conditions yield qualitatively different processing activities during learning. As a general example of this approach, Hicks, Tarr, and Young (1973) used a transfer task to assess the nature of prior INC learning. Thus, the INC learning of words occurred during "mechanical repetition" involved in Ss' passively reading words out loud. Performance on a second INT free recall task involving identical or related words was found to be related to the number of repetitions and degree of semantic relatedness of the prior, passively read words.

It is also traditional that studies of INC learning use either a Type I or Type II research design (Mechanic, 1962). In the Type I design, Ss in the INC group perform an orienting task to ensure responding (and exposure) to the to-be-recalled stimuli. The performance of the INC group is compared to that of an INT (control) group told to learn the stimuli. In the Type II design, Ss learn information they are not instructed to learn while learning other information they are instructed to learn. However, the distinction between a Type I and Type II research design, although important in that no learning instructions occur in the former, should not obscure the fact that the sine qua non of INC learning is the absence of the subjective experience by the S that he intended to learn the INC material during the INT learning task (Type II) or the orienting task (Type I). Moreover, in a Type I design instructions for performing the orienting task specify a requirement for INT behavior, and, thus, it represents a form of Type II design. The present study belongs within the tradition of Type II research but employs the verbal-discrimination (VD) task with the assumption that it provides a protypical INC learning situation.

In a VD task using the anticipation method, the S is shown a pair of verbal items and instructed "to chose" and "to pronounce" out loud the item arbitrarily designated by E as correct. During an immediately following feedback interval, the correct item is indicated (e.g., underlined) to inform the S of the correctness of his chosen pronunciation. Although the S's INT task consists of learning only to make correct recognition-discrimination, bidirectional intrapair associations between wrong (W) and right (R) items (i.e., W-R and R-W associations) are also learned as an INC component of VD acquisition. On an associative matching task (AM; McGovern, 1964), associative learning is measured as the number of correct associations S can match when given simultaneously lists of the W and R items. Keppel (1966) found that on the AM task, in which item availability is not a limiting variable, associative learning is about 50% complete following mastery of a VD list of low frequency words. With high frequency words, the AM measure also shows that associative learning is about 50% complete (Kanak and Curtis, 1970). Lists of high frequency words presented at a 2:2 sec. rate via the anticipation method can be expected to show about 50% W item learning and at least 50% R item learning (Kausler and Sardello, 1967). Similarly, with high frequency words learned under these conditions, Kanak (1968) also showed about 50% W-R and R-W associative learning measured by a modified free recall (MFR; Briggs, 1954) task in which Ss were given either W or R items and instructed to recall the appropriate R or W items, respectively.

The contemporary frequency theory of the INT component of VD learning, (Ekstrand, Wallace, and Underwood, 1966) specifies three types of explicit responses (viz., representational, pronunciation, and rehearsal responses) made by S that provide an accrual of subjective experience for each item. Since R items are experienced more frequently as a result, primarily, of S's rehearsals of R items during feedback, the S can correctly perform the INT task by using a "rule" to choose the more frequently experienced item of each pair. The rote responses activities that form the basis for the accrual of frequency units are types of "differential responses" according to Postman's (1964) theory of incidental learning. A "differential response" is simply a habit S brings to the experimental task (Postman, Adams, and Phillips, 1955), but as Ryan (1970) noted, this definition of a "differential response" is tantamont to "anything the S does." Nevertheless, even the occurrence of the differential responses specified by the frequency theory of VD acquisition provides no apparent basis for explaining the formation of INC associations. Associative learning during VD learning, however, is an intrinsic component of VD learning (Lovelace and Bansal, 1973). Even when Ss are instructed to free recall list items following VD practice, there is typically significantly greater clustering by intrapair relations than by W or R functioning (Mueller, Jablonski, and Fulkerson, 1971).

Spear, Ekstrand, and Underwood (1964) earlier explained the INC associative connection that develops between two verbal items presented together on a VD list as an instance of learning by contiguity. These authors also suggested that with verbal material, the degree of learning by contiguity is related to the level of meaningfulness of the items. Thus, since the stability of a representational response may be assumed to be directly related to an item's meaningfulness, it was suggested that "maximum learning by contiguity will occur when the verbal unit evokes a consistent and stable response . . . . (p. 161)." Spear, et al. further noted that since the VD task represents a Type II design that necessarily involves learning instructions, it cannot be concluded that contiguity alone is a sufficient condition for INC associative learning. However, learning by contiguity is apparently possible in the absence of any instructions to learn (Type I design). For example, Rosenberg (1962) demonstrated INC associative learning of pairs of pictures and (two-digit) numbers to be equivalent for groups told either to learn the pictures or merely to observe them. In spite of the uncertainty concerning the mechanism(s) for INC associative learning, the intrinsic, intrapair, associative learning that develops during VD practice is an important type of INC learning. Thus, unlike studies criticized by Wolk (1974) that merely examine retention of aritifcial, irrelevant INC stimuli, a study of the INC associative learning occurring during VD practice, represents, particularly for high meaningfulness material, processes intrinsic to the formation of intentional verbal discrimination.

In situations in which INC learning of W-R (or R-W) associations provide a potentially detremental influence on later, INT VD learning, as in a W_1-R_1, W_1-R_2 (same W items on Lists 1 and 2 but different R items), unlearning of List 1 R items and W_1-R_1 associations has been shown (Kausler, Fulkerson, and Eschenbrenner, 1967). Moreover, a general two component (INT and INC) conceptualization is apparently necessary to explain VD transfer. That is, Kanak and Dean (1969) showed that a group given a re-paired (noncorresponding) List 2 made significantly more total errors in 10 trials of List 2 relative to a group given continued practice on the same (corresponding) list. On the noncorresponding list, List 2 W and R items were the same as those on List 1, but each R item was paired with a W item on List 2 different from the W item on List 1. A noncorresponding list is analogous to an A-Br paired-associate (PA) list given after A-B practice. On an A-Br list, the B items on List 2 are re-paired relative to the List 1 pairings. Relative transfer on an A-Br transfer list is typically negative as a result of the potent interference from competing List 1 forward and backward associations elicited during practice on the A-Br transfer list (Martin, 1965). Comparable forward and backward INC associative interference seems to occur on a re-paired transfer VD task. In this regard, the Kanak and Dean finding of a decrement in VD transfer on a noncorresponding list was recently corroborated but only when re-pairing was introduced after List 1 was nearly mastered (Lovelace and Bansal, 1973).

The INC associative learning occurring during VD acquisition has also been shown to influence INT transfer performance on a second, PA list. Thus, negative transfer was found for list pairs having noncorresponding (e.g., A-Br; A items are List 1 W items and B items are List 1 R items) relationships to List 1 pairs (Battig, Williams, and Williams, 1962; Spear, Ekstrand, and Underwood, 1964). These investigations included noncorresponding B-Ar pairs, and analyses were reported for combined noncorresponding lists. Spear, et al. included a C-D, nonspecific control list in which new items appeared on the second, PA list. Relative to the C-D list, noncorresponding lists yielded significantly fewer correct responses on 10 trials of second list practice. Although Battig et al. also found evidence for INC interference for noncorresponding pairs on their PA transfer list, they did not find a significant faciliation of PA learning (from nonspecific sources) as a function of prior VD learning of the same pairs. In other words, only Spear, et al., who used low frequency words, found that a C-D transfer list was learned with more difficulty than an A-B list. However, Battig, et al. used a mixed list procedure with lists of nonsense syllables; their findings, therefore, may have more limited generality.

The present study also examined the transfer effects from prior INC associative learning on a second, noncorresponding list. The use of highly meaningful words maximized INC associative learning while minimizing the positive component of response learning. Moreover, a determination of possible differences between <u>what</u> is learned under INC and INT associative learning conditions was made possible by including appropriate INT comparison groups learning first list INT associations via the conventional PA procedure. An advantage in using PA and VD acquisition tasks is that both require the same overt behaviors (i.e. pronunciation of the R or response term), thus allowing a comparison of INT and INC groups given the same instructions regarding the performance of INT behaviors.

A Proposed Paradigm for Studying Incidental Learning

The proposed paradigm obviates the notion of distinct (INC versus INT) types of learning. It is hoped that this model allows a logical basis for investigating qualitative differences between INC and INT conditions. Although a relevant dimension to the study of INC learning, the difference between Type I and Type II research designs is not emphasized in favor of highlighting a heretofore neglected commonality. Thus, in either the Type I or II design, the S is given instructions to perform INT behavior.

The most widely cited theoretical account of the effects of instructions is that they control the activation of differential responding. Another theory holds that instructions determine the type of "strategy" or "plan" Ss use in processing stimulus information. Either theory is interpreted to mean that instructions control the type and degree of "attention" to stimulus information (Schneider and Kintz, 1967) so that a choice between them cannot be based on empirical data (Dornbush and Winnick, 1967). Since "attention" may refer to diverse processes (Ryan, 1970), the explanation that instructions control attentions raises many important questions but does not account for the effects of INC and INT learning conditions.

What is the function of instructions? Instructions refer to either an independent or dependent variable (Sutcliffe, 1972). In referring to an independent variable, instructions inform the S to activate specific processes, e.g., choose the underlined item and recall the response term. In this way instructions allow E to assume he is manipulating the independent variable selected for investigation. In referring to a dependent variable, instructions inform the S what behaviors to perform for E to record, e.g., pronounce out loud the R, or response, term. The E can often observe the effectiveness of instructions in controlling a dependent variable but cannot observe variations in S's control of an independent variable ("choice" and "recall" processes). The study of INC learning may be regarded, therefore, as research into how well E's instructions referring to dependent variables (Type I) or to dependent and independent variables (Type II) are effective in regulating the S's processing activity. This is the same as Postman's (1971) view that INC learning is "optional" but INT learning is "prescribed." Accordingly, INC learning conditions are also suited for the study of selectivity in learning (Plenderlith and Postman, 1957).

An INC paradigm may be characterized as a transfer situation in which (a) a (prescribed) INT task is performed after performing (b) a prior (prescribed) INT task but (c) without information concerning a relationship between the two tasks during at least the first task. That is, despite its name, an INC paradigm involves INT behaviors throughout both tasks. The critical variable in most current examples of this paradigm of INC learning is information concerning a relationship between the tasks. Researchers implicity assume that if discovery of a relationship occurs during the first task, an INT rather than INC paradigm obtains. That is, data from Ss in an INC group are discarded if Ss report that they discovered the purpose of an orienting task, expected a retention task, or intended to learn the INC material.

A unique characteristic of the INC paradigm is that instructions prior to the second task are necessary since a change in S's behavior (dependent variable) is thereby specified. Although necessary in order to inform Ss what INT behaviors to perform, instructions prior to the second task in some cases specify behavioral changes so slight that they are not also accompanied by changes in Ss' implicit activity (independent variables). For example, when the second task consists of a recognition test of retention, either no difference between INC and INT groups or superior INC retention are common findings (Dixon and Moulton, 1967; Dormbush and Winnick, 1967; Eagle and Leiter, 1964; Estes and DaPolito, 1967; Neiberg, Morgan, and Levine, 1969). Eagle and Leiter's (1964) explanation of this effect is that although not suited for preparing Ss for a recall task, INC instructions do enable Ss to scan a larger range of items during acquisition and this activity is most facilitative for performance on a recognition task. That is, the implicit processing activities during INC acquisition and later recognition are similar despite the minor changes in Ss' overt, INT behaviors. Consequently, instructions prior to the second task in an INC paradigm are not "informative" to the extent that the Ss own implicit behaviors may provide a basis of "informing" Ss of a relationship between tasks. On the other hand, the INT paradigm obtains when instructions prior to the second task are not necessary because S is informed beforehand or because the Ss own behavior is implicity informative of a task relationship.

In transfer studies using two successive INT PA lists, the INT paradigm obtains and instructions prior to the second list are often not mentioned. For example, in learning two PA lists forming an A-B, A-Br transfer relationship, the INT behaviors and implicit memory activities are identical even though specific stimulus information differs. However, even in the INT paradigm in which instructions are not necessary since the S's own behavior is informative of task relationships, further information concerning the specific stimulus content of the second task may be effective in changing S's implicit processing activity. For example, in a PA transfer situation involving two lists forming an A-B, A-Br relationship, the effect of specific instructions given prior to List 2 (viz., informing S of the associative relationship between Lists 1 and 2) could be examined. Instructions like this may reduce the level of interference by providing a basis for "list differentiation" (Underwood, 1945). That is, "list differentiation" may be activated by instructions so that early in second list practice Ss discriminate the entire set of first list associations from those of the second list. The positive influence of "list differentiation" at transfer is generally more likely with increasing levels of first list learning (Martin, 1965). However, the A-B, A-Br paradigm involves the same stimuli and responses in both lists so that the opportunity for differentiation would be expected to develop slowly (Postman, 1962).

The INC paradigm of the present study employs VD first lists learned to mastery followed by instructions for a second, PA task. The INT paradigm, involving the same word lists as in the INC paradigm, consists of a PA task followed by a second PA task. In both paradigms, the degree of List 1 associative learning is made comparable so the differences in List 2 learning would result from possible qualitative differences between what is learned in INC and INC conditions. In one INT group the criterion of List 1 learning was controlled by a yoking procedure (Yoked-PA group). An additional VD group (Control-VD) was used in which each S was given an AM task immediately after VD learning in order to provide a measure yielding the largest estimate of INC associative learning. The AM measure of associative learning was unconfounded, that is, by limited W or R item availability as would occur, for example, on an MFR task. The number of correct associations given on the AM task served as the acquisition criterion for correct responding in yoking a given S in the Yoked-PA group. By use of this yoking procedure, it was possible to compare INT transfer performance on an A-Br list involving interference from prior INT and INC associations of equivalent strength.

Second list performance is influenced by nonspecific (warm-up and learning-to-learn) and specific (item and associative learning) sources of transfer. In an INT paradigm, nonspecific sources are expected to be facilitative since both tasks require identical explicit or implicit behaviors. Performance continues to improve while practicing the same behaviors as a result of warm-up and learning-to-learn. Increasing proficiency in the performance of any INT behavior is partly accounted for by Kimble and Perlmuter's (1970) theory of behavioral automaticity. Accordingly, as INT behavior is repeatedly practiced it becomes automatic insofar as it moves toward completion with increasing rigidity. Behavioral automaticity is also accompanied by a reduced level of attention to the S's own behavior. Although tentative, this theory of behavioral automaticity predicts that automatic INT behavior is performed "unintentionally" or, that is, without S attending to his own behavior. While performing automatic behavior the S can thereby perform more efficiently by directing attention to task stimuli. The notion of automaticity makes no assumption concerning the cause of attention but rather the object of attention. The influence of behavioral automaticity may be regarded as one of several variables responsible for the development of a "set" to learn (Postman and Schwartz, 1964), along with, for example, increased familiarity with the experimental setting and postural adjustments.

To the extent that automaticity is a component of learning "set", there exists a basis for predicting that the INC paradigm can be expected to show detremental effects from this nonspecific transfer component. If the INC paradigm is conceived as two tasks requiring different INT behaviors, then the automaticity from the first task is disrupted by the "new" behavioral requirements of the second. That is, Kimble and Perlmuter's theory includes a hypothesis, supported only by common observation, that automatic behavior is disrupted if attention to the S's own behavior is renewed. They also suggested that disrupted automaticity results in "diffuse" (e.g. irrelevant) responding. An extrapolated hypothesis is tentatively advanced predicting negative nonspecific transfer effects in the INC paradigm of the present study. Thus, when Ss are transferred from a VD to a PA task they attend to (a) the "new" implicit activity of recalling the appropriate B item and (b) the "old" behavior of pronouncing an item during the anticipation interval. It is apparent that the "new" task requirement (i.e., "recall" of B items as opposed to their prior "recognition") calls attention to the S's implicit activity in recall. Since "new" implicit behaviors are required, automaticity is disrupted and should result in "diffuse" responding. To the extent that attention directed toward the "new" implicit behavior generalize to "old" pronunciation behavior, the resulting disruption of automaticity should be reflected by intrusion errors, i.e., the occurrence of a pronounced response given incorrectly upon presentation of a given List 2 A item.

With regard to specific transfer, it should be noted that the present study provides a framework for studying possible qualitative differences between INC and INT acquisition groups. List 2 performance is measured by several dependent variables believed to reflect various aspects of learning or performance. Insofar as INC and INT instructions lead Ss to use different processing activities, the resulting differences in implicit behaviors should be revealed by comparisons between the INC and INT groups on the A-Br list involving specific transfer components. Eagle and Leiter's (earlier mentioned) explanation of increased recognition under INC conditions, relative to an INT group, implies that Ss in an INC group perform implicit scanning activity during acquisition that is qualitatively different from the rehearsals of INT Ss. Others have found generally that when the semantic or meaningfulness property of to-be-recalled verbal items is emphasized by INC instructions, INC retention approximates that of an INT group (Hyde and Jenkins, 1969; Postman, Adams, and Phillips, 1955; Wicker and Bernstein, 1969). It seems to follow that implicit associative responses are somewhat less readily activated under INC conditions requiring only rote responding (Wallace and Calderone, 1969). Frequency theory clearly predicts that the VD acquisition task does not require a semantic or associative response during acquisition of pairs of unrelated words. Thus, the semantic property of the INC associations developed during VD learning is not expected to be pronounced and it is therefore possible that they are not readily activated as a competing source of interference during practice on an A-Br transfer list. However, instructions prior to List 2 informing Ss of the specific relationship between the pairs of both lists may be expected to form an implicit behavioral relationship between the lists that would otherwise remain unrelated.

On the other hand, to the extent that a comparable level of INT associative learning represents a qualitatively distinct learning with salient meaningfulness properties, the interference on an INT A-Br list should be greater than on an INC A-Br list. If differentiation of associations can occur, then specific instructions informing Ss of the relationship between Lists 1 and 2 may enhance list differentiation. This prediction is based on the assumption that distinctiveness of meaning rather than the degree of first list learning, allows list differentiation. This assumption, moreover, is supported by one study showing no empirical evidence of a covariation between differentiation and degree of List 1 learning for digit-adjective or adjective-digit pairs (James and Greeno, 1970). Thus, with digit stimuli or responses, overtraining on List 1 did not yield increasing negative transfer on an A-Br list. However, with adjective pairs, overtraining yielded increasing negative transfer. That differentiation occurred only for pairs having a digit item was explained as the result of multiple encodings for digits. Digits were assumed to be less meaningful than nonsense syllables. This explanation was in accord with Martin's (1968) notion that item meaningfulness is related inversely to the number of possible encodings of an item. It is not the instability of encoding variability but rather the opportunity to differentiate distinct encodings that explains list differentiation of digit pairs in learning an A-Br list. This interpretation is relevant to the present hypothesis in that James and Greeno have shown that encoded distinctiveness is an important dimension to list differentiation of INT association in the A-Br paradigm.

If nonspecific transfer differences are present between INC and INT groups, comparisons between these groups on an A-Br list must be interpreted accordingly. The extent of influence of nonspecific effects may be assessed by the performance of groups given a second, PA task as a C-D nonspecific control list. To provide additional data concerning the nature of interference effects, all groups are given an unpaced, counterbalanced MFR task in which one-half of the Ss in each transfer group were instructed to recall the first list R (or B) items to presented W (or A) items followed by recall of W (or A) items to presented R (or B) items. The MFR task, given immediately after List 2 mastery, was counterbalanced in that the remaining half of the Ss were given the reverse sequence. The W-R (and R-W) recall for Ss given a C-D second list provides a baseline for determining the level of W and R item availability following List 2 practice in the absence of associative interference. Differential retroactive inhibition (RI) is also expected to occur as a function of an INC versus INT difference in the level of associative interference in the A-Br condition. However, RI is also a function of variables other than interference (Postman and Underwood, 1973). A finding of considerable heuristic value would occur if the MFR data and List 2 performance measures do not mutually corroborate the inference of an INC versus INT interference difference. If these measures do not converge in suggesting the same inference, that is, an INC versus INT difference in the extent of dependency between retroaction and interference may exist.

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APPENDIX B

STATISTICAL ANALYSES

Table 1

Summary Table for the 2 Paradigms X 2 Instructions Analysis of Variance of the Results from Association Matching after List 1 in the Control-VD Condition (N = 8 per treatment combination)

Source	Sum of Squares	d.f.	Mean Square	F
Paradigm (P)	1.12	1	1.12	< 1
Instruction (I)	1.12	1	1.12	< 1
P X I	1.13	1	1.13	< 1
Error	328.51	28	11.73	

Table 2

Means and Standard Deviations for Correct Associative Matchings after List 1 in the Control-VD Group

	Paradigm			
	C-D		A-Br	
Instructions	$\bar{x}$	SD	$\bar{x}$	SD
I	6.62	2.50	6.62	4.74
NI	6.62	2.50	5.88	3.44

Table 3

Summary Table for the 2 Acquisition Groups (Yoked-PA and Mastery-PA) X 2 Paradigms X 2 Instructions Analysis of Variance of Trials of List 1 Practice (N = 8 per treatment combination)

Source	Sum of Squares	d.f.	Mean Square	F
Paradigm (P)	3.52	1	3.52	< 1
Instruction (I)	21.39	1	21.39	1.74
Acquisition Group (A)	356.27	1	356.27	29.03**
A X P	13.13	1	13.13	1.07
A X I	2.64	1	2.64	< 1
P X I	4.51	1	4.51	< 1
A X P X I	17.03	1	17.03	1.39
Error	687.12	56	12.27	

**$p < .001$

Table 4

Summary Table for the 2 Acquisition Groups (VD and Control-VD) X 2 Paradigms X 2 Instructions Analysis of Variance of Trials of List 1 Practice (N = 8 per treatment combination)

Source	Sum of Square	d.f.	Mean Square	F
Paradigm (P)	.28	1	.28	< 1
Instruction (I)	1.26	1	1.26	< 1
Acquisition Groups (A)	.76	1	.76	< 1
A X P	34.62	1	34.62	2.70
A X I	.02	1	.02	< 1
P X I	15.12	1	15.12	1.18
A X P X I	1.79	1	1.79	< 1
Error	717.62	56	12.81	

Table 5

Means and Standard Deviation for List 1 Trials to

Criterion for Selected Groups

	Intentional (PA) Groups		Incidental (VD) Groups	
	Yoked	Mastery	VD	Control-VD
$\bar{x}$	6.06	10.78	7.62	7.84
SD	3.49	3.46	3.24	3.79

Table 6

Summary Table for the 3 Acquisition Groups (VD, Control-VD, Yoked-PA X 2 Paradigms X 2 Instructions Analysis of Variance of Trials to List 2 Criterion (N = 8 per treatment combination)

Source	Sum of Squares	d.f.	Mean Square	F
Paradigm (P)	304.59	1	304.59	13.60**
Instruction (I)	15.84	1	15.84	< 1
Acquisition Group (A)	2.02	2	1.01	< 1
A X P	67.94	2	33.97	1.52
A X I	17.07	2	8.53	< 1
P X I	21.10	1	21.10	< 1
A X P X I	51.06	2	25.53	2.27
Error	1,880.38	84	22.39	

**$p < .001$

Table 7

Summary Table for the 2 (Paradigms) X 2 (Instructions) Analysis of Variance of Trials to List 2 Criterion in Mastery-PA Group

Source	Sum of Squares	d.f.	Mean Square	F
Paradigm (P)	569.53	1	569.53	35.64**
Instruction (I)	57.78	1	57.78	3.62
P X I	9.04		9.04	< 1
Error	447.38	28	15.98	

$^{**}p < .001$

Table 8

Means and Standard Deviation for Trials to List 2 Acquisition for Each Paradigm and Acquisition Group

	Paradigms			
Acquisition Groups	C-D		A-Br	
	$\bar{x}$	SD	$\bar{x}$	SD
VD	11.13	5.17	13.63	4.99
Control-VD	11.00	3.74	13.25	3.77
Yoked-PA	9.50	3.97	15.44	6.00
Mastery-PA	7.18	2.32	15.62	5.38

Table 9

Summary Table for the 4 (Acquisition Groups) X 2 (Paradigms) X 2 (Instructions) Analysis of Variance of the Average Trial on which a Response is First Given (FG) whether Correct or Not on List 2 Practice

Source	Sum of Squares	d.f.	Mean Square	F
Paradigm (P)	26.69	1	26.69	13.76**
Instruction (I)	6.83	1	6.83	3.52
Acquisition Group (A)	6.83	3	2.13	1.10
P X I	0.0	1	0.0	< 1
P X A	13.21	3	4.40	2.27
I X A	7.94	3	2.65	1.36
P X I X A	4.89	3	1.63	< 1
Error	217.28	112	1.94	

**$p < .001$

Table 10

Means and Standard Deviations for the Average Trials of the First Given Response as a Function of Paradigms and Acquisition Groups

	Paradigms			
	C-D		A-Br	
	$\bar{x}$	SD	$\bar{x}$	SD
Overall	4.05	1.27	4.96	1.57
VD	4.60	1.37	4.96	.99
Control-VD	4.22	1.45	4.71	.92
Yoked-PA	3.91	1.16	5.59	2.46
Mastery-PA	3.47	.83	4.85	1.38

Table 11

Summary Table for the 4 Acquisition Groups X 2 Paradigms X 2 Instructions

Analysis of Variance of Correct Responses

on Trials 1-5 of List 2 Practice

Source	Sum of Squares	d.f.	Mean Square	F
Paradigm (P)	2,080.12	1	2,080.12	27.53**
Instruction (I)	364.50	1	364.50	4.82*
Acquisition Group (A)	71.12	3	23.71	< 1
P X I	112.50	1	112.50	1.49
P X A	203.13	3	67.71	< 1
I X A	167.25	3	55.74	< 1
P X I X A	76.68	3	25.60	< 1
Error	8,464.51	112	75.57	

*$p < .05$

**$p < .001$

Table 12

Means and Standard Deviations for Correct Responses on Trials 1-5 of

List 2 Practice for Significantly Different Conditions

	Paradigm		Instructions	
	C-D	A-Br	I	NI
$\bar{x}$	24.06	16.00	21.72	18.34
SD	9.20	8.10	9.29	9.54

Table 13

Summary Table for the 3 Acquisition Groups (VD, Control-VD, Yoked-PA)

X 2 Paradigms X 2 Instructions Analysis of Variance of

Trials to the Criterion of 6 out of 12

Correct Responses on List 2

Source	Sum of Squares	d.f.	Mean Square	F
Acquisition Group (A)	4.52	2	2.26	< 1
Paradigm (P)	49.59	1	49.59	7.20*
Instruction (I)	8.76	1	8.76	1.27
A X P	26.69	2	13.34	1.94
A X I	19.77	2	9.88	1.43
P X I	7.59	1	7.59	< 1
A X I X P	17.70	2	8.85	1.28
Error	578.62	84	6.89	

*$p < .01$

Table 14

Means and Standard Deviations for Trials to the Criterion of 6 out of 12 Correct Responses on a Particular Trial on List 2

	Acquisition Groups											
	VD				Control-VD				Yoked-PA			
Instructions	C-D		A-Br		C-D		A-Br		C-D		A-Br	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
I	3.38	1.18	4.63	3.38	4.25	1.39	4.38	1.18	2.88	.83	7.50	5.56
NI	5.38	3.34	6.25	3.83	4.38	2.56	5.00	1.31	4.25	1.91	5.38	2.39

Table 15

Summary Table for the 3 Acquisition Groups (VD, Control-VD, Yoked-PA) X 2 Instructions Analysis of Variance of the Percentage of Transfer for Rate of Correct Responses Early in Transfer

Source	Sum of Squares	d.f.	Mean Square	F
Acquisition Groups A	756.45	2	378.22	2.76
Instructions (I)	17.86	1	17.86	< 1
A X I	540.89	2	270.45	1.97
Error	5,752.01	42	136.95	

Table 16

Means and Standard Deviations for Percentage of Transfer Measures for Rate of Correct Responses Early in Transfer

	VD	Control-VD	Yoked-PA
$\overline{x}$	-.93%	-6.18%	-10.65%
AD	10.68	8.14	15.43

Table 17

Summary Table for the 3 Acquisition Groups (VD, Control-VD, Yoked-PA) X 2 Instructions Analysis of Variance of the Percentage of Transfer for Omission Rate Early in Transfer

Source	Sum of Squares	d.f.	Mean Square	F
Acquisition Group (A)	2,651.21	2	1,325.60	4.19*
Instruction (I)	572.77	1	572.77	1.81
A X I	1,146.41	2	573.21	1.81
Error	13,278.82	42	316.16	

*$p < .05$

Table 18

Means and Standard Deviations for Percentage of Transfer Measures for Rate of Omission Errors Early in Transfer

	Acquisition Groups		
	VD	Control-VD	Yoked-PA
$\bar{x}$	+2.92%	-5.74%	-15.28%
SD	24.13	9.27	18.19

Table 19

Summary Table for the 3 Acquisition Groups (VD, Control-VD, Yoked-PA) X 2 Paradigms X 2 Instructions X 2 Orders of Administration x 2 Directions of Recall Analysis of Variance of the Number of Correctly Recalled Associations on the MFR Task

Source	Sum of Squares	d.f.	Mean Square	F
Between-Subjects	1,583.33	95		
Acquisition Group (A)	306.38	2	153.19	15.12**
Instruction (I)	16.92	1	16.92	
Paradigm (P)	322.92	1	322.92	31.88**
Order (O)	2.75	1	2.75	< 1
A I	16.62	2	8.31	< 1
A P	43.88	2	21.94	2.17
A O	3.04	2	1.52	< 1
I P	12.51	1	12.51	1.23
I O	18.13	1	18.13	1.78
P O	2.75	1	2.75	< 1
A I P	40.04	2	20.02	1.97
A I O	12.57	2	6.28	< 1
A P O	6.56	2	3.28	< 1
B P O	29.30	1	29.30	2.89
A I P O	19.59	2	9.79	< 1
Error (Ss within groups)	729.37	72	10.13	

**$p < .001$

Table 19 (continued)

Source	Sum of Squares	d.f.	Mean Square	F
Within-Subjects	790.50	96		
Direction (D)	10.54	1	10.54	1.00
AD	.88	2	.44	< 1
ID	.64	1	.64	< 1
PD	.14	1	.14	< 1
OD	5.66	1	5.66	< 1
AID	.76	2	.38	< 1
APD	.28	2	.14	< 1
AOD	4.63	2	2.32	< 1
IPD	.62	1	.62	< 1
IOD	.64	1	.64	< 1
POD	.44	1	.44	< 1
AIPD	2.33	2	1.17	< 1
AIOD	.06	2	.03	< 1
APOD	5.37	2	2.69	< 1
IPOD	.61	1	.61	< 1
AIPOD	1.02	2	.51	< 1
Error (D X Ss within groups)	755.88	72		

Table 20

Means and Standard Deviations for Combined Forward and Backward List 1

MFR as a Function of Acquisition Condition

	Acquisition Group			
	VD	Control-VD	Yoked-PA	Mastery-PA
$\bar{x}$	3.28	4.97	9.28	16.22
SD	3.99	5.15	6.32	6.59

Table 21

Means and Standard Deviations for Combined Forward and Backward List 1 MFR and as a Function of Transfer Paradigm and within Acquisition Groups

	Paradigms			
	C-D		A-Br	
	$\overline{x}$	SD	$\overline{x}$	SD
Overall	11.50	7.83	5.38	5.68
VD	4.94	4.67	1.63	2.31
Control-VD	7.19	5.53	2.75	3.72
Yoked-PA	13.19	5.43	5.38	4.51
Mastery-PA	20.69	4.09	11.75	5.51

APPENDIX C

INSTRUCTIONS

List 1 Instructions

VD Acquisition. I am going to present to you a list of paired words that will be shown in the window of the memory drum in front of you. You will see the pairs in two second intervals. First, a pair will appear like this for two seconds (show "APPLE HOUSE" example); then, the same pair will appear with one of the words underlined like this (show "APPLE HOUSE" example). The underlined word of each pair was selected arbitrarily. Your task is to learn which word of the pair is underlined.

There are 12 pairs in the list and each run through the whole list is called a trial. The first time through the whole list you should study the pairs while trying to remember which word is underlined for each pair. After the first study trial you should then pronounce outloud the word you remember to be the underlined word when you see a pair presented like this (show "APPLE HOUSE" example) without underlining.

These stars (point to the asterisks appearing in the window of the memory drum) tell you when you have gone through the whole list of 12 pairs and are ready to begin another trial. The list will be shown for as many times as you need. I'll stop the drum when you are finished.

PA Acquisition. I am going to present to you a list of paired words that will be shown in the window of the memory drum in front of you. You will see the pairs in two second intervals. First, one word will appear alone like this (show "APPLE" example); then, the same word will appear paired with another word like this (show "APPLE HOUSE" example). Your task is to learn the paired word that goes with each single word.

There are 12 pairs in the list and each run through the whole list is called a trial. The first time through the whole list you should study the pairs while trying to remember the paired word for each pair. After the first study trial you should then pronounce out loud the word you remember to be paired each time you see a single word like this (show "APPLE" example).

These stars (point to the asterisks appearing in the window of the memory drum) tell you when you have gone through the whole list of 12 pairs and are ready to begin another trial. The list will be shown for as many trials as you need. I'll stop the drum when you are finished.

List 2 Instructions

List-2 in the INC paradigm. Now I would like you to learn a second list. This list is presented differently. First, one word will appear like this (show "APPLE" example); then, the same word will appear paired with another word like this (show "APPLE HOUSE" example). Your task is to learn the paired word so that you can pronounce it out loud whenever you see the one word alone like this (show "APPLE" example).

The first time through the list you can study the pairs trying to remember each paired word. After the first trial be sure to pronounce out loud the paired word that goes with each single word. You may guess, however, any time you wish. I'll stop the drum when you are finished.

Insert under I (Specific Instructions) A-Br. All the words on this list are the same as the words on the list you just learned. However, the words are going to be paired differently now. For the C-D groups, this should read: All the words on this list are entirely new.

List-2 in the INT paradigm. Now I would like you to learn a second list. This list is presented in the same manner as the first one. The first time through the list you can study the pairs trying to remember each paired word. You may guess, however, any time you wish. I'll stop the drum when you are finished.

Insert under I (Specific Instructions). This is the same as above.

Instructions for Retention Tasks

Associative Matching after List-1: Control-VD. (Hand the S the appropriate AM sheet.) Now I would like you to recall as many pairs as you can remember from the list you just learned. Place the number here (point to the blank to the left of the W (or A) item) of the item on the right that went with the item on the left.

Retention Tests after List-2: All Groups. (Hand first S either a W-R (A-B) or R-W (B-A) recall sheet, whichever is appropriate for Order-1 or Order-2, respectively. Read instructions. After S indicates he is finished with his first recall task, he is then handed the other, (R-W (B-A) or W-R (A-B), recall sheet followed by a reading of the second instructions.)

W-R (or A-B). Please write down as many words as you can remember from the first list you learned that were underlined (paired) words for each of these.

R-W (or B-A). Please write down as many words as you can remember from the first list you learned that went with each of these underlined (paired) words.

APPENDIX D

LISTS

List A

A-B (List 2)		A-Br (List 1)	
Long	Bitter	Long	Often
High	Younger	High	Because
Always	Because	Always	Bitter
Dark	Often	Dark	Younger
Queen	Color	Queen	Author
Carpet	Author	Carpet	Morning
Needle	Morning	Needle	Color
Return	Fruit	Return	Lamp
Anger	Lamp	Anger	Dream
Square	Dream	Square	Fruit
Scissors	Eagle	Scissors	People
Doors	People	Doors	Eagle

List B

A-B (List 2)		A-Br (List 1)	
Beautiful	Heavy	Beautiful	Happy
Hard	Slow	Hard	White
Cold	Happy	Cold	Heavy
Hungry	White	Hungry	Slow
Baby	Figure	Baby	Money
Spider	Manner	Spider	Figure
Ocean	Money	Ocean	Manner
Reply	Shoes	Reply	Soldier
Danger	Table	Danger	Shoes
Health	Soldier	Health	Table
Letter	Hammer	Letter	River
Sugar	River	Sugar	Hammer

APPENDIX E

RETENTION TASKS

Associative Matching Task

List A, A-Br
List B, C-D

______	Carpet	1.	Lamp
______	Return	2.	People
______	Doors	3.	Because
______	High	4.	Dream
______	Queen	5.	Eagle
______	Long	6.	Bitter
______	Always	7.	Morning
______	Anger	8.	Author
______	Square	9.	Younger
______	Needle	10.	Color
______	Dark	11.	Fruit
______	Scissors	12.	Often

List B, A-Br
List A, C-D

______	Spider	1.	River
______	Health	2.	White
______	Cold	3.	Slow
______	Sugar	4.	Happy
______	Reply	5.	Heavy
______	Ocean	6.	Money
______	Danger	7.	Figure
______	Letter	8.	Shoes
______	Hard	9.	Manner
______	Beautiful	10.	Soldier
______	Baby	11.	Table
______	Hungry	12.	Hammer

Modified Free Recall Task

List A, A-Br List B, C-D		List B, A-Br List A, C-D	
A-B	B-A	A-B	B-A
(W-R)	(R-W)	(W-R)	(R-W)
Carpet	Lamp	Spider	River
Return	People	Health	White
Doors	Because	Cold	Slow
High	Dream	Sugar	Happy
Queen	Eagle	Reply	Heavy
Long	Bitter	Ocean	Money
Always	Morning	Danger	Figure
Anger	Author	Letter	Shoes
Square	Younger	Hard	Manner
Needle	Color	Beautiful	Soldier
Dark	Fruit	Baby	Table
Scissors	Often	Hungry	Hammer