Correction procedures in A-Br transfer: Error elimination?*

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Feedback in A-Br transfer was varied, with Ss given specific correction (SC) on error trials by getting the correct pairing or given outcome correction (OC) on error trials by being given outcome information only ("right"/"wrong"). Error elimination was considered more likely with OC than with SC. Relative to A-B, C-D, there was more negative transfer for the Ss learning A-B, A-Br with OC feedback on both lists than was the case for Ss given SC feedback. This difference presumably resulted because the repairing made an elimination correct, and this interference combined with associative interference to increase negative transfer. Negative transfer was reduced when the stimuli allowed a recoding of the functional stimulus, i.e., low formal similarity of CVCs, independent of the feedback procedure.

It is possible to use at least two types of feedback on error trials in paired-associate (PA) learning: specific correction (SC), by showing the correct pairing, or merely outcome correction (OC) with just the outcome of "wrong." These have been compared (e.g., Bower, 1962) with the OC procedure usually leading to slower learning, though not always (Rimm & Biggs, 1969). One interpretation of this is suggested by the axioms of a mathematical model proposed by Nahinsky (e.g., 1967). The model assumes that errors are eliminated in an all-or-none fashion on error trials, while correct responses are associated in an all-or-none fashion on correct anticipation trials. It has been found (Nahinsky & Mueller, 1968) that the error elimination model provided a good fit to data collected with the OC procedure when the number of response alternatives was greater than two. Since two alternatives with OC is actually equivalent to SC feedback, this suggests that the OC procedure may involve more error elimination than the SC method. Error elimination in OC has also been considered by, e.g., Mosberg (1970) and O'Hara & Erickson (1969), but they made no statement about elimination in SC relative to OC.

The possibility that elimination of errors may be more of a factor with OC also seems intuitively reasonable. The S only knows what was wrong on error trials with OC feedback, while showing the correct pairing with SC feedback shifts the emphasis from the response actually made. However, most approaches to explaining feedback effects (e.g., Buchwald, 1969) have not specifically compared SC with OC but have instead considered variations in designating outcomes.

At the empirical level, error elimination is a difficult process to identify, since an item may fail to be used as a response for reasons other than elimination, e.g., availability and accessibility. However, to the extent that the preceding interpretations are correct, the repairing transfer paradigms may offer a test and further the explanation of such transfer at the same time. Presumably, all items other than the correct response will be classified as errors when criterion is attained, if not during the course of acquisition. Consequently, the repairing in A-Br transfer will essentially make correct an item which had been eliminated as a possible response, and this should combine with the forward and backward associative interference (Martin, 1965, 1968) to hinder learning in the second list. While the relative contributions are difficult to specify, certain task parameters might influence the magnitude of the elimination process, so that, for example, more negative transfer would be expected in the A-Br paradigm with OC feedback than with SC feedback.

As a secondary problem, the present experiment used the degree of formal similarity to influence the opportunity to reselect a functional stimulus. It would be expected that both sources of interference would be overcome by a "recoding" of the functional stimulus during A-Br learning. This has been shown with stimuli of different meaningfulness (Martin, 1968) in A-Br transfer, and such a process also seems to reduce retroactive inhibition (e.g., Bryk & Kausler, 1966; Weaver, 1969).

DESIGN AND SUBJECTS

The 96 Ss served as part of course requirements in introductory psychology, and none had previously participated in verbal learning studies. The overall design was a 2 by 2 by 2 by 3 mixed factorial, with first list correction (SC, OC), second list correction (SC, OC), and paradigm (A-Br, C-D) varying between Ss, and the degree of stimulus similarity (high, medium, low) as a within-S factor.

MATERIALS

Two nine-pair PA lists were used, with digits as responses and low association value CVCs (15%-25%; Archer, 1960) as the stimuli. In each of nine A and C terms (stimuli), there were three with no letter overlap with any other CVC, three which shared the same vowel among themselves, and three which shared the same vowel plus the first or last letter with each other, thus providing three levels of similarity within each set of A and C terms. These sets were not completely dissimilar due to the size of the letter pool, but no vowel was a repeater in both sets. That is, if Y and U were used more than once in Set A, other vowels were repeated in Set C.

The B and D terms were the numbers 1-9 and 10-18, respectively. Since the Ss were informed of the response pool, response learning was minimized, the C-D paradigm seemed appropriate as a control, although Martin (1968) has noted that the C-B paradigm may be used if response learning is involved. When the A-B list was repaired, no restriction was made on maintaining a response from the same level of similarity, as undesired "rules of response restriction" would have resulted.

PROCEDURE

Each S learned two PA lists corresponding to either the A-B, A-Br or the A-B, C-D paradigm, with the same final list. On the first list half of the Ss were specifically corrected (SC), i.e., shown the correct response during feedback, while the others received only outcome feedback (OC), i.e., told only "right" or "wrong." In the SC condition the stimulus appeared for 2 sec, with the S responding, then the correct pairing appeared for 2 sec. In the OC condition the anticipation was the same, but the stimulus simply reappeared alone for 2 sec, with the E then saying "right" or "wrong," thus equalizing delay of feedback. These were further divided factorially for second-list correction, with half of the SC group continuing with SC feedback on the second list (SC-SC), but the other half getting OC on the second list (SC-OC). The Ss with OC on the first list were likewise divided, with OC-SC and OC-OC groups resulting.

Learning was by the anticipation method to a criterion of two consecutive errorless trials, using a 2:2-sec rate and a 4-sec intertrial interval. Three different presentation

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Table 1
Difference Between A-Br and C-D Transfer Scores by Correction Procedure and Similarity Level

Similarity	Feedback Conditions SC-SC	SC-OC	OC-SC	OC-OC
Low	−2.1	−4.1	−13.5	−21.9
Medium	−26.9	−16.9	−16.6	−22.2
High	−24.2	−17.3	−21.7	−34.9

orders were used in each list. Following the first list, and again after the second list, the responses were read aloud one at a time by the E, and the S was allowed 4 sec to spell the trigram used as the stimulus.

RESULTS

First List

Analysis of variance for errors on the first list revealed that the SC feedback procedure was superior to OC [$F(1,80) = 54.00$, $p < .001$]. The similarity main effect was also significant [$F(2,160) = 24.49$, $p < .001$], with highly similar stimuli producing the most errors. The second-list correction procedure and paradigm factors were also included in the analysis as dummy factors, but these produced no effects [$Fs(1,80) < 1$ and 2.67], indicating comparability of the subgroups and two first lists, so that the transfer effects should be primarily due to the treatments.

Transfer: Feedback

Each S's first- and second-list errors per similarity level were substituted in the (Task 1 — Task 2)/(Task 1 + Task 2) formula to determine percentage transfer scores, and the average list scores are shown in Fig. 1 for each feedback condition by paradigm. The A-Br arrangement produced negative transfer in all feedback conditions [$F(1,80) = 23.22$, $p < .001$], as indicated by the slope of the lines. Both first-list and second-list feedback conditions produced reliable effects [$Fs(1,80) = 91.31$ and 91.43, respectively, $ps < .001$], with a significant interaction [$Fs(1,80) = 9.94$, $p < .005$], but with no interactions with paradigm. A separate analysis of the apparent reversal for OC-OC and SC-SC in Fig. 1 indicated that it was nonsignificant.

Transfer: Similarity

The transfer scores by similarity level, using errors for the three items of a given type, are shown in Table 1. Each entry is the difference between A-Br and C-D percentages for that feedback condition, thus giving transfer relative to C-D. Although the difference scores indicate a general trend toward less negative transfer as similarity of the stimulus term decreases, when transfer relative to a control is considered, this similarity effect did not reach significance [$F(2,160) = 2.30$] in analysis of the transfer scores. In the actual raw error data, the effects of similarity were quite clear for each list [$Fs(2,160) = 24.49$ and 19.86, $ps < .001$].

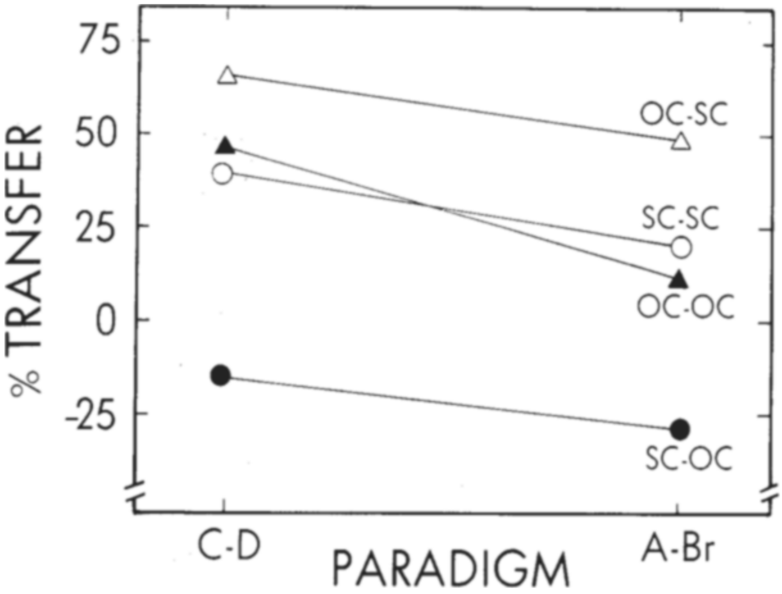

Fig. 1. Percent transfer between first and second lists in each paradigm by feedback conditions.

R-S Recall

It had been anticipated that stimulus recall would provide information about recoding, but this did not prove to be the case. Correction procedure had no effect on the first-list recall ($F < 1$), but similarity was significant [$F(2,160) = 40.04$, $p < .001$], with more recall of low similarity stimuli. Similarity was also effective in the second-list data [$F(2,160) = 105.25$, $p < .001$], with both high and low similarity leading to more stimulus recall than medium similarity. The first-list correction procedure was also effective, with OC on the first list leading to more stimulus recall in the second-list data [$F(1,80) = 3.35$, $p < .10$], although there was no effect of second-list correction procedure and no interaction bewteen first- and second-list procedures ($Fs < 2.11$).

While the preceding R-S analyses were based upon correct recall of the three letters in the proper position, other analyses were considered in the A-Br groups. Since Ss may often use only a single letter in a trigram as the functional stimulus, the number of incomplete recalls with a single letter in the correct position on the first list were considered. These were followed up in the second-list recall, with attention to how many of these were recalled with another part in place of, or in addition to, the old component. There were no effects due to similarity, probably due to the limited number of such items and the reliance upon a fractionation definition of a functional stimulus. To the extent that Ss engage in some transformational encoding of the nominal stimulus, the preceding analysis would not detect recoding, and R-S recall is of only limited value in that case. The presence of a gradient in the similarity data for the magnitude of transfer seems the only good indication of recoding in the present experiment.

DISCUSSION

The correction procedures produced effects consistent with the hypothesis that error elimination combined with associative interference to increase negative transfer (relative to C-D), with OC used instead of SC. While the results are in accord with the expectations, the present case rests upon the assumptions of a model (Nahinsky, 1967) and intuitive appeal. It may be noted that the fit of the model was only relatively in accord with the requirements of the present argument, i.e., the fit was somewhat better for OC than for SC but not good in any absolute sense. This discrepancy is probably attributable to the absence of a memory postulate in the model and the present use of an E-paced presentation instead of self-pacing, which was used in previous tests of the model.

The assumption that OC places more emphasis upon the response actually made on an error trial than does SC feedback is still tenable and receives some support in the interpretation of certain results. The superior performance (Fig. 1) of OC-SC in both paradigms suggests that OC primed the use of the elimination strategy, which could also be used with SC on the second list, whereas in Group SC-OC, the SC feedback first did not involve the acquisition of any strategy that was equally compatible with OC on the second list, as would be expected if the same processes were involved equally in both cases. This is also true when SC-OC is compared with OC-OC or when OC-SC is compared with SC-SC. Since different processes seem to have been involved, and since the transfer effects are in the expected direction, it is proposed that error elimination is one process that is likely to differ, but two alternatives will be noted.

Buchwald's (1969) distinction between the S's memory for the specific response as opposed to his memory for the outcome of that response to the stimulus does not seem to provide as good an explanation of the transfer effects. That is, SC might make the S less likely to forget either of these events, relative to OC, since he sees each on every trial. While this readily accounts for the more rapid acquisition of the first list with SC, it seems to imply that the first-list associations would also be stronger and thus interfere more during second-list learning, which was not the case. Although this distinction may be involved with other variants in designating outcomes, it does not seem predictive here.

Likewise, it is known (Bjork, 1970) that Ss can benefit from instructions to forget specific items. While the link may not be immediately clear and the procedures do differ substantially, elimination may be useful during acquisition, but the S might then instruct himself to forget later. This being the case, there should be little difference between SC and OC, which was clearly not so.

Neither instructions to forget nor the distinction between memory for the response and outcome seem to provide as adequate an explanation for the feedback effects in transfer as does elimination. Other mechanisms may also be involved differentially in the two feedback conditions, e.g., anxiety (Bower, 1962), but, on the basis of the present data, elimination seems the preferred explanation of transfer differences as a function of feedback method, and elimination of errors seems implicated as a mechanism in A-Br transfer, varying as a function of feedback procedure and possibly other secondary variables.

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The probability of probability concept transfer*

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An attempt was made to demonstrate positive transfer of probability concepts from tasks in a mathematics classroom setting to similar tasks presented outside of the mathematics classroom. The results indicated that learning occurred as a result of classroom instruction. However, there was no evidence of transfer of the probability concepts.

Justification for instruction in a curriculum is commonly made on the grounds that there is positive transfer from the instruction to a variety of tasks not included in the instruction. In spite of this claim, the question of whether positive transfer can be demonstrated in various curriculum areas remains largely unexplored.

The purpose of this study is to demonstrate the positive transfer, if any, obtained through instruction in

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