Transfer from serial to paired-associate learning*

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Groups with preliminary free recall were added to an experiment testing the position hypothesis in serial to paired-associate transfer. The Ss with paired-associate lists that had pairings related to the serial list positions did better than all other groups, indicating that such differences are not completely attributable to interference in previous studies.

Transfer from serial learning (SL) to paired-associate learning (PAL) has often been used to test the hypothesis that the functional cue during SL is some symbolic indicant of the position of the item in the SL list (e.g., Mueller, 1970a). For example, given the A-B-C-D sequence as the serial list, a subsequent list with pairs 1-A, 2-B, 3-C, 4-D is learned faster than random pairings such as 3-A, 1-B, 4-C, 2-D. It has been widely observed (e.g., Bewley, 1972; Ebenholtz, 1972; Young, 1968) that the unrelated pairings normally used as a control group do not constitute a truly neutral control condition if the position hypothesis is valid, since the scrambled pairings should produce some interference. Thus the PAL performance for a group with related pairings may be different from that of the unrelated group due to interference as well as facilitation.

At least two approaches seem to be suggested. First, the control Ss might learn a completely unrelated set of words in the SL phase, followed by the "related" PAL task. However, this group would differ from the true related group in terms of degree of response learning at the outset of PAL. Alternatively, the control Ss might learn the same words, but in a preliminary free recall (FR) phase followed by the "related" PAL task. If a few Ss subjectively organize along a numerical dimension in FR, some interference might still be present in the PAL phase, but it should be less than if all Ss were required to use the position dimension. The present experiment included such FR control groups in a test of the position hypothesis. Ebenholtz (1966) has earlier indicated how FR familiarization might serve as a control group in tests of the chaining hypothesis.

An additional problem in interpretation concerns the possibility that Ss respond in a rulelike manner in PAL if the stimulus and response terms covary along separate dimensions (Mueller, 1970b). That is, if the lowest stimulus on some dimension has as its response the lowest item on another dimension, and so forth, Ss seem

to perform better than if the pairings are scrambled. Since the positional indicants constitute a dimension and SL forms an artificial one, perhaps the apparent facilitation with related lists derives to some extent from this phenomenon. Groups were also included to test this possibility.

METHOD

Design and Subjects

The basic experimental design was a 2 by 2 by 2 factorial for type of familiarization (FR, SL), type of stimulus in PAL (number words, "one"- "ten", or months, February-November), and two pairing arrangements (related or unrelated to SL position). Eighty Ss served in partial fulfillment of course requirements in introductory psychology, with six women and four men in each group.

Materials

Ten AA frequency words were used and arranged into two different serial orders for SL, generating two forms for each of the four PAL list types; no order (form) effects resulted, so this factor will not be considered further. Four PAL lists were derived from each order, two with number stimuli and two with months as stimuli. The position-related (PR) list had the word "one" as the stimulus for the response word from the first position in the SL list, with the other stimuli likewise related to the item's position in SL. The position-unrelated (PU) list was the PR list repaired nonsystematically relative to SL.

The month-related (MR) list simply replaced the stimuli, "one" through "ten," in the PR list with the months February through November. Thus a dimension remained among the stimuli, correlated to the dimension formed among the responses by SL, but the stimulus dimension seems unlikely to be that which Ss used during SL, even though rulelike behavior might still result. The sequence February-November was used rather than January-October in order to avoid the possibility of direct mediation from the numbers 1-10. The month-unrelated (MU) list substituted the month stimuli for the number words in the PU list.

Procedure

Each S learned the 10 words in either serial recall or free recall fashion to a criterion of two consecutive errorless trials, with input order being varied across trials with the FR task. The words were presented at a 2-sec rate, with 60 sec for written recall each trial.

The familiarization task was followed by one of the four types of PAL lists. The PAL phase was by the anticipation method at a 2:2-sec rate, to a criterion of two consecutive errorless trials. One familiarization trial was given, but Ss were not informed of the pairing relationships in the PR and MR groups.

RESULTS AND DISCUSSION

Overall, the FR task required more trials to criterion than did SL (8.5 vs 5.4), $F(1.64) = 17.54$, $p < .001$, but no differences were present for the dummy factors of type of stimulus or subsequent pairing arrangements, $F_s(1.64) < 1.83$. The latter results suggest comparability in sampling for these subgroups.

Table 1 presents the error data from PAL; this analysis included position as a repeated-measures factor (as well as the serial-order or form factor). Trials to criterion revealed similar between-group differences, but

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Table 1
Average Errors in Paired-Associate Learning by Group
With Standard Deviations in Parentheses

Type of First Task	Type of Second Task			
	PR	PU	MR	MU
Serial	25.2	72.6	57.4	34.1
Recall	(21.4)	(31.1)	(48.0)	(16.0)
Free	48.2	43.6	45.1	33.6
Recall	(20.8)	(14.9)	(21.9)	(15.7)

Note—*P* and *M* refer to whether the stimulus was a number or a month, and *R* and *U* refer to whether the list pairings were related or unrelated to serial position.

were not amenable to positional analysis, and the errors on the early trials revealed similar effects. The errors in PAL were generally more prevalent for the pairs with stimuli from the middle of the sequence, but no interaction of position with pairing arrangement was obtained for the Ss with SL familiarization, $F < 1$.

The primary result of interest was the triple interaction of Type of Stimulus by Pairing Arrangement, $F(1.64) = 7.24$, $p < .01$. It seemed to indicate several things, supported by the following statements based upon individual comparisons of means. First, the conventional position hypothesis effect was present, i.e., SL-PR better than SL-PU, $p < .01$, but the PR and PU groups with preliminary FR did not differ. Secondly, relatedness produced an effect in the opposite direction with the month stimuli, though it fell short of significance, $p < .10$, thus failing to replicate the correlated dimensions facilitation (Mueller, 1970b).

The difference between the FR and SL conditions for the PU list is perhaps the best estimate of the

interference present in the usual control group (SL-PU), and SL-PU was in fact significantly worse than FR-PU, $p < .01$. However, this interference does not account for all of the difference between the SL-PR and SL-PU groups, since SL-PR was still better than both FR-PR and FR-PU, $p < .05$ and $.10$, respectively. Since there may have been some advantage in response learning for the FR groups, the amount of actual interference may be slightly underestimated, but it seems unlikely that this is responsible for all of the remaining difference between SL-PR and the FR groups.

While there may be other problems which remain for transfer tests of the position hypothesis, these results suggest that not all of the apparent facilitation in past studies can be attributed to interference in the control group, since reliable facilitation was also present.

REFERENCES

- Bewley, W. L. The functional stimulus in serial learning. In R. F. Thompson and J. F. Voss (Eds.), *Topics in learning and performance*. New York: Academic Press, 1972.
- Ebenholtz, S. M. Serial-position effect of ordered stimulus dimensions in paired-associate learning. *Journal of Experimental Psychology*, 1966, 71, 132-137.
- Ebenholtz, S. M. Serial learning and dimensional organization. In G. H. Bower (Ed.), *The psychology of learning and motivation*. Vol. 5. New York: Academic Press, 1972.
- Mueller, J. H. Response properties of the position indicant in serial learning. *Journal of Experimental Psychology*, 1970a, 84, 35-39.
- Mueller, J. H. Correlation of stimulus and response dimensions in paired-associate learning. *Psychonomic Science*, 1970b, 18, 315-316.
- Young, R. K. Serial learning. In T. R. Dixon and D. L. Horton (Eds.), *Verbal behavior and general behavior theory*. Englewood Cliffs, N.J.: Prentice-Hall, 1968.

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