Comparison of recall and anticipation paired-associate procedures within mixed aurally-presented lists¹

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Abstract

Superior performance within aurally-presented mixed paired-associate lists was demonstrated for pairs representing recall (Rec) as compared with standard anticipation (Ant) procedures, contrary to previous research. Facilitation on both Rec and Ant pairs resulted from their increased temporal separation, either by not mixing Rec with Ant pairs or by surrounding the temporally separated Rec pairs or S-terms by 15-sec. blank intervals.

Problem

The present experiment compared paired-associate performance under recall (Rec) and anticipation (Ant) procedures using aurally-presented mixed lists within which half of the pairs were presented under each procedure. These conditions were dictated by previous comparisons between Ant and Rec procedures with aural Morse-code stimuli (Levine & Barch, 1963) and under visual mixed-list conditions (Rothkopf & Coke, 1963), both of which showed significantly superior performance under the Ant procedure, in contrast with the usual Rec superiority demonstrated over a wide range of conditions in our laboratory (Battig & Brackett, 1961, 1963; Battig, Brown, & Nelson, 1963; Schild & Battig, in press). In addition to determining whether the Levine-Barch results may be unique to their nonverbal Morse-code stimuli, and eliminating the greater practice time per trial provided for Ant than Rec pairs under the self-paced conditions used by Rothkopf and Coke, the present design also permitted a more precise analysis of the role of temporal separation under the Rec procedure of presentation of pairs for learning from that of stimulus (S) terms alone for performance measurement in accounting for the usual superiority of Rec performance. That separation of these two functions significantly enhances learning efficiency under the Rec procedure was indicated by the elimination of the Rec over Ant superiority under 50% ORM conditions wherein half of the response terms were omitted from the S-R pairs, thus in effect mixing pairs with S-term presentations within each trial (Battig & Brackett, 1963). Differential separation of learning and performance functions could be manipulated under the present mixed-list procedure both by (a) presenting either the six Rec pairs or the six S-term recall-test items together and temporally separated from any of the Ant pairs, and (b) introducing blank intervals both preceding and following the separated Rec pairs or S-terms.

Method

Each of 64 Ss, all fulfilling an introductory psychology course requirement through their participation, were assigned on the basis of a predetermined unsystematic sequence based on order of appearance in the laboratory to one of eight groups representing the possible combinations of (a) two different lists, (b) two sequences of item presentation, and (c) presence or absence of interpolated blank intervals.

Both lists consisted of the same 12 pairs of common three-letter words as stimulus (S) terms with low-frequency bigrams as responses, selected on the basis of their minimal similarity and near-equal learning difficulty from the 72 such pairs constructed by Battig & Nelson (1962). The two lists differed only in that the six-pair subsets representing anticipation (Ant) and recall (Rec) pairs in one list were interchanged in the other.

All S-terms and pairs were presented at a constant 4-sec. rate by tape recorder, with words being pronounced and bigrams spelled. Each Ant pair always followed immediately the presentation of its S-term alone for attempted bigram anticipation, whereas the pair and S-term presentations for each Rec pair were always separated by the interpolated presentation of other pairs or items.

Following an initial presentation of each of the 12 pairs for all Ss, different sequences of presentation for the groups representing separate pair (P) and test (T) conditions were maintained on all subsequent trials. Each T-sequence trial began with the S-terms of the six Rec pairs alone, followed by the presentation of the six Rec pairs intermixed with the Ant S-terms and pairs. The P sequence differed in that S-terms for the Rec pairs were intermixed with the Ant S-terms and pairs, all of which were followed by the successive presentation of the six Rec pairs. Thus the P sequence involved temporal separation of the Rec pairs but not of the Rec S-terms, whereas the reverse held for the T sequence.

Further temporal separation of the Rec pairs or S-terms under P or T conditions was provided under the interval (Int) condition by both preceding and following these with an unfilled 15-sec. blank interval, whereas the continuous (Con) conditions involved an uninterrupted 4-sec. presentation rate both within and between 12 successive trials. A 1-min. interval was required after Trial 12 under all conditions to rewind

the tapes. Separate tapes for each P and T list included 12 different intratrial serial orders, determined by a balanced Latin square which provided that each pair and S-term appeared twice in each sequential position relative to its Ant or Rec subset of pairs.

All Ss were instructed to try to spell the paired bigram during each presentation of the word alone. Learning was to a criterion of two successive errorless trials on the entire list (except for five Ss who were terminated after 24 trials without reaching criterion, four in the T-Con and one in the T-Int condition).

Results and Discussion

Performance comparisons and analyses were based on measures of total errors to criterion summed over all trials separately for Ant and Rec pairs. The two lists did not differ significantly, either alone or in interaction with other variables, all $F_s < 2.0$, $p > .10$.

Except for the T-Con group, where slightly fewer errors were made on Ant (63.1) than Rec pairs (64.3), consistently better performance was observed on Rec pairs, and the overall Rec (44.8) over Ant (49.5) superiority was highly significant, $F(1,56) = 10.16$, $p < .005$. However, the contrasting Rec-Ant equivalence for the T-Con group failed to produce any significant interactions of Rec-Ant with P-T or Int-Con conditions, all $F_s < 2.2$, $p > .10$.

A marked overall superiority was also obtained for Ant and Rec pairs combined for P (74.2) over T sequences (114.2), $F(1,56) = 18.14$, $p < .001$, and to a lesser extent also for Int (82.4) over Con conditions (106.1), $F(1,56) = 6.36$, $p < .025$. However, P-T sequence did not interact with Int-Con conditions ($F < 1$). Thus the temporal separation of the Rec pairs, and the concomitant mixed testing of the S-terms for both Ant and Rec pairs, significantly facilitated performance on pairs of both types. Apparently the separation of the pairs into two temporally distinct groups for learning had served to reduce interpair interference between pairs of the two sets, whereas the intermixed presentation of both Rec and Ant pairs under the T condition prevented such a distinction between pairs of the two types.

The facilitation produced by the blank interval preceding and following the separated Rec pairs or S-terms also affected the Ant pairs as well as the Rec pairs, although a separate analysis of the Ant pairs alone indicated the Int (44.6) over Con (54.3) superiority to be of borderline significance ($F = 3.98$ as compared with 4.02 for $p = .05$). This Int-Con difference contrasts with the usually small and inconsistent effects of increased intertrial interval on paired-associate learning (Underwood, 1961), probably due to the increased separation of functionally different parts

of the list provided by the blank interval under the present mixed-list procedure.

The present results thus not only refute the Levine-Barch (1963) and Rothkopf-Coke (1963) suggestions that the superiority of Rec over Ant procedures is eliminated under either aural or mixed-list conditions, but also indicate the temporal separation of either pair presentations for learning or S-terms for attempted recall to be sufficient to produce this superiority. The only exception was the T-Con condition, where only the S-terms were separated with no surrounding blank intervals. This result, combined with the greater overall P-T than Int-Con effect is thus indicative that requiring S to learn at the same time that performance is being measured is largely responsible for the lesser learning efficiency under the Ant than the Rec procedure, inasmuch as the increased separation of the Ant from the Rec pairs produced by either P or Int conditions led to substantial improvement on Ant as well as on Rec pairs. Or stated conversely, the separation of learning from performance measurement necessarily provided by the recall procedure is of considerable help to the learner, in addition to its obvious advantages to the experimenter as detailed elsewhere.²

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Notes

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2. The procedural advantages of the Rec paired-associate procedure are presented in detail in an unpublished manuscript by the senior author entitled "Procedural problems in paired-associate associate learning research," and a more general presentation of the case against the Ant procedure as applied also to other types of verbal-learning situations (e. g., serial and verbal-discrimination learning) is currently in preparation.