Locus of facilitation for paired-associate learning under fixed-order presentation[1,2]

S. JAY SAMUELS, *UNIVERSITY OF MINNESOTA*
WENDELL E. JEFFREY, *UNIVERSITY OF CALIFORNIA, LOS ANGELES*

Experiments comparing the effects of fixed- and random-order serial presentation on paired-associate learning have not produced consistent results. On the assumption that differences may appear at only a certain point in the learning process, an experiment was devised to determine the form of the learning curves under the two conditions. A test trial on which the order of the pairs were randomized from test to test followed each of 20 study trials with pairs in either random or fixed order. Facilitation by fixed order presentation appeared toward the end of learning and although both groups reached asymptote, the fixed-order group reached it considerably ahead of the random-order group Analysis of the data suggests a possible reason for the superiority of fixed-order presentation.

Interest in the effect of the order of presentation of paired associates upon the learning of test pairs dates back to the studies of McGeoch & McKinney (1937) and McGeoch & Underwood (1943) who found enhanced learning when stimuli were presented in fixed rather than random order.

Several recent studies have found that the presentation of paired associates in fixed sequence is likely to facilitate learning only when stimulus similarity is high (Newman & Saltz, 1962; Samuels & Jeffrey, 1966; and Rubin & Brown, 1967). Carluccio & Crowder (1966), however, failed to find facilitation with either high or low stimulus similarity lists, but they gave only eight learning trials prior to a test trial. They hypothesized that if facilitation did not occur until late in the learning process, eight trials may not have been enough. Samuels and Jeffrey, for example, gave eighteen trials prior to a test, and Rubin and Brown had Ss learn to a criterion or 43 trials, whichever came first.

An additional study in our laboratory lent support to the Carluccio and Crowder hypothesis. High stimulus similarity lists were presented in both fixed- and random-order with five study trials, a test trial, and then five more study trials followed by a second test. On Test 1, differences between Ss given fixed and random presentation conditions were not significant. On Test 2, however, differences in favor of fixed presentation approached significance ($p < .10$, one tail). This latter result suggested the present study in which the training period was prolonged and the amount of testing increased in order to establish more precisely the characteristics of the learning curves under fixed- and random-order presentation. Paired-associate lists with high stimulus similarity and low response similarity were used.

Subjects

The Ss were 20 undergraduates enrolled in educational psychology. All Ss were female and under 25 years of age. They were randomly assigned to either the fixed-order or random-order group, 10 Ss in a group.

Materials

The high stimulus similarity list contained the following pairs: XYZ - MONEY, XAF - JEWEL, XAZ - KITCHEN, VAF - DINNER, VUF - GARMENT, FYV - INSECT, VYX - HEAVEN, ZOV - VILLAGE, ZOF - WAGON, ZYX - OFFICE. The R-terms were the same as those used by Newman & Saltz (1963). The S-terms were nonsense syllables ranging in associative value from 7% to 20% (Glaze, 1928), and were drawn from a pool of four consonants. The S-R pairs for the study trials were presented with a Lafayette memory drum. The stimulus terms for the tests were typed on 3 x 5 index cards and presented by the E.

Procedure

The Ss received 20 study trials, each of which was followed by a test. During the study period, each of the 10 S-R pairs were exposed for 4 sec. In the fixed-order condition the S-R pairs appeared in the same order in each study period. In the random-order condition the S-R pairs were presented in five different orders.

A test followed each study presentation. On the test each S-term was presented for 10 sec. A total of nine orders of presentation for the S-terms were used, none of which were used on the study trials. The S was instructed to respond with the appropriate R-term when the S-term was presented.

Results and Discussion

For purposes of analysis, the trials were combined into blocks of two trials each. As seen in Fig. 1, the means for number of correct responses on tests is higher for fixed than for random sequence on nine of the 10 blocks. The slopes of the learning curves are approximately the same for the first two blocks, and then the fixed-order condition shows an accelerated rate of learning in comparison to the random presentation condition. Asymptote is reached by the fifth block under the fixed-order and by the eighth block under random-order conditions. The learning curves for Blocks 8, 9, and 10 are nearly coterminous and represent the final stages of acquisition.

Separate analyses were computed for each block of two trials to determine where mean differences were significant. Since variances were zero in some blocks, the Mann-Whitney U Test was used. As seen in Table 1, there was no difference between fixed- and random-order presentation on Blocks 1 and 2. Differences for

Table 1. Means, Standard Deviations, and One-tailed Probability Values for Blocks of Two Trials as Determined by a Mann-Whitney U test. Block 4 is also significant when tested by a t test.

		1	2	3	4	5	6	7	8	9	10
Random Fixed Order	x	3.25	6.70	8.85	9.65	10.00	9.95	9.95	9.90	9.90	10.00
	SD	1.06	1.34	1.22	.53	.00	.16	.16	.32	.21	.00
Random Order	x	2.65	6.40	7.35	8.75	9.10	9.35	9.65	10.00	9.80	9.90
	SD	1.13	1.65	1.47	1.25	1.24	1.18	.63	.00	.48	.21
		N.S.	N.S.	$p < .025$	N.S.	$p < .05$	N.S.	N.S.	N.S.	N.S.	N.S.

$n_1 = n_2 = 10$

Blocks 3 and 5 favored fixed-order ($p < .025$ and $p < .05$). Although the U test did not reach significance on Block 4, a t test on that block did indicate a significant difference favoring fixed-order presentation.

Inasmuch as the pairs were presented in random order on test trials it would appear that even if serial position cues did serve some mediational function as Newman & Saltz (1962) suggest, such cues would prove to be relatively inefficient at best. An alternative explanation is that a combination of primacy effects and serial position cues permit Ss in the fixed-order condition to learn selected pairs relatively quickly once they become familiar with the procedure. As a consequence the list is effectively shortened, and the remaining unlearned words would also be learned readily. Thus, serial position effects are seen as facilitating the learning of the paired associates per se, rather than facilitating recall on the test trials, particularly when the order of the pairs is rearranged from one test trial to the next.

To shed some light on these notions, performance on the first and second halves of the list were compared for the fixed- and random-order groups. The mean number of correct anticipations for the fixed-order group per S per trial for the first five trials on the first and last halves of the list is 3.20 and 2.30 respectively. The means for the same items for the random order group were 2.52 and 2.54. The performance of the constant order group is significantly better on the first set of items than that for the random order group ($p < .05$) whereas the difference between the performance on the last five items is in the opposite direction but not significant ($0.20 < p > 0.10$). Thus the data suggest that the constant order group may be learning the list relatively methodically from top to bottom.

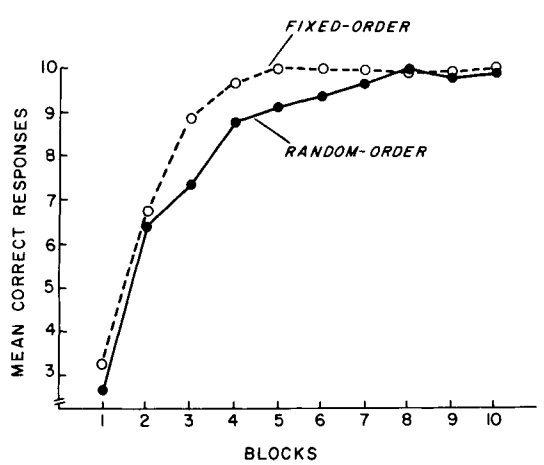

Fig. 1. Mean number of correct responses for blocks of two trials.

An additional observation of interest is that the median trial for the first completely correct test trial performance for the fixed order group is 6.6. The median remains the same when one uses a criterion of two successive correct performances inasmuch as there are only four additional errors, which occur on only two items, i.e., items 6 and 7. For the random order group, however, whereas the median trials to first correct performance is 8.5, for a criterion of two consecutive correct performances the median is 13.5. Twenty errors, distributed across seven items, intervene between these two medians. Thus, the Constant Order group not only shows evidence of learning the list from the beginning as one would expect from serial position curves, but it also apparently suffers less from interference effects on the test trials.

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Notes

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