Meaningfulness and percentage occurrence of items in serial learning¹

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Two levels of percentage occurrence of items (%OI) were combined factorially with two levels of meaningfulness (M) in a serial task. Item deletion appeared to have a greater effect in early than late stages of learning, and to be more detrimental to low M than to high M materials.

A number of recent studies have investigated the effect of manipulation of the percentage occurrence of stimulus and response members (%OSM and %ORM) on rate of acquisition in paired-associate (PA) tasks (e.g., Schulz, 1965; Schulz & Runquist, 1960; Goss, Morgan, & Golin, 1959). These studies suggest that if either the stimulus or response terms occur less than 50% of the time it is detrimental to PA acquisition. A study by Young & Fuhrmann (1965) has shown that 40% ORM was far more detrimental for a double-function PA list than a single-function or conventional PA list.

The present study assessed the effects of percentage occurrence of items (%OI) in serial learning (SL) at two levels of meaningfulness (M). If a serial list is learned as a chain of S-R associations, random deletion of items should be very detrimental to performance since each item has both a stimulus and a response function. If item deletion has its effects primarily in the associative phase, it should have a proportionately greater effect upon high M than low M materials, since a larger portion of total learning time is spent in associative learning with the high M items. If, however, the effects are mainly in the response-learning phase, deletion of items should be more detrimental to low M lists.

Although item deletion in SL may make the formation of interitem associations more difficult, ordinal position cues will remain intact. Reduction in %OI might lead Ss to rely more heavily on these position cues. If so, a position-naming task (Schulz, 1955) following SL might show superior position-naming ability for Ss in conditions receiving partial item occurrence.

Method

The Ss were 52 male undergraduates enrolled in introductory psychology. All Ss were naive with respect to the materials and procedures of this experiment.

The stimulus materials were 10 CVC trigrams—either of high or low M (Archer, 1960). High M items were of 75% to 78% association value; low M items were 26% to 31%. Formal similarity was minimized within each M level.

Two %OI conditions, 100% and 60%, were combined factorially with the two levels of stimulus M. The 100% conditions were conventional serial anticipation tasks. The same lists were used in the 60% OI conditions, but items were randomly deleted (and replaced with asterisks) with the following restrictions: (a) 40% of the items in each trial were deleted; (b) each item occurred exactly three times in each block of five trials; (c) no item was deleted in more than two trials in succession; (d) no more than two successive items in a trial were deleted; (e) the first item was not deleted on the first trial. The SL trials were given on a Lafayette memory drum at a 2 sec rate by the anticipation method until the criterion of one errorless trial was reached. The Ss were then given the following position-naming task: Each of the items was presented by a Kodak Carousel slide projector at a 2 sec rate. The order of presentation of the items was random with the restriction that the first item in the serial list not be presented first. The S was required to call out the numerical position which each item had occupied in the serial list.

Results

A factorial analysis of numbers of trials to criterion on the serial task showed the effect of M to be significant ($F=4.08$, $df=1/48$, $p<.05$). The effect of %OI only approached significance ($F=3.52$, $df=1/48$, $.05 < p < .10$). The interaction term was not significant.

Since no S reached criterion in less than nine trials an analysis was performed on total correct responses for these trials. Meaningfulness was again significant ($F=7.74$, $df=1/48$, $p<.01$), and again the interaction was nonsignificant. The %OI variable, however, was found to be significant at the .001 level ($F=14.83$, $df=1/48$); poorer performance obtained, of course, for the 60% conditions.

These two sets of data suggest that the effects of %OI are sizeable early in acquisition, but diminish by the time total list learning is accomplished. Figure 1 shows the mean numbers of trials to successive criteria for the four conditions. In order to determine how M and item deletion related to stage of learning, factorial analyses of trials to reach each of the successive criteria were performed. The F ratios for the effects of M were significant at all stages ($F_s \geq 6.03$, $df=1/48$, $ps < .05$). The effects of %OI were not significant for the first two criteria nor for the criterion of 10 correct. Item deletion was significantly detrimental, however, for criterion levels 3 through 9 (all $F_s \geq 4.56$, $ps < .05$); indeed, at criterion levels 4, 5,

Fig. 1. Mean numbers of trials to successive criteria for the four %OI-M combinations.

and 6 the effects of %OI were significant at the .001 level ($F_s \geq 16.32$, $df=1/48$). It is also of interest to note that at criterion levels 4, 5, and 6 the interaction of M and %OI was significant ($F_s \geq 5.74$, $ps < .05$). It can be seen from Fig. 1 that this interaction is attributable to a larger effect of %OI on the low M than on the high M list.

Performance on the position-naming task confirmed Schulz's finding of a bowed serial position curve for position-naming ability. Performance was essentially equivalent, however, for all of the groups.

Discussion

The discrepancy between the effects of %OI for the two measures (correct responses on Trials 1-9 and trials to criterion), as well as the results of the analyses for successive criteria, suggest that the

effects of item deletion are greater during the early stages of learning, but are reduced or eliminated by the time the entire list is learned. The results may, however, simply indicate that the number of trials to complete learning is a relatively insensitive measure.

The interaction of M and item deletion in analyses of trials to intermediate criteria indicates that the effects of deletion are detrimental to SL at an earlier stage for low M than high M lists. This interaction, coupled with early effects of item deletion, implies that a large part of the effect of item deletion is due to interference with the response integration component of the task rather than the ordering component. This cannot, of course, account for the subsequent effect on high M items, and it would appear that item deletion is also detrimental to the ordering component of SL, though probably less so than to response integration.

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Note

1. A paper based on the present data was read at the meetings of Southern Society of Philosophy and Psychology in Roanoke, March, 1967.