

Selective interference in immediate recall

JOHN MORTON,¹ M. R. C. APPLIED PSYCHOLOGY RESEARCH UNIT, Cambridge, England

An experiment is described which investigates the effects of irrelevant digits interpolated into a list of letters presented for recall. The main result is that when an irrelevant digit follows the final recall item there is a massive serial position effect, with later items in the list being affected more than earlier items. This corresponds to stimulus suffix effects reported by other authors and differs from response prefix effects where no differential serial position effects are noted. It is concluded that the two effects must be ascribed to two different kinds of store, one post-recognition, and one pre-recognition store.

When we hear a list of disconnected items the final item, especially, has a quality in memory not shared by the others. This is usually called an "echo" effect, and could be ascribed to a store different in kind to those from which other information is retrieved. It is suggested that this is a pre-recognition store where the information is still coded in a sensory form. If such a store makes a contribution to the recall of the final item in a list, then the presence of a further, irrelevant item, following the final item, should selectively impair the recall of the final item compared with other items. In general, assuming that this store has a limited capacity and that earlier material is overwritten by later material, its contribution to the recall of items in different serial positions should become progressively smaller with items earlier in the list. The following experiment tests such a proposition.

Method. The Ss were presented with lists of six letters drawn from the vocabulary H, J, K, L, N, R, W, X, Y, and Z, these letters being the 10 least acoustically interconfusable. There were four conditions: (1) *Normal* (N). Six letters were spoken at the rate of one per 2 sec. (2) *Repeated* (R). Each of the six letters was presented twice. (3) *Digits First* (F). The letters were interleaved with six digits, drawn at random, the list beginning with a digit. (4) *Digits Second* (S). Letters and digits were again interleaved, the digits this time following the letters. In this condition, then, the final item heard was a digit.

The Ss would hear, in the four conditions, lists of the following kinds:

- N - "L, . . . Z, . . . R, . . . X, . . . N, . . . H"
- R - "L, L, Z, Z, R, R, X, X, N, N, H, H"
- F - "4, L, 5, Z, 3, R, 9, X, 1, N, 2, H"
- S - "L, 2, Z, 1, R, 9, X, 3, N, 5, H, 4"

In all these cases the Ss had to write down "LZR XNH". Eighty lists, 20 of each condition, were presented to a group of 20 Ss, male and female, aged 21-50, from the MRC subject panel. The conditions were randomized within each block of 20 lists. Ss were requested to write down the letters on an answer sheet in their order of occurrence and were asked to leave no blanks. Selection of the letters was balanced for serial position: digits were selected at random. Neither digits nor letters were repeated within a list.

The following predictions were made:
(1) Conditions F and S should be worse than Conditions N and R owing to the presence of irrelevant material.
(2) Preliminary experiments indicated that Condition R was slightly more difficult than Condition N. This appeared to be because of interference with the Ss' normal rehearsal strategy. Such a difference, if confirmed, would be at variance with the model for memory presented by Waugh & Norman (1965) who predict no difference between two such conditions.

(3) If the contribution of the primary sensory store to the recall of the final letter outweighs all other sources of information, then performance on the final letter in Condition F should be equivalent to performance on the final letter of Conditions R and N. With earlier serial positions the decrement should tend to increase.

(4) Performance on the final letter of Condition S should be substantially worse than performance on the final letter of all the other lists.

(5) Performance should become progressively worse in Condition S compared with Condition F as serial position increases. **Results.** A response was counted as correct if and only if it was in the correct position. Figure 1 shows the total number of errors made by all the Ss on all lists in the four conditions. Differences between serial positions and between conditions were tested by the Wilcoxon matched-pairs signed-ranks test.

(1) When errors on all serial positions were pooled, performance in Condition S was worse than in Condition F which in turn was worse than that in either of Conditions N or R ($p < .005$).

(2) There was no significant difference in overall performance between Lists N and R. When individual serial positions were examined, R was worse than N only on serial Position 6 ($p < .005$). This difference was very small in magnitude and does not in itself constitute too strong a challenge to Waugh and Norman.

(3) There was no significant difference in performance on Position 6 between Conditions F and R. These conditions did differ on Positions 2, 3, and 4 ($p < .005$).

(4) Performance on Position 6 was significantly worse in Condition S than in the other conditions ($p < .005$).

(5) Further comparisons were made between Conditions S and F by comparing the differences in the error scores between these two conditions in different serial positions. The difference between S and F was greater on serial Positions 4, 5, and 6 than on Positions 1 and 2; the difference on Positions 5 and 6 was greater than on 3 and 4. In general, then, the difference between the two conditions increases with serial position. Although the absolute difference on Position 6 was greater than on 5, it did not reach the required significance level. If the comparisons were made proportionally, however (and we have no a priori reason for counting such a method as invalid), the difference between F and S would be vastly greater on Position 6 than on 5. Any final comparison of the last two serial positions in this experiment would be the last two serial positions in the underlying model for memory. Discussion. The main result is in agreement with our initial hypothesis of a memory store, the material which is subject to overwriting. The general effects of irrelevant items upon short-term memory are well known. Conrad (1958, 1960) showed that Ss recalling lists of digits suffered a substantial memory loss when they had to prefix their responses with the digit "0." Dallett (1964) confirmed this result and showed a similar decrement when

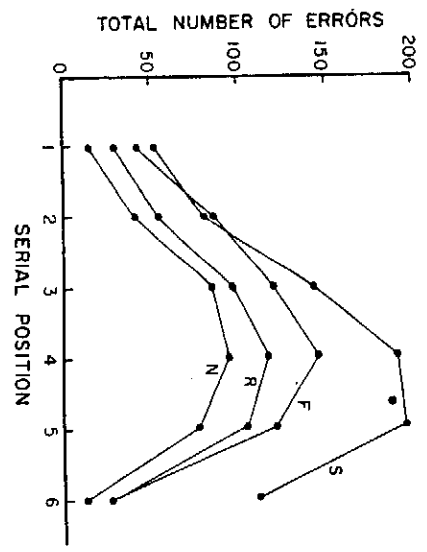


Fig. 1. The total number of errors for each serial position: 20 Ss x 20 lists in each condition. N represents the normal condition; R the condition in which each item is presented twice; F the condition in which interfering digits were interleaved, with digits preceding the letters; and S the equivalent condition in which digits followed the letters.

the stimulus string was prefixed by the (again redundant) digit "0" to which no response had to be made. Neither of those authors published serial position data, but unpublished data from Conrad's 1958 experiment makes it quite clear that, if anything, the effect of a response prefix is strongest on the earlier rather than the later serial positions, the mean percentage increase in errors being 52.5% for the first four positions and 30.9% for the last four positions. It might have been crucial to note then that Conrad's Ss made a motor, and not a verbal response. However, Crowder (1967) carried out a similar experiment in which he did require the Ss to make verbal responses. He showed that a redundant "0" in the stimulus, prefix or suffix, and a redundant prefix in the response all lead to worse performance than in the control condition. The condition analogous to the S condition in the present inquiry, i.e., a suffix in the stimulus, also produced a significant decrement in the final serial position compared with his stimulus prefix condition, a result also shown by Dallett (1965). The decrement in his response prefix condition, however, showed no such serial position effect. In addition, since there was no effect at all of a response suffix upon recall, no explanation based on a general increased memory load, for the redundant item or the instruction to retrieve the item, can account for the effect of the redundant response prefix. It would seem then that we are faced with two distinct phenomena corresponding to effects in two different stores.

Conrad's (1958) result shows that the effect of a response prefix is not modality specific and so does not depend upon there being auditory feedback from the S's own voice. This effect must therefore take place at a stage in the process of responding before the output modality is specified. This could correspond to Waugh & Norman's (1965) "Primary Memory" or to what Morton (1964) calls an "available response." The nature, as opposed to the location, of the effect seems more likely to be one of interference with other, about-to-be-available responses rather than decay-by-delay or rehearsal interference, since Conrad (1960) showed that it made no discernible difference whether a prefix response was made before or after a 10-sec interval during which a digit string could be rehearsed.

The effect of a stimulus prefix is amenable to a similar interpretation, since, as Dallett (1964) points out, it is likely that the S has to reject the potential "zero" response. This was confirmed by Dallett (1965) who showed that the effect of a "zero" preceding a seven-item list was to lower performance on the first item recalled to a level corresponding to the second item on an eight-item list in which no redundant item was added in either stimulus or response.

Since the effect of a stimulus suffix interacts with serial position, it cannot be dealt with in the same way in spite of the fact that the event occurs at roughly the same time as the response prefix. The original hypothesis of a pre-recognition auditory store accounts economically for the difference between these effects. The further implications of this hypothesis remain to be explored.

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NOTE

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