Recency effect in recall of a word list when an immediate memory task is performed after each word presentation

The recency effect

The serial position function for the immediate free recall of a list of items shows the likelihood of recall to increase steadily over the last several list positions. This "recency effect" has traditionally been interpreted as the product of a limited immediate memory capacity. By immediate memory we mean continuous retention in conscious mind, the dominant metaphor for which has been an all-purpose short-term store (e.g., Waugh & Norman, 1965).

The recency effect with a continual distractor procedure

A problem for the immediate memory account of the recency effect arose with the introduction of the continual distractor procedure, in which a distractor task is given after each item (or each pair of items). If the recency effect were the product of an all-purpose immediate memory capacity, then the distractor task should, presumably, draw upon this capacity to the detriment of the recency effect. But in fact this procedure results in a marked recency effect (Bjork & Whitten, 1974; Silverstein & Glanzer, 1971; Tzeng, 1973).

This problem could be resolved with the assumption that the tasks used in the continual distractor procedure—such as repeatedly subtracting a single-digit number from a three-digit number—do not in fact put much of a burden on immediate memory capacity. To be sure, they require thought, but the amount of memory capacity they consume could be minimal. The purpose of this note is to summarize two experiments designed to determine whether a recency effect would occur under conditions of continual distraction by a task that should tax immediate memory to the full. The task was the immediate reproduction of a supraspan sequence of digits.

A test of the spare capacity hypothesis

In the first experiment, 20 University of Houston undergraduates heard a series of 12-word lists and after each list recalled as many of the words as they could in whatever order they wanted. After the presentation of each word within a list, they heard and immediately tried to reproduce a sequence of nine digits.

For the stimulus materials, 96 words were randomly sampled from the
Toronto word pool, a collection of common, two-syllable words (Friendly, Franklin, Hoffman, & Rubin, 1982). They were randomly assigned to eight 12-word lists, of which one was used for practice and seven for the experiment proper. Ninety-six different digit sequences were constructed, one for each word. Each sequence comprised the digits 1 through 9 in random order, with the constraint that numerically consecutive digits could not occupy adjacent positions within the sequence.

The word lists, complete with the interpolated digit sequences, were recorded in a male voice on audiotape. The words were recorded at a rate of one every 12.5 s, and the digits at a rate of one every 0.5 s, beginning 2 s after the onset of the preceding word. Each digit sequence was followed by a silent 6-s reproduction interval. The last of these reproduction intervals was followed by a beep, which signaled the onset of a 30-s word recall interval. A beep was also recorded 2 s before the end of the recall interval to warn subjects that the next list was about to be presented.

The experiment proceeded as follows. Subjects heard a series of word lists. After each word within a list, they engaged in an immediate memory task. For this task, they heard a sequence of nine digits and immediately afterwards reproduced on a prepared response sheet as much of the sequence as they could. The digits had to be written in appropriate positions, but there were no constraints on which digit was to be written first, which second, and so on. After the response interval for the last digit sequence of a list, subjects were signaled to write down as many of the words as they could without regard to their order of presentation.

Before the presentation of the first list of the experiment, subjects were given a practice list and invited to ask questions. They were told that the word recall task and the digit reproduction task were of equal importance.

Figure 1 shows the mean proportion of words recalled at each of the 12 positions within a list. The important finding is the clear indication of a recency effect, with level of recall increasing fairly steadily toward the end of the list. For the second half of the list, Spearman's rank-order correlation between serial position and probability of recall was .94, which was significant at \( p = .01 \).

Analysis of the digit reproduction data revealed that of the nine digits within a sequence, the mean number written in correct position was 5.01. There was no evidence of reproduction accuracy varying with the position of the sequence within the word lists; it was, for instance, identical for the first six sequences and the remaining six.

**A comparison of distractor tasks**

Although the recency effect obtained in the first experiment was pronounced, it is possible that it was less pronounced than it would have been if we had used a more conventional distractor task. To check this possibility, we devised a second experiment in which we included two conditions of distraction, one involving the digit reproduction task used in the first experiment and the other a subtraction task.

The word lists, complete with the digit sequences, were constructed in
the way described in the first experiment, except that this time there were 16 lists, 1 for practice and 7 for the experiment proper in each of the two conditions. They were recorded on audiotape in a male voice, with the words occurring at intervals of 12.5 s. For the reproduction task, the digit sequences were presented as in the first experiment. The subtraction task resembled the reproduction task in that the same sequences of digits were presented at the same rate, and the same amount of time was allowed for responding. It differed in that instead of a single 6-s pause at the end of the sequence, a 2-s pause was interpolated after every third digit.

Twelve Rice University undergraduates received the same series of 12-word lists under conditions of continual distraction. For half the subjects, the distractor task for the first half of the lists involved reproducing a nine-digit sequence, and for the remaining half it involved subtracting 7 from each of three 3-digit numbers. For the remaining subjects, the subtraction task was used in the first half of the lists and the reproduction task in the second half. The procedure for the reproduction task was as described in the first experiment. For the subtraction task, three sets of three digits were presented and the subjects considered each set as a number (e.g., "8, 4, 7" as eight hundred forty-seven), subtracted 7, and wrote the answer in the appropriate place on their response sheets. We might note that subjects appeared to the experimenter to write down the first digit as it was presented and then subtract 7 from the remaining two. Because zero was never presented, this strategy was always appropriate. The word recall test was as in the first experiment. The first list of each condition served for practice.

The results of the second experiment are summarized in Figure 2. Both the reproduction condition and the subtraction condition yielded a clear

Figure 1. Mean proportion of items recalled by serial position
Figure 2. Mean proportion of items recalled by serial position and type of distractor task

recency effect in word recall. Most important, the effect was no less pronounced with the reproduction task than with the subtraction task. Spearman's rank-order correlation between probability of recall and the last six positions was .986 ($p < .01$) for the reproduction task and .943 ($p = .01$) for the subtraction task.

Analysis of distractor task performance showed that the reproduction accuracy was somewhat higher than in the first experiment, with a mean of 5.64 digits per sequence being correctly positioned. In the subtraction condition, a mean of 75.0% of the subtraction problems were performed correctly. In neither condition did performance change much across positions within a list. For the reproduction condition, the mean number of digits correctly placed was 5.75 for the first half of the list and 5.54 for the second. For the subtraction task, the mean number of problems correctly performed of the three that followed each word was 2.27 for the first half of the list and 2.22 for the second.

Implications

The findings of these two experiments extend the known conditions under which the continual distractor procedure will yield a recency effect. They show that a recency effect occurs even when we can be sure that the distractor task draws heavily on immediate memory, and they therefore allow us to conclude that the recency effect is not the product, or at least not invariably the product, of some all-purpose immediate memory capacity.

This conclusion confirms that reached by others, sometimes on the basis of evidence obtained with other procedures. For example, it is well estab-
lished that the recency effect is impaired little by the performance of a task concurrently with list presentation. Although much of this research has involved card sorting (e.g., Baddeley, Scott, Drynan, & Smith, 1969; Bartz & Salehi, 1970; Murdock, 1965), a task that would not seem to unduly strain immediate memory, Baddeley and Hitch (1974, Exp. 9; see also Baddeley & Hitch, 1977) required the immediate reproduction of four short sequences of up to six digits during the presentation of a 16-word list. The probability of recall for the recency words was found to be almost as high as when no concurrent task was given. It could be argued that Baddeley and Hitch’s subjects had to contend with no more than a six-digit sequence during the presentation of all items in the recency positions whereas our subjects had to contend with a nine-digit sequence after each and every list item. In addition, Baddeley and Hitch used different presentation modalities for the list items and the digit sequence, thereby leaving open the possibility that their recency effect resulted from a functionally separate, modality-specific component of immediate memory (see Frick, 1984; Penney, 1975). Nevertheless, their findings are clearly consistent with the view that the recency effect can emerge for reasons having nothing to do with immediate memory.

Also consistent with this view are findings of another study by the same researchers (Baddeley & Hitch, 1977), in which rugby players were asked, following a weekly game, to recall the teams they had played that season. Although immediate memories are surely taxed at least once a week, when the probability of a game being recalled was plotted against the number of intervening games, a recency effect was found. A more formal demonstration of such long-term recency has been made by Glenberg, Bradley, Draus, and Renzaglia (1983, Exp. 5).

All in all, then, there would seem to be a strong case for rejecting the traditional view that the recency effect requires that the last few items be continuously maintained in mind until reported. Rather, it seems that, under certain conditions, the most recent of a string of items have a comparatively high probability of being recalled even if they have slipped out of mind.

Summary

Subjects studied 12-word lists for free recall. During presentation of the lists, each word was followed by a supraspan sequence of digits, which the subjects tried to reproduce. This task, unlike those used in previous research with this continual distractor procedure, presumably taxed immediate memory capacity to the full. Nevertheless, the word recall data showed a pronounced recency effect. Moreover, the magnitude of the recency effect was found to be just as great with this task as with a more typical task in which the demands on immediate memory are likely to be fewer. These findings reinforce the emerging view that the recency effect need not be the product of immediate memory.

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Notes

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