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Free recall of minimally rehearsed but "deeply" encoded words

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Eight subjects recalled lists of unrelated words, presented at a rate of one word every 8 sec, under one of two conditions. In the "association" condition, subjects were induced to semantically encode the items by instructions to report, during the presentation of each test item, as many words as possible semantically related to that item. Recall under this strategy was compared with that in the "repetition" condition where the subjects were instructed to repeat each test item aloud continuously during its presentation. No significant difference was found between the total number of words recalled under the two strategies. However, the primacy effect, present in the repetition condition, was found to be absent in the association condition. This loss of primacy was interpreted as being due to the prevention of rehearsal by the association task. The results have implications for research into the effects of orienting tasks on free recall.

Craik and Lockhart (1972) have suggested that the ease of recall of a verbal item is determined by the level to which it is analyzed. Level of analysis can vary from that of the crude physical attributes of the item to that of its sophisticated semantic attributes. They further suggest that the "deepest" level of analysis is semantic. Once an item has been semantically encoded, it can only be made more recallable by further elaboration of its semantic coding, particularly by being associated with more of the information already stored in memory.

Several investigators (e.g., Hyde, 1973; Hyde & Jenkins, 1969; Walsh & Jenkins, 1973) have provided evidence for the above view of memory by demonstrating that incidental recall of words about which semantic decisions have been made is as good as recall of those words under intentional learning instructions. However, since there can be only one trial per subject in an experiment involving incidental learning, there is little opportunity for the subjects in the intentional condition to develop a strategy for memorizing the material presented. The relatively poor performance of these subjects may be due to their bewilderment when, in the absence of practice, they are left to their own devices in deciding how to tackle the memory task. Their more fortunate counterparts in the incidental condition (who are probably feeling less harassed by not expecting a test) are at least being forced by the orienting task to focus their attention on each item as it is presented. In studies which include a control condition of intentional learning combined with the orienting task, there is the additional problem that, however serious the subjects' intent to learn the material, the orienting task may place such high demands on their capacity of attention that any increase in memorizing activity is impossible.

The present experiment examined intentional free recall of lists of unrelated words presented at a slow rate. The subjects were induced to semantically encode the items by instructions to report, during the presentation of each test item, as many single words as possible which were related to that item. Recall under this strategy was compared with that under a control condition where the subjects were instructed to repeat each test item aloud continuously during its presentation. The question of interest was whether the former strategy (the "association" condition) and the latter (the "repetition" condition) would lead to equally good recall.

METHOD

Subjects

Eight male undergraduates of the University of Oxford served as unpaid volunteers for two sessions.

Materials

Each of 22 lists of 20 randomly selected monosyllabic English words was typed on the first 20 pages of 22 spirally bound notebooks, one word per page. There were no homphones.

Procedure

In the repetition condition, the subject turned the pages of a notebook in pace with the occurrence of a 500-Hz .5-sec tone whose presentation, once every 8 sec, was controlled by an automatic timer. During the 8-sec presentation of each word, the subject repeated that word aloud according to the instructions "as many times" as he could comfortably manage. When he reached the end of the list, denoted by the occurrence of the first blank page in the notebook, he was given 2 min to write down all the words he could recall from that list in any order he chose. (The auditory cue was not presented during the recall period.) The next trial followed immediately, the experimenter instructing the subject to "get ready" about 8 sec before the first tone. There was one practice trial, after which the subject could ask questions, followed by 10 consecutive experimental trials.

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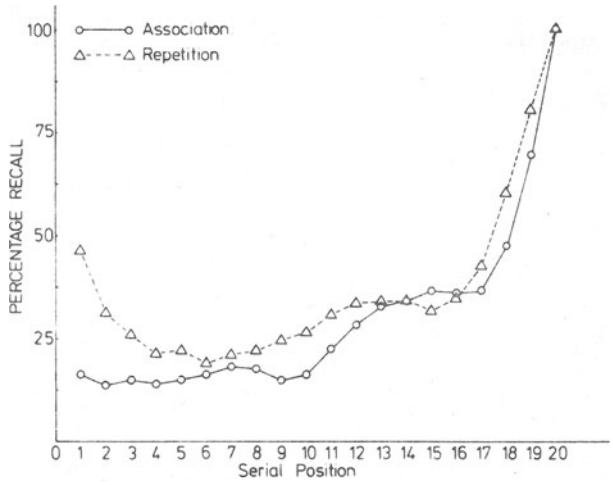

Figure 1. Percentage recall as a function of input serial position, under strategies of repetition and association. These curves have been smoothed after the manner suggested by Craik, Gardiner, and Watkins (1970). All statistical analyses were carried out on the original unsmoothed data.

The procedure for the association condition was similar to that for the repetition condition, except that the subject, instead of repeating each word, generated associations to it. He was instructed to say aloud as many words as he could which he felt were related to the currently presented word. He was told not to associate in chains, all the associates were to be related to the word on the page.

Each subject completed two sessions, one in the association condition and one in the repetition condition. The first 11 lists were presented in one of these sessions and the second 11 lists in the other. The order in which subjects underwent the repetition and association conditions and the particular half of the 22 lists used in each of a subject's sessions were counterbalanced. The 11 lists in a session always occurred in the same order. The subjects' overt responses to the items during their presentation were recorded on magnetic tape.

RESULTS AND DISCUSSION

A three-way analysis of variance was carried out on the free recall data, the factors being strategy (two levels, association and repetition), serial position (20 levels), and subjects (eight levels, random). The main effect of serial position was significant [$F(19,133) = 41.13$, $p < .001$]. The main effect of strategy failed to attain significance [$F(1,7) = 2.85$], although, on average, repetition gave superior recall to association (see Figure 1). The interaction between serial position and strategy was marginally significant [$F(19,133) = 1.67$, $p \leqslant .05$]. Inspection of the serial position curves in Figure 1 suggests that this interaction was mainly due to the lack of primacy effect in the association condition. To investigate the primacy effects, t tests comparing the mean number of items recalled in Serial Positions 1-4 with that of items in Serial Positions 5-8 were carried out for each of the conditions. Their results revealed a significant primacy effect under repetition [$t(7) = 3.29$, $p < .02$, two-tailed] but no such effect under association [$t(7) = .11$, $p > .9$, two-tailed).

In summary, while there was no significant difference between the total number of words recalled under the strategies of repetition and association, analysis of serial position effects revealed an unpredicted difference between the two conditions. This difference arose from the absence of the commonly observed primacy effect in the association condition.

One possible reason for expecting poor performance in the association condition is that subjects may find difficulty in distinguishing at recall between the words actually presented and their overt associations to them. This "response interference" hypothesis seems inadequate for two reasons. First, it would predict the occurrence of more intrusion errors in the association than in the repetition condition. In fact, the opposite was found. A related measures t test revealed that there were significantly more intrustion errors in the repetition condition than in the association condition. [Total number of intrusions under repetition = 17; total number of intrusions under association = 7; $t(7) = 2.37$, $p < .05$, two-tailed.] Second, it is not clear how the response interference hypothesis would predict the observed interaction between strategy and serial position. Any explanation of the present results must take into account an explanation of the primacy effect in free recall.

An hypothesis which fulfills the latter condition, although not mutually exclusive with the response interference hypothesis, is that the production of associations places high demands on the subject's capacity of attention, rendering it difficult or impossible for him to rehearse an earlier item during presentation of a later one. A subsidiary experiment was carried out to test the hypothesis that generating associations to words is more attention demanding than is repeating them aloud continuously. Six subjects were shown two successive lists of 20 words, presented at the same rate as in the main experiment. While performing a difficult card-sorting task, they generated associations to the items of one list and repeated the items of the other list. The results show unequivocally that the association strategy is more attention demanding than the repetition strategy, the latter allowing significantly more cards to be sorted than the former [average number of cards sorted under repetition = 114.33; average number of cards sorted under association = 64.2; $t(5) = 6.83$, $p < .01$, two-tailed].

It should be noted, however, that the effects of generating associations are not simply equivalent to those of a secondary task. The effect of the latter is to reduce recall of items in both the initial and middle input serial positions (Murdock, 1965). there is no selective reduction of primacy. Free recall serial position curves showing a lack of primacy have been observed only rarely by previous investigators.

Atkinson and Shiffrin (1971), for instance, report that primacy was absent in a memory task where subjects were instructed to repeat each item aloud three times as it occurred and *not to think of previous items*. Marshall and Werder (1972) found a lack of primacy in incidental free recall of words about which subjects had made decisions of a nonsemantic nature. Baddeley and Hitch (1974) report further analysis of the results of an experiment, originally reported by Baddeley (1962), on incidental free recall of anagram solutions. This analysis revealed a lack of primacy in the serial position curve. The results of these studies, together with those of the present experiment, indicate that the absence of the primacy effect in free recall is associated with absence or reduction of rehearsal. The nature of the rehearsal activity crucial to the occurrence of the primacy effect is as yet undetermined.

The present results suggest that previous investigators of the effects of orienting tasks on incidental and intentional learning may not have made full use of their data. It is recommended that, in such experiments, serial position effects should be analyzed. This analysis may reveal differences between orienting tasks which are not apparent when only the total number of items recalled is considered. In particular, measurement of the strength of the primacy effect obtained when an orienting task is combined with intentional learning instructions might be used to assess the degree to which that orienting task engages the subject's attention capacity.

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