Stimulus context and retroactive inhibition in free recall

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This study examined the effect of changes in stimulus context in a paradigm that had previously been shown to produce retroactive inhibition (RI). All Ss learned the same first list of 20 words to a criterion of one perfect recitation. As an intervening task, two groups of 30 Ss were given four trials in which to learn as many words as they could from a 30-word list containing the same word categories as in the first list. One group (Group B) saw the words in normal black type, the other (Group R) saw the words in red upper-case type. A control group of 10 Ss completed arithmetic problems. Both groups learning an interpolated list exhibited a large amount of RI, but this effect was considerably less for Group R.

A number of recent articles (e.g., Shuell, 1968; Watts & Anderson, in press) have demonstrated that similar organizational characteristics of successively learned free-recall lists result in a considerable amount of RI.

Besides sharing similar organizational cues, the items in each free-recall list share similar contextual cues. McGovern (1964) has used this association between list items and the general experimental context to account for the response-learning stage in paired-associate learning. However, in a free-recall situation, Tulving (1968) does not see the necessity to stress strengthening of contextual associations to account for trial-to-trial increments. His argument is that such increments can be accounted for by the strengthening of interitem associations or secondary organization.

In both the Shuell (1968) and the Watts & Anderson (in press) studies, duplication of encoding cues was cited in explanation for the strong RI effects at recall after learning two similar lists. It seems reasonable to assume, then, that any change in context which would ease this duplication of encoding cues would be an aid to list differentiation at recall. Greenspoon & Ranyard (1957) have previously reported that RI can be decreased by changing the environmental conditions in which recall occurs. The present experiment will attempt to demonstrate a similar effect by manipulating the contextual features of the stimuli themselves.

DESIGN AND MATERIALS

Seventy undergraduate volunteers were presented with the same initial list of 20 words, consisting of four words each from the countries, birds, materials, animals, and crimes categories of the Connecticut word-association norms (Cohen, Bousfield, & Whitmarsh, 1957). Words having less than 1% association value were used in order to minimize guessing on the basis of category identification alone, and all words were drawn from the 1- to 10-in-a-million range of the Thorndike-Lorge lists (Thorndike & Lorge, 1944).

Following attainment of criterion performance on the initial list, Ss were randomly assigned to one of three transfer conditions. The first group (Group B), consisting of 30 Ss, transferred to a 30-word list made up of six words from each of the previously mentioned categories. These words met the same association value and Thorndike-Lorge specifications as did the first-list words. A second group (Group R) of 30 Ss transferred to a list identical to that of Group B, except that the list was printed in red upper-case type. The remaining 10 Ss (Group C) completed arithmetic problems while the two treatment groups studied the second list.

PROCEDURE

The lists of words were presented on a Lafayette memory drum (Model 303A) at a speed of one word per second. Following each study trial, Ss were given 90 sec in which to orally recall as many of the 20 first-list words as they could. The Ss were instructed that they could recall the words in any order they wished.

Upon attaining one perfect recitation of the first list, the two treatment groups studied the second list under the same conditions, with the instruction to learn as many words as they could in the number of trials allowed. In addition, Group R Ss had their attention drawn to the fact that their second list would be printed in red upper-case type. This second-list task consisted of four study and test trial alternations. The arithmetic task for the control group (Group C) was represented as a mathematics competence test, with each S allowed 2 min per page to complete problems in addition, subtraction, multiplication, and series completion. No S finished any page within the time allowed.

Immediately after completing the interpolated task, all Ss were given 3 min to recall as many words as they could from the

first list. Following first-list recall, all Ss were given another 3 min to recall as many words as they could from either list in any order they wished (MMFR procedure, Barnes & Underwood, 1959). On prepared response sheets, the Es noted the words recalled on each trial as well as the order in which each word was recalled.

RESULTS

First-List Learning

All groups learned the same first list. Trials to criterion on this list proved to be reliably different for the two treatment groups [$F(1,58) = 16.71$, $p < .01$]. Group R achieved criterion in an average of 8.39 trials, Group B in an average of 5.7 trials. The Ss were randomly assigned to groups and to the two Es. It is possible that the effect resulted from differences in abilities between the two groups. We will return to this point following presentation of the second-list results.

Second-List Learning

Analysis of word recall on both the first and fourth trials showed no evidence of significantly different transfer effects for the two treatment groups (see Table 1 for means). Whether a S learned a second list printed in normal black type or in upper-case red type apparently had no differential effect on performance.

List 1 Recall

When Ss were instructed to recall as many words as they could from the first list only, the results significantly varied with the treatments. The control group evidenced virtually no decrement in performance, with a mean recall of 19.20 words. Relative to the control group, both treatment conditions demonstrated a loss in words recalled, but of particular interest to the present study is the comparison between these conditions. From Table 1, it can be seen that there was a difference in the mean number of first-list words recalled, and this difference was found to be significant [$F(1,58) = 14.13$, $p < .01$].

It could be argued that this difference was due solely to the variation in the number of trials to criterion taken on the first list. That is, since Group R took more trials, and therefore had extra practice on the first list, they would thus be less susceptible to interference during the fixed number of second-list trials. With this in mind, the recall scores were reanalyzed, with Ss leveled into three blocks on first-list trials to criterion. An unweighted means analysis revealed that, under both treatment

Table 1
Average Number of Words Recalled for B and R Groups in Original Learning (OL), Interpolated Learning (IL), and Recall Test

Groups	Recall Situation				$\bar{x}$ differences between first list words recalled on initial recall and on MMFR recall
	First trial OL	First trial IL	Fourth trial IL	First list recall	
B	8.83	10.16	23.19	9.66	+2.09
R	9.03	9.3	21.53	13.83	+4.46

conditions, there was a positive relationship between number of trials to criterion on the first list and total words recalled [$F(2,54) = 9.55, p < .01$]. With the variance due to trials to criterion now accounted for, there was still a significant difference between the treatment groups in the direction already indicated [$F(1,54) = 4.83, p < .05$]. Further evidence for the treatment effect was found by reanalyzing the first-list recall, but only for the last five words learned by each S on the first list. Since these words were the last ones learned, they should have been least subject to any overlearning that might have taken place. This analysis showed a significant first-list recall difference between the two groups in the predicted direction. Group B recalled a mean of 1.93 words, and Group R a mean of 3.23 words [$F(1,58) = 12.99, p < .01$].

When Ss were instructed to recall as many words as they could from both lists, there was an increase in recall of first-list words for both treatment groups. However, as can be seen from Table 1, Group B made a significantly greater gain under the MMFR recall procedure [$F(1,58) = 7.24, p < .01$].

Clustering Scores

Clustering scores (Bousfield & Bousfield, 1966) for final-trial OL, final-trial IL, initial recall, second-list recall under MMFR, and total recall under MMFR were analyzed for differences between the two treatment conditions. All of these comparisons proved to be nonsignificant (all F s < 1.3). The comparison between Group B and Group R clustering scores for first-list items under the MMFR procedure produced a slightly larger statistic [$F(1,58) = 3.23$], but was again not significant.

DISCUSSION

While previous studies (e.g., Greenspoon & Ranyard, 1957) have shown that changes in the immediate environment can significantly alter the amount of interference observed when CVCs are used

as learning stimuli, the present experiment demonstrates a similar effect for contextual alterations of the word stimuli in a free-recall situation.

The group receiving the second-list words in a distinctive color type recalled significantly more first-list words when required to do so. On a subsequent MMFR trial, the group with the two lists printed in the same color type made a significantly greater gain in number of words recalled when they no longer had to cope with a more difficult list-differentiation problem. It seems reasonable to assume that the color cue with one set of list words eased the problem of duplication of coding cues involved in learning two lists of words containing the same set of conceptual categories. Both treatment groups shared common item strength and recency cues to aid in list differentiation. The added color cue apparently provided an extra means of list identification for one group.

It was unfortunate that these results were clouded by the significantly different performance on trials to criterion on the first list. It is a well documented point that increased practice on original learning reduces interference from an intervening list, and the added trials for the color-tagged group would have been to their advantage at recall. That trials to criterion on the first list did play a part in subsequent recall is evident in the highly significant main effect for that factor in the levels analysis reported. At the same time, it should be stressed that the same analysis still found a significant advantage for the color-tagged treatment group at recall.

The gain in total words recalled from the restricted to the MMFR procedure seems a somewhat cleaner result. The present experiment asked for first-list recall and then asked for recall of both first- and second-list items. Confusion between contextual associations should be maximal in recall of first-list items alone. Conversely,

contextual factors in recall of both first- and second-list items should be minimal. If this is the case, then one would expect a larger difference gain in recall of first-list items across the two recall procedures for the group where contextual confusion should be maximal. And this was indeed the case in the present experiment. Ss in the B condition evidenced a significant gain in recall of first-list words in the MMFR procedure when compared to the gain evidenced by the R group.

The present study suggests that contextual factors contribute to the RI resulting from similar categorization of materials in free-recall learning. It is apparent, however, that future studies will have to determine the extent and reliability of this contribution.

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NOTE

1. The authors are grateful to Joseph L. Wolff for his helpful suggestions.
2. Requests for reprints should be sent to G. H. Watts, 8 Lincoln Hall, University of Illinois, Urbana, Ill. 61801.