Delayed retroactive inhibition with categorized lists¹

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Recall of List 1 was tested immediately and at 24 h following the learning of blocked, categorized lists in a conventional retroactive inhibition (RI) design. Significant RI was found only at 24 h. The results were discussed in terms of loss of list differentiation with time.

This report presents the outcome of an exploration of retroactive inhibition (RI) with categorized lists at two retention intervals. Tulving (in press) and Mandler (1967) have recently emphasized the importance of organizational factors in free recall. The research reported here arose from an interest in exploring the role of interference processes, specifically RI, with highly organized lists learned by the method of free recall.

Lists were composed consisting of blocks of five categories each presented serially. For each block, the category name was followed by five instances of the category, with recall tested after each presentation of the list. When List 1 was learned, Ss in the experimental group learned a second list constructed of five different categories. Since there was no formal similarity relationship across lists, the procedure may be viewed as conforming to an A-B, C-D paradigm in conventional terms. Recall of List 1 was required upon completion of List 2. It should be noted that significant RI at immediate testing has been found with the A-B, C-D paradigm in paired-associate learning by McGovern (1964) and Houston (1967), and in free recall by Postman and Keppel (1967) with dissimilar lists.

Method

Two lists of 30 items each were composed from the Connecticut category norms (Cohen, Bousfield, and Whitmarsh, 1957). Each list consisted of five category names and five instances of each category presented in blocked fashion. Each category name was typed in small letters on the memory drum tape followed by the five words in that category in capital letters. Three orders of each list were used with lists counterbalanced so that each list appeared equally often for each group as List 1 and List 2. The words were taken from the twelve most frequent responses appearing in the norms and the average frequency within each category was equated at about 110. Normative word frequency was approximately the same across categories. The categories on one of the lists were: musical instruments, sports, furniture, human dwellings, and colors. The categories on the other list were: weapons, cloths, vegetables, vehicles, and trees.

Subjects were run individually and the lists were presented on a memory drum at a 2 sec rate. The instructions made clear the categorical structure of the list and that recall would be tested after each exposure. After each presentation of the list Ss were allowed 2 min to write down all the category names and items that they could on the test sheet. The test sheet had a space for the category name and five spaces for the words in that category. There were five such groupings on each test sheet. Following the first trial on which perfect recall occurred, experimental Ss were instructed that a second list, identically constructed but with different categories, was to be learned. List 2 learning was conducted in the same manner as was List 1. Control Ss were yoked to the preceding experimental S in that they worked on a filler task for the same amount of time that the experimental S had spent on the interpolated list. The filler task was an adaptation of the Stroop test.

For those groups tested immediately after either List 2 learning or the filler task, recall of List 1 was tested with the usual test sheet. Unlimited time was allowed for recall. Ss in the 24 h groups were tested the next day at about the same time in the same manner.

The Immediate groups were run first and then the 24 h groups. There were 12 Ss in each group at each interval. Subjects were male and female students taking a course in Educational Psychology at Teachers College during the summer. They were paid for participating and were alternately assigned to experimental and control groups at each retention interval.

Results

Learning. List 1 learning was rapid for all groups. Mean trials to criterion for the Immediate groups were 3.9 and 3.4, for Experimental and Control groups respectively. For the 24 h groups, the comparable values were 2.9 and 3.5 trials. The four groups do not differ significantly ($F=1.82$, $df=3/44$). For the Experimental groups, List 2 learning took 2.7 and 2.4 mean trials to criterion for the Immediate and 24 h groups respectively.

Recall. The recall scores were separated into total number of words (instances) correct, excluding category names, and total category names correct. Table 1 presents the means and medians for both measures for all groups. Recall is very high, it is clear, and only the 24 h Experimental group has a median recall score below the maximum of 25 words. The extreme skewness of the scores mitigates against using conventional analysis of variance. Instead, separate analyses between Experi-

Table 1. Mean and Median (in parentheses) Words and Categories Recalled.

	Experimental	Control
Immediate		
Words	23.67 (25)	24.67 (25)
Categories	4.83 (5)	5.00 (5)
24 hours		
Words	20.75 (21.5)	24.42 (25)
Categories	4.25 (4.5)	4.92 (5)

mental and Control groups were performed at the two retention intervals with the Mann-Whitney U test for both words and category names recalled. On neither measure does the immediate comparison approach significance. However, the difference in mean number of words recalled at 24 h for the Experimental and Control groups is significant, $U=33.5$, $p<.05$ (all p values reported are for a two-tailed hypothesis). At 24 h, comparison of mean number of categories recalled yields $U=40.5$, $p<.10$. In short, there is evidence of RI only with delayed recall. It should be noted that the median number of items recalled per category, given category recall, is 5.0 for all four groups.

Statistical evaluation of the change in interference with time was attempted by comparing the difference scores between experimental and yoked control Ss at the two retention intervals. The mean difference scores for words recalled are 1.00 and 3.67, respectively, at immediate and delayed tests. There are eight zero scores for Immediate groups and three zero difference scores at 24 h. A Mann-Whitney U test corrected for ties (Siegel, 1956, p. 125) yields a z score of 1.86, $p=.063$. The difference in interference at the two intervals is close enough to conventional significance levels to lead us to consider an alternative account than "chance."

Discussion

From the point of view of two-factor interference theory, these results at first are disconcerting. The failure to find immediate RI is evidence that unlearning did not occur. In that case, to what may the RI found at 24 h be attributed? The answer suggested here is loss of list differentiation over time. The data on intrusions are consistent with the implication of loss of differentiation. While none of the three Experimental Ss tested immediately who did not show perfect recall made any List 2 intrusions, after 24 h each of the six Experimental Ss who did not recall perfectly intruded List 2 categories. In fact, there were no omissions on the 24 h recall sheets at all for Experimental Ss. Of course, intrusions can be

interpreted as either responses offered in lieu of unavailable List 1 categories, that is as the outcome of forgetting, or instead as reflecting confusion as to which of ten available categories are in fact from List 1. The latter alternative points to loss of differentiation as the cause of the observed recall decrement. Since intrusions are notorious for their relative scarcity, a case where the ratio of observed intrusions over opportunities equals 1 points to a loss of differentiation. In addition, three Ss in the 24 h group were observed writing down all ten category names on the side of the test sheet and then choosing the five discriminated as coming from List 1, while other Ss asked E, following the test, whether they had "picked the right ones" and recited all ten category names. An MMFR test would be required to conclusively demonstrate, however, that there was no significant loss of availability.

That there is a steep loss of differentiation over time has been demonstrated elsewhere (Winograd, in press). It has further been argued that the effect of such a loss, in any study of delayed RI or PI which tests recall of a single list, is to overestimate loss of availability in the experimental group. If the interpretation of the present results just offered is correct, these data are an example of such an overestimation.

References

- COHEN, B. H., BOUSFIELD, W. A., & WHITMARSH, G. A. Cultural norms for verbal items in 43 categories. Technical Report No. 22, 1957, University of Connecticut, Contract Nonr 631(00), Office of Naval Research.
- HOUSTON, J. P. Unlearning of specific associations in the A-B, C-D paradigm. *J. exp. Psychol.*, 1967, 74, 254-258.
- McGOVERN, J. B. Extinction of associations in four transfer paradigms. *Psychol. Monogr.*, 1964, 78, No. 16 (Whole No. 593).
- MANDLER, G. Organization and memory. In K. W. Spence & J. T. Spence (Eds.) *The psychology of learning and motivation: Advances in research and theory*. New York: Academic Press, 1967.
- POSTMAN, L., & KEPPEL, G. Retroactive inhibition in free recall. *J. exp. Psychol.*, 1967, 74, 203-211.
- SIEGEL, S. *Nonparametric Statistics for the Behavioral Sciences*. New York: McGraw-Hill, 1956.
- TULVING, E. Free recall. In T. R. Dixon & D. L. Horton (Eds.) *Verbal behavior theory and its relation to general S-R theory*. New York: Prentice Hall, in press.
- WINOGRAD, E. List differentiation as a function of frequency and retention interval. *J. exp. Psychol.*, in press.

Notes

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