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Instructed Forgetting: Rehearsal Control or Retrieval Inhibition (Repression)?[1]

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In a Brown–Peterson short-term memory task three different incentive conditions (remember and rehearse, remember without rehearsing, or forget) were cued by varying the color background of a trigram slide. A self-paced interpolated task was used so that differences in covert rehearsal could be inferred from backward counting rates under the various motivational conditions. It was concluded that S's poor recall in the forget condition was due to a slower rehearsal rate than in the other conditions. However, this explanation was insufficient in accounting for poorer recall in the forget as compared to nonrehearse condition, where an interpretation involving differential attention to the trigram at presentation was offered. Each difference in memory performance was matched by a corresponding difference in counting performance. Results of a postexperimental recognition test and questionnaire supported these conclusions.

A recent series of studies by Weiner (1968) and Weiner and Reed (1969) have helped to renew interest in the issue of motivated forgetting. In these studies Weiner and Reed have used a short-term memory task similar to that of Brown (1958) and Peterson and Peterson (1959) where S reads aloud a consonant trigram and then performs an interpolated distractor task for 3, 9, or 17 sec before recall. Concomitant with the presentation of the trigram, S receives a color cue denoting one of three instructional sets: Remember and rehearse the trigram, remember it without rehearsing, or forget it. The general finding is that at the shortest interval there is little difference among conditions, but that at the longer intervals recall is greatest in the remember and rehearse condition and smallest in the forget condition with the nonrehearse condition intermediate.

Various findings have led Weiner to the position that the motivational cueing effects are not due to factors operating at trace formation or

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trace storage, but rather to factors operating at the stage of trace utilization or retrieval (Melton, 1963). Specifically, these effects have been termed "retrieval inhibition" and linked to the Freudian concept of repression. Weiner and Reed (1969, p. 229) state that "the motivated forgetting . . . is not due to differential search or response suppression. Rather, some dynamic process, akin to what might be meant to be repression, appears to be operative and functions to impede trace retrieval." Freud did specify repression as a phenomenon of trace utilization rather than trace formation or trace storage. He states in one place that "The forgotten material is not extinguished, only 'repressed,' its traces are extant in memory in their original freshness, but they are isolated by 'counter-cathexes' [1939, pp. 120–121]."

An alternative interpretation of these results is that the instructions simply produce differential covert rehearsal on the part of S during the retention interval. That is, S rehearses most when told to remember and rehearse, less when told to remember without rehearsing, and least of all when told to forget. In discussing the effects of positive motivation on memory Weiner and Walker (1966, p. 192) note that "if motivational manipulations result in differential rehearsal, then the degree of learning becomes confounded with the storage process, and demonstrating that motivation influences retention would certainly be a formidable problem. In this experiment subjects were paced during the interpolated task to minimize the amount of rehearsal; there is no evidence that subjects do or do not covertly rehearse one set of stimuli more than another set."

Weiner's studies have invariably used force-paced interpolated tasks in an effort to minimize rehearsal. That is, the Ss in these studies were required to perform the interpolated task to the beat of a metronome. However, it is unlikely that any single rate of the metronome could be equally effective for all Ss in preventing rehearsal; therefore, at least some Ss probably had ample time to rehearse. Crowder (1967a,b) has argued that short-term memory tasks with interpolated activity bear a close relation to procedures used for the study of division of attention, since there is competition in the former between tendencies to rehearse the memory item and execute the filler activity. Using a self-paced task (where S is told to perform the interpolated activity as fast as possible), Crowder found that even when Ss are told not to rehearse, their performance on the interpolated activity is worse when they are simultaneously trying to remember an item than when simply performing the interpolated activity in absence of a memory load. This decrement in performance presumably reflects S's rehearsal.

The purpose of the present research was to clarify motivated forgetting effects in the Weiner paradigm by using a self-paced interpolated task, thereby allowing indirect evaluation of rehearsal. Wickens and Simpson (1968) have similarly analyzed Weiner's experiments on the effects of positive incentives on memory (e.g., Weiner & Walker, 1966).

METHOD

Subjects. The Ss were high school and college students paid $1.75. Some Ss had participated in experiments on human memory, but never with CCC trigrams and never with the STM distractor technique. There were 7 males and 11 females.

Materials and design. All materials were presented by a Kodak Carousel slide projector placed behind S and focused on a white screen approximately three feet in front of him. Three Hunter variable interval timers associated with the projector governed the intervals during the trials.

The to-be-remembered items were 54 CCC trigrams of less than 35% associative strength (Witmer, 1935), none of which contained two or more highly confusable letters (B, D, P, T, V, Z; Conrad, 1964). Below the trigram was a three-digit number used in connection with the distractor task. Thus each trigram was always associated with the same three-digit number. The trigrams were presented in the same order for every S, thus perfectly confounding items with practice. A discriminative color cue (blue, green, or yellow) was also randomly associated with each stimulus in order to convey differential instructions to Ss. The color was constant for each trigram, but each of the six possible color-instruction combinations was used for subgroups of three Ss. The three instructional sets combined with three time intervals to make nine conditions, with six trials given in each condition. Order of conditions was determined so that across Ss each trigram appeared in each condition equally often. Thirty-six three-digit numbers were prepared alone on slides. These number slides were used, 12 before, 12 half-way through, and 12 after the 54 STM trials, as measures of counting performance in the absence of memory load.

Procedure. The Ss were told that they would be given two basic tasks, one involving counting backwards by 3's as fast as possible, and the other involving trying to remember a "nonsense word." For the memory task Ss were told to read both the letters and digits aloud without hesitation before counting backwards "as fast as possible without making errors."

The Ss were next given instructions on the meaning of the color cues. On a third of the trials the cue indicated that S should try to remember and rehearse the item while still counting quickly, and to "try not to slow down your counting during your efforts to rehearse the item." On another third of the trials Ss were told to try to remember the item during the retention interval, but without covert rehearsal. On the remaining third of the trials, *S* was told that *E* wanted him "to try something rather novel. I want you to deliberately attempt to forget the letters between the time you first see them and read them aloud, and the time the dashed line appears after your backward counting."

The Ss were told to attempt to "erase the letters from their memory." *E* continued:

> Now of course anyone could pretend to have forgotten the letters simply by voluntarily not reporting them when the dashed line appears. I am counting on you not to do this but rather to give us an honest report of what you remember when the recall period comes. But until asked for your recall, you should be trying to forget the letters.

The two blocks of 27 STM trials were interspersed among the three 12-trial blocks of counting only. There were approximately 45 sec between blocks for changing slide trays, and before each block *S* was reminded to count as fast as possible. Before STM blocks he was also reminded of the meaning of the color cues. Each trial began with a 1.5-sec presentation of the stimulus slide (timed from onset to offset of slide). There was then a 3, 9, or 17 sec period for backward counting (retention interval). The counting interval was timed from stimulus offset to the onset of a recall cue—a slide with 5 blank spaces. One point was scored for each letter recalled, and two points if the letter was retained in its correct position. The *S* was informed that both the number and order of the letters would be scored. The *E* counted how many three-digit numbers were spoken during the retention interval, but kept no record of accuracy. The *S* was given credit for his initial reading of the three-digit number as well as any counting responses he could accomplish before offset of the stimulus slide.

Following the last block of backward counting, *S* was given a sheet with 100 trigrams (54 used on the memory trials randomly intermixed with 46 more from the same pool) and told to proceed through the list at their own rate circling all those they remembered seeing (regardless of the original instructional condition). After this *S* filled out a questionnaire concerned with his strategies during the experiment.

RESULTS

Figure 1 gives the mean retention in the three experimental conditions at each delay interval. Numbers in parentheses give percentage retention for each point. It can be seen that recall was best in the remember and rehearse, intermediate in the remember without rehearsing, and worst in the forget conditions, respectively. A repeated measures analysis

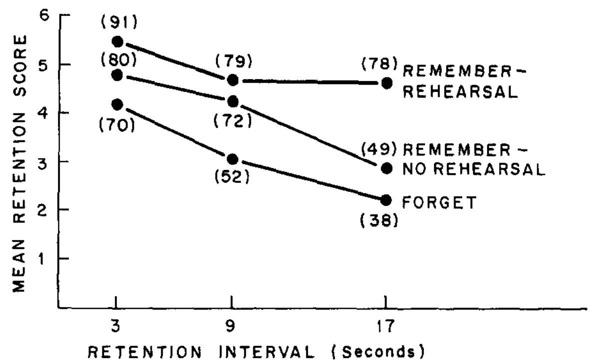

FIG. 1. The relation between mean retention scores (no. correct letters plus no. in proper position) and retention interval. Numbers in parentheses are mean percentages of the maximum retention score.

of variance gave statistically significant main effects of instructional set, $F(2,34) = 28.92$, $p < .001$; delay, $F(2,34) = 35.28$, $p < .001$; and a statistically significant Instruction $\times$ Delay interaction, $F(4,68) = 4.83$, $p < .005$.

The mean number of counting responses in each condition for each delay is shown in Fig. 2. For each of the three instructional conditions (and also for the counting-only condition) the best-fitting linear functions are shown; the nonzero intercepts result from the opportunity for beginning number counting while the stimulus trigram was still on the screen (i.e., before timing of the retention interval started). It should be noted that the intercept for the counting-only function is artificially high because S was not required to read a trigram before he began counting. An analysis of variance performed on the 3 instructional conditions (i.e., omitting the counting-only control) $\times$ 3 delay intervals showed a statistically significant effect of instructions, $F(2,34) = 20.20$, $p < .001$; delay, $F(2,34) = 213.70$, $p < .001$; and Instruction $\times$ Delay interaction, $F(4,68) = 7.30$, $p < .001$. It appears that S counted slowest in the rehearse condition and fastest in the forget condition (except when counting in absence of a memory load).[2]

[2] Broverman, Klaiber, Kobayashi, and Vogel (1968) have reviewed evidence indicating that women are generally superior to men on simple, repetitive motor tasks (e.g., typewriting), while men are superior to women on tasks requiring "cognitive restructuring" (e.g., discovery of hidden figures). Since backward counting is defined by them as a cognitive restructuring task, the present data were analyzed for sex differences. On the 36 trials where Ss counted as fast as possible in absence of a memory load, men counted significantly faster than women (1.33 vs 1.04 responses/sec), $t(16) = 1.77$, $p < .05$, one-tailed. However, across all trials the difference was not significant (1.07 vs .90 responses/sec), $t(16) = 1.39$.

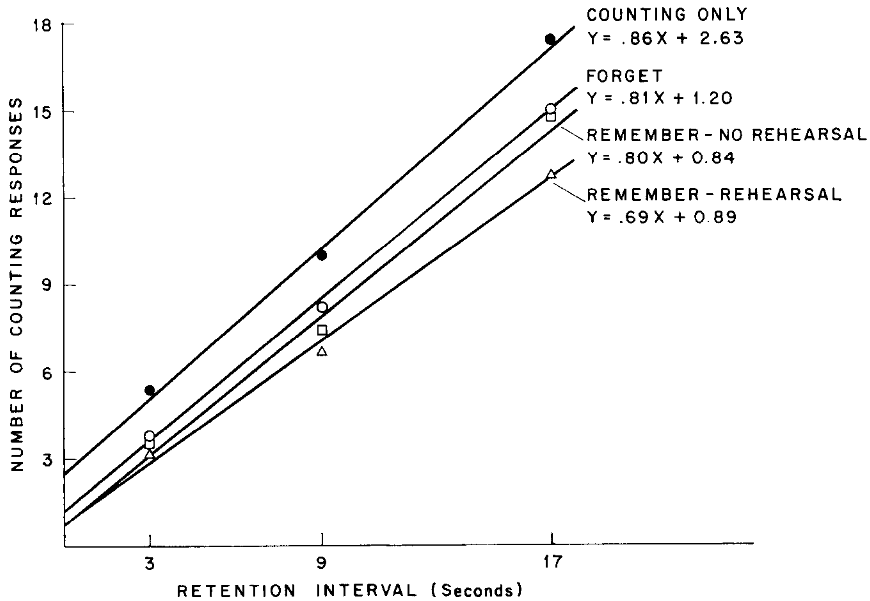

FIG. 2. The relation between number of counting responses (interpolated task) and retention interval, with experimental conditions the parameter. The straight lines and their equations were determined by the least-squares method.

Mean performance (correct positives) on the recognition test (out of a possible 18) was as follows: remember and rehearse, 7.89; remember without rehearsing, 7.39; and forget, 5.94. The forget condition differed significantly from the other two conditions ($p < .02$, signed-ranks test), which were not different from each other. The mean number of false positives was 8.95.

DISCUSSION

Since the present results on recall of trigrams match the typical Weiner–Reed pattern of results, it may be concluded that the procedural changes made here (to permit measurement of distractor-task performance) did not alter the operation of the instructional variable. However, the generally lower recall found in the present study is probably due to such changes in procedure as the switch from a forced-paced to a self-paced interpolated task. Also, in the present study S was responsible for reading off the number from the slide on which the trigram appeared, thus perhaps allowing less time for initial rehearsal than in Weiner's studies, where the distractor task was delayed until the second slide appeared.

Given the assumption that S has limited information-processing capacity which he must divide, during the retention interval, between covert rehearsal and performance on the distractor task, then the backward counting scores may be interpreted as an inverse index of covert rehearsal. Specifically, the slopes of the best-fitting linear function relating counting to retention interval gives information about the average rate of counting backward after the initial three seconds. (Although the functions appear slightly bowed, linear regression accounts for more than 98% of the variance of the overall mean number of counting responses for each condition.) The most straightforward test of the logic of this research is a comparison of the counting rate when S was asked deliberately to rehearse with the rate when he was asked not to rehearse, values of .69 responses/second, and .80 responses/second, respectively. This significant slope difference (demonstrated by the Instruction $\times$ Delay interaction in counting responses) indicates that instructed adjustment of rehearsal rates had measurable consequences for performance on the distractor task.

The main result concerning voluntary forgetting was that with respect to counting rate, i.e., slope of the counting function, an instruction to forget had the same effect as an instruction not to rehearse (slopes of .81 and .80, respectively). However, recall was better in the rehearsal-avoidance condition than in the forget condition. Fortunately, the equality of slopes in counting for these conditions makes the significant intercept difference between them interpretable in terms of differences in counting performance occurring in the initial period (before 3 sec) of the retention interval. The significance of this difference is demonstrated by the greater overall number of counting responses emitted in the forget than in the nonrehearse condition, $t(35) = 2.13$, $p < .025$, one-tailed. In other words, Ss accomplished more responses in the initial three seconds under the forget instruction than under the remember-without-rehearsal instruction, though they counted at nearly identical rates afterwards.

One especially plausible interpretation of this finding is that when warned against rehearsal yet responsible for retention, Ss hesitated longer initiating their counting than when allowed to forget the item, as if "taking a longer look" (or repeating the item quickly to himself) was not really noncompliance since the distractor task had not yet started. Thus, we are arguing, once the distractor task was underway, a forget instruction was interpreted exactly as an instruction not to rehearse. The fact that good recall was the target and was achieved in one condition but not in the other is associated with differences in initial study time. Although the intercept difference between the forget and nonrehearse conditions was statistically significant, the numerical size of this difference was not impressive. Still, in the absence of detailed knowledge concerning the trade-off between counting responses and retention it is not possible to evaluate absolute differences with any conviction. The important point remains that each statistically significant recall difference in this experiment was matched by a statistically significant difference in the interpolated counting task.

These results indicate that Weiner's instructional manipulations affect strategies during trace formation and trace storage, but no evidence was found requiring appeal to retrieval effects. Results from the postexperimental recognition test are not inconsistent with this conclusion. If it is assumed that items learned under the different instructional sets are equally strong in storage, but differentially available at retrieval (due to retrieval inhibition), then on the postexperimental recognition test items from the different conditions should be recalled equally, since they are dissociated from the motivating instruction. However, "forget" items were recalled more poorly than "rehearse" or "nonrehearse" items, which seems to indicate that their poorer retention in the recall test was due to a failure of acquisition or storage rather than inhibition at retrieval or repression. A possible problem with this interpretation of the recognition results is that those conditions with superior postexperimental recognition were also those where recall was superior during the earlier STM trials. If correctly recalling an item constitutes an additional learning trial for it, then the recognition differences could be an artifactual consequence of the recall differences. However, in a somewhat different experimental situation, recognition differences have been shown to survive this confounding (Davis & Okada, 1971).

Further evidence comes from the postexperimental questionnaire where in three items, S was asked simply to "Describe briefly what you did in trying to remember and rehearse (or remember without rehearsing or forget) an item." Fourteen of 18 Ss specified that in trying to remember and rehearse an item they repeated the item to themselves at some point during their backward counting. In forgetting an item, 16 of 18 Ss said they tried to concentrate on counting as fast as possible to aid in forgetting, though many admitted that this did not always enable them to "erase" the item from memory. There was no consistent description of the remember-without-rehearsing condition, although six Ss said they tried to take more time with the trigram initially before beginning their backward counting. Only two Ss admitted to response suppression, and both claimed to have done so only occasionally. Their data were included in the analyses since any response suppression would seem to work against the hypothesis being tested.

Although the present results do not require appeal to retrieval effects, several other studies with the same task have been interpreted as showing "retrieval inhibition." Weiner and Reed (1969) compared the effects of forget and nonrehearse instructions as a function of when during the retention interval these instructions were given. According to rehearsal interpretation of cueing effects, the differences should have been larger with early cueing than with late cueing. In the Weiner–Reed study (Exp. II) the results showed a larger difference between the forget and nonrehearse instructions when these were given after the first 3 sec of the interval than when they were given at 6, 9, or 13.7 sec; however, the difference was not statistically significant. In a subsequent experiment based on the same logic, Reed (1970, Exp. II) presented pairs of trigrams on individual Brown–Peterson type trials and measured recall of the first as a function of when the second was cued for intentional forgetting. In this case, there was a statistically larger cueing effect when the instruction was given early in the interval than when it was given late, supporting the rehearsal interpretation. Another class of experiments involving multiple presentations of each stimulus with the instructional set (either the same or different) has also been interpreted as favoring a retrieval-inhibition hypothesis (Weiner & Reed, 1969, Exps. III & IV; Reed, 1970, Exps. III & IV).

In instructed forgetting studies with other than Brown–Peterson tasks the rehearsal hypothesis seems necessary, but not sufficient, to account for the results. Studies by Bjork (1970), Gross, Barresi, and Smith (1970), Bruce and Papay (1970), and Reitman, Malin, Bjork, and Higman (1971), using different techniques all support the interpretation that instructions to forget produce altered rehearsal strategies. That this is not the only effect is indicated by a failure to find retention differences between "remembered" and "forgotten" items on recognition tests (Bruce & Papay, 1970; Elmes, Adams & Roediger, 1970; Elmes & Wilkinson, 1971; however, see Davis & Okada, 1971). It seems most likely that subjects in these situations organize the presented material along a dimension of to-be-rememberedness (or into the groups "remember" and "forget"), and then set aside the irrelevant or to-be-forgotten set (cf. Bjork, 1970; Epstein, 1969). Such a strategy is relatively unlikely to occur in the Brown–Peterson task. Bugelski's (1970) finding that when Ss are instructed to form images to words these words are less amenable to instructed forgetting seems to imply that the process of voluntary (or positive or cued) forgetting is more complicated than a simple theory involving differential rehearsal and grouping of items would indicate.

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