Bulletin of the Psychonomic Society
1976, Vol. 8 (6), 449-452

The effects of recognition and recall instructions on short-term and long-term retention of unfamiliar visual information

THOMAS E. EVANS and M. RAY DENNY
Michigan State University, East Lansing, Michigan 48824

The effect of temporal placement of instructions and processing demands on long- and short-term retention was studied using random visual patterns to minimize effects of verbal coding and prior learning. Long-term recognition was superior to long-term recall under the recognition but not the recall-demand condition. Errors in short-term memory perseverated across trials, and repetition enhancement of short-term recall accuracy (learning) occurred under a pre- but not a poststimulus instruction to recall, suggesting that temporal placement of recall instructions is critical to coding accuracy.

A number of studies indicate that subjects who are informed that they will be tested for recall of to-be-learned material perform differently at retention test than those who are given recognition instructions (e.g., Bernbach, 1973; Bernbach & Kupchok, 1972; Loftus, 1971).

The main concern here was to investigate the effects of recall and recognition instructions on the long-term retention of *nonverbal* rather than verbal materials, using random visual patterns that were difficult to code verbally and reproduced with errors even after several presentations. We expected recall to maximize and recognition instructions to minimize retrieval activity even though the materials were nonverbal, so that long-term recall of visual patterns would be better following instructions to recall than following instructions to recognize during repeated short-term tests (trials).

The present study also dealt with the enhancement of short-term recall with repeated trials (learning). Hebb (1961) and Melton (1963) have found increased accuracy of recall when a particular stimulus string is repeated several times while alternating with novel strings. Turvey (1967), using the Sperling method (1960), found no repetition enhancement, presumably because processing with the Sperling model does not require central encoding and encoding is responsible for learning. We assumed, accordingly, that a pre- but not a poststimulus instruction to recall increases encoding or maximizes retrieval activity, so that improvement of short-term recall over trials occurs mainly for prestimulus conditions.

T. E. Evans is now at the Department of Psychology, Olivet College, Olivet, Michigan 49076. Requests for reprints should be sent to Dr. Evans at that address. The advice and assistance of Drs. Lester Hyman and James Uleman are gratefully acknowledged.

METHOD

Subjects and Materials

The subjects were 100 volunteers from introductory psychology classes at Michigan State University, randomly assigned to four equal groups. The experimental room was 2 x 5.5 m, seating 8-12 subjects in three rows of four seats, with the nearest row 1.5 m and the furthest less than 4 m from the screen. The memory items were patterns of black squares on a white background. In a 5 x 5 in. field, each of the 25 1-in. squares was numerically coded, and 8 numbers were chosen for each pattern without replacement from a table of random numbers. From 25 eight-square patterns generated in this manner, six pairs of patterns were chosen; six for original learning plus six highly similar mates as alternatives for the 24-h recognition test. For counterbalancing purposes, the six original patterns were divided equally into Pattern Set 1 and Pattern Set 2. The patterns were projected on a .6 by .6 m screen with a Kodak Carousel in a semidarkened room.

Procedure

The experiment used a mixed 2 x 2 x 2 x 2 design (short-term test by long-term test by temporal placement by pattern sets). On Day 1 all subjects were given short-term (5 sec) recall tests for half of the patterns and short-term recognition tests for the other half. On Day 2 all subjects were given both a 24-h recall test and a 24-h recognition test, in that order, for retention of all patterns seen on Day 1. Subjects in Groups 1 and 3 received prestimulus instructions during acquisition, while subjects in Groups 2 and 4 received poststimulus instructions 5 sec after stimulus presentation. Groups 1 and 2 had to recall Set 1 patterns and recognize Set 2, while the reverse was true for Groups 3 and 4.

Presentation of the six different patterns constituted a trial. There were four trials, and the order of patterns within each trial was randomized. The subjects were not told that patterns appeared more than once; terminal questioning indicated that most were unaware of the repetition and that all subjects were unaware that certain patterns were tested in a particular way.

Each subject had a prearranged stack of data sheets, a different sheet for each trial. On a recall trial, reproductions were drawn in the empty grid on the data sheet. On a recognition trial, there were three randomly positioned grids with Xs in the appropriate squares for the three patterns of a recognition set (Set 1 or 2). The experimenter read: "You will be shown a series

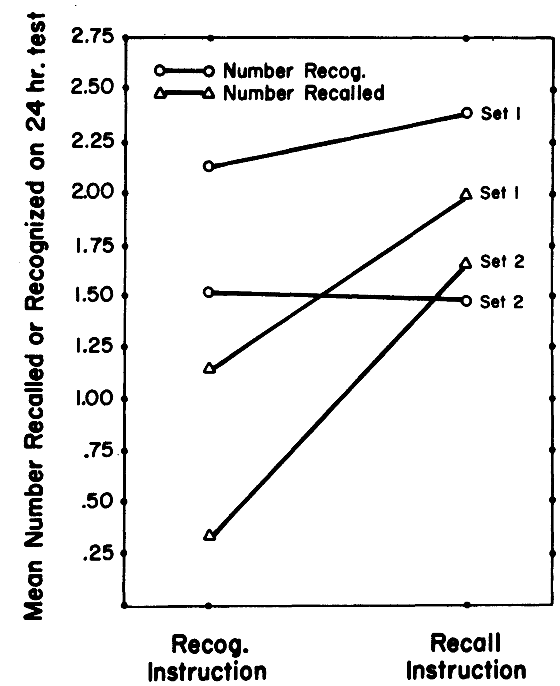

Figure 1. Mean number of patterns recalled and recognized on the 24-h test as a function of recall vs. recognition instructions given during short-term testing and pooled across pre- vs. poststimulus instructions.

of patterns of black squares on a white background. We are investigating the ability of humans to maintain the image of a visual pattern. The patterns will appear only briefly, so you must concentrate to see them. For 5 seconds following the termination of the pattern, try to maintain the image while continuing to look at the screen." Explanations of "select it" (recognition) and "draw it" (recall) instructions followed. Under recognition conditions subjects traced the Xs to control for time spent and amount of kinesthetic information gained. The pattern, flashed for approximately .5 sec on each trial, was followed by a 5-sec blank field and preceded by "Here is the next pattern."

The instruction to "draw it" or "select it" was given prior to the pattern for the prestimulus condition and 5 sec after pattern presentation for the poststimulus condition. For the prestimulus condition, the experimenter said, "Proceed" at the end of the 5-sec interval. Immediately following a drawing or selection, the data sheet was covered.

Twenty-four hour test. The subjects were unaware that they were to be tested for retention in the second session, returning ostensibly to participate in a second experiment. On Day 2 the experimenter said, "Produce any correct pattern which you can recall from yesterday's series. Only six correct patterns were presented, four times each, during yesterday's series, three of which you were to recall, three of which you were to select individually from three alternatives." Five minutes after recall, the recognition test with a series of 12 patterns, including the six completely new mates, was presented, When asked, no subject reported suspecting a 24-h retention test.

Scoring procedure for accuracy of recall. The procedure for assessing learning during short-term recall gave a direct-overlap square 3 points, a right-angle proximity square 2 points, and a diagonal-proximity square 1.5 points. No square was scored more than once. The three scores were added and averaged to give a total mean score, which was carefully corrected for guessing. In general, the uncorrected data were very much like the corrected, and in every case a perfect score of 3.0 could only be obtained with a perfect reproduction.

RESULTS AND DISCUSSION

The 24-Hour Test

We could not expect 24-h reproductions to be perfect, since most subjects could not draw a pattern perfectly on short-term tests. When a pattern was recalled on Day 2, it was, in most instances, recalled with the same degree of accuracy as on short-term tests. Thus, frequency data were used; a pattern was scored recalled or not recalled. All reproductions were scored blind for all conditions, and those not clearly identifiable as approximating an original pattern were scored as not recalled.

Frequency scores ranged from 0 to 3 correct for each pattern set for both 24-h recognition and recall tests. Two 2 by 2 by 2 analyses of variance, with one repeated measure on the last factor, were conducted. The three factors were Pattern Set (1 and 2), Temporal Placement of instructions (pre- and post-), and Tests (recognition and recall). The analysis was done separately for recognition and recall instructions.

The frequency of correct recognition was greater than the frequency of correct recall when the patterns were processed under a recognition instruction [$F(1,103) = 151.48$, $p < .001$]. But, as can be seen in Figure 1, this difference disappeared when the patterns were processed under a recall instruction [$F(1,103) = 1.40$, n.s.]. Such a finding seems to be quite independent of how comparable the measures of recognition and recall were or their order of presentation and extends the similar findings of Bernbach (1973) to nonverbal materials.

The simplest interpretation of these results is that processing in an explicit recall task is different from that of a recognition task. These data can be interpreted as in agreement with the dual-process theory described by Kintsch (1970), in which retrieval is independent of recognition, as well as the levels of analysis position (Craik & Lockhart, 1972) that predicts better recall following recall instructions. The analysis revealed other

Table 1
Mean Number of Patterns Recognized and Recalled at 24-H Test Under Recall and Recognition Instructions Pre- and Poststimulus

		Pattern Set 1		Pattern Set 2	
		Number Recognized	Number Recalled	Number Recognized	Number Recalled
Recall Instruction	Pre	2.48	1.92	1.32	1.80
	Post	2.32	2.04	1.64	1.56
Recognition Instruction	Pre	1.88	.92	1.28	.28
	Post	2.39	1.35	1.74	.37

results bearing on these positions. Patterns processed under a recognition instruction were both recalled and recognized more frequently under the poststimulus than under the prestimulus condition [$F(1,103) = 12.05$, $p < .001$], while the pre- vs. poststimulus variable had no significant effect when patterns were processed under a recall instruction [$F(1,103) = .0021$, n.s.] (see Table 1). These findings seem to indicate that a prestimulus recognition instruction has a negative impact on long-term retention, regardless of which measure of retention is used. Also, Set 1 patterns were unexpectedly recalled and recognized more frequently than Set 2 patterns, regardless of the type of instruction [$F(1,99) = 44.900$, $p < .001$ under recognition instructions; $F(1,99) = 27.154$, $p < .001$ under recall instructions].

Learning: Change In Accuracy from Trial 2 to Trial 4

Since recognition was virtually perfect throughout short-term testing, only the recall condition allowed for an analysis of the learning with repeated testing. The analysis of variance for a 2 by 2 by 2 design with repeated measures on the Learning factor included Temporal Placement of instructions, Pattern Sets, and Learning (the accuracy on Trial 2 vs. that on Trial 4 since Trial 2 was more stable than Trial 1). There were no significant main effects for Temporal Placement, but a significant Instructions by Learning interaction [$F(1,89) = 5.412$, $p < .05$] indicated a greater increase in performance from Trial 2 to Trial 4 for the prestimulus condition for recall than for the poststimulus condition for recall (mean differences of .112 and .019, respectively; see Figure 2). The finding of greater repetition enhancement under the pre- than under the poststimulus instruction

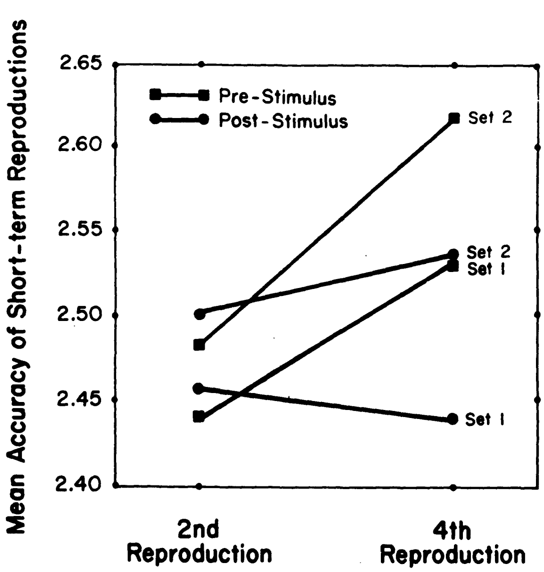

Figure 2. Mean accuracy of recall during short-term testing for the second and fourth reproductions of Pattern Sets 1 and 2 under pre- and poststimulus instructions.

Table 2
Mean Accuracy Score for the Fourth Reproduction During Short-Term Testing, Using the Second Reproduction (2) and the Original Pattern (0) as Scoring Standards

Temporal Placement of Instructions	Scoring Standard	Set 1	Set 2
Pre	2	2.596	2.294
	0	2.532	2.617
Post	2	2.480	2.319
	0	2.443	2.534

Note–Maximum score = 3.00

seems consistent with both the retrieval and the level of analysis positions.

Learning occurred, i.e., the differences between scores on Trial 2 and Trial 4 were significant [$F(1,89) = 9.108$, $p < .01$], and a significant Pattern Set effect [$F(1,89) = 4.223$, $p < .05$] reflected greater learning for Pattern Set 2 than the easier Set 1.

Encoding Fixation

Errors in initial encoding seemed to perseverate under the recall condition. A subject who misplaced a square on Trial 1 was likely to continue doing so. To evaluate the possibility that encoding fixation tended to prevent accurate learning of the original pattern, a repeated measures 2 by 2 by 2 analysis of variance was conducted, using as the Encoding Fixation factor the accuracy score on the fourth reproduction scored with two different standards, the second reproduction (4 on 2) and the original pattern (4 on 0).

There was no significant Instructions effect, and the main effect of Pattern Set was borderline [$F(1,89) = 2.849$, $p < .10$]; pattern sets showed up prominently in a highly significant Pattern Sets by Encoding Fixation interaction [$F(1,89) = 21.81$, $p < .001$]. This interaction resulted from a higher 4 on 2 than on 0 score for Set 1, with the reverse (a higher 4 on 0 than 4 on 2) for Set 2 (see Table 2). The main effect for encoding fixation was significant [$F(1,89) = 10.263$, $p < .01$], reflecting fixation when the subjects were processing patterns of Set 1. This result is consistent with the finding that patterns in Set 2 yielded more learning than patterns in Set 1: an encoding fixation would interfere with learning the original pattern. In other words, unfamiliar visual information tends to be encoded in the same manner repeatedly, regardless of accuracy, as is the case for meaningful paragraphs (Kay, 1955), and is consistent with elicitation theory (Denny, 1966).

REFERENCES

Bernbach, H. A. Processing strategies for recognition and recall. *Journal of Experimental Psychology*, 1973, **99**, 409-412.

Bernbach, H. A., & Kupchok, P. G. Recognition and recall in short-term memory. *Journal of Mathematical Psychology*, 1972, **9**, 237-242.

Craik, F. I. M., & Lockhart, R. S. Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, 1972, **11**, 671-684.

Denny, M. R. A theoretical analysis and its application to training the mentally retarded. In N. Ellis (Ed.), *International review of research in mental retardation* (Vol. 2). New York: Academic Press, 1966.

Hebb, D. O. Distinctive features of learning in the higher animal. In J. F. Delafresnaye (Ed.), *Brain mechanisms and learning.* London: Oxford University Press, 1961.

Kay, H. Learning and retaining verbal material. *British Journal of Psychology*, 1955, **44**, 81-100.

Kintsch, W. *Learning, memory, and the conceptual processes.* New York: Wiley, 1970.

Loftus, G. R. Comparison of recognition and recall in a continuous memory task. *Journal of Experimental Psychology*, 1971, **91**, 220-226.

Melton, A. W. Implications of short-term memory for a general theory of memory. *Journal of Verbal Learning and Verbal Behavior*, 1963, **2**, 1-21.

Sperling, G. The information available in brief visual presentations. *Psychological Monographs*, 1960, **74**(No. 11).

Turvey, M. T. Repitition and the pre-perceptual information store. *Journal of Experimental Psychology*, 1967, **74**(No. 2, Part 1), 289-293.

(Received for publication August 4, 1976.)