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Encoding processes for recall and recognition: The effect of instructions and auxiliary task performance

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The present experiment investigated the hypothesis that encoding for recall involves organization of input stimuli, while recognition entails encoding to achieve discriminability of individual items. Subjects were given either recall or recognition instructions, one or three presentations of a list of nouns, and did or did not perform an auxiliary task of repeating the words aloud at input. All subjects received recall and recognition tests. The results showed higher recall with recall instructions in the no-task condition. Oral repetition produced a decrement in recall following recall instructions, but had no effect with recognition instructions. Also, the auxiliary task had no effect on recall with recognition instructions, but with recognition instructions recognition performance was increased to the level of recall subjects. The results are discussed in terms of current models of recall and recognition.

In accounting for free recall performance, models of recall and recognition have incorporated the finding that organization (i.e., forming associations among items) of target items is positively related to efficient retrieval of those items from memory (Klatzky, 1975). However, models of recall and recognition can be distinguished on the basis of the role ascribed to retrieval processes in recognition memory. Dual process theories (Anderson & Bower, 1972; Kintsch, 1970) assume that recall involves search and decision stages, while recognition involves only a decision process. Efficient search is said to require organization of the learning material, but for the decision process stage only individual item discriminability is important. More recent models (Anderson & Bower, 1974) hypothesize that, under certain conditions of testing, retrieval processes play a substantial role in recognition memory.

The relative role of retrieval processes in recall and recognition memory has implications for encoding strategies used during learning by individuals instructed for recall and recognition tests. If it is accepted that people encode information in a manner most consistent with retrieval demands (Craik & Lockhart, 1972; Tversky, 1973), theories hypothesizing that recognition involves a minimal problem in retrieval predict that individuals instructed for recall should organize target items at input, while instructions for recognition should lead to a strategy of encoding to maximize individual item discriminability. To discriminate an item correctly, "information about other items need not be stored with the encoding of that item" (Tversky, 1973, p. 285). However, if retrieval processes are important for recognition, then there should be much overlap in how information is encoded following instructions for recall and recognition tests.

Several researchers have examined encoding differences in recall and recognition. Loftus (1971) presented evidence suggesting different storage processes for recall and recognition. Frost (1972) studied encoding differences using pictorial stimuli that could be encoded on a semantic and/or a visual basis and found that recall- and recognition-instructed subjects encoded similar information during learning, but the information retrieved was a function of the memory test requirements.

In a similarly designed study, Tversky (1973) instructed subjects that they would receive either a recall or recognition test of pictorial stimuli that could be encoded either visually or semantically. All subjects received recall and recognition tests. The results showed both instructional groups encoded visual and semantic information during learning, but subjects performed better on the memory test they were led to expect. The results also suggested that subjects led to believe they would receive a recall test formed associations among picture names, while recognition-instructed subjects encoded information to enable discrimination of the individual pictorial stimulus.

A study by Miller, Maisto, and Rosinsky (Note 1) assessed differences in encoding for recall and recognition of verbal stimuli. The results supported the authors' hypothesis that recall-instructed subjects organize verbal information, while subjects given instructions for recognition tend to encode information to allow discriminability of individual items.

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While the Miller et al. data (Note 1) suggest differential encoding of verbal information as a function of instructions, more conclusive evidence might be obtained through interference with the hypothesized encoding strategy of the instructed groups. In this regard, interference may be possible using an auxiliary task during learning. Using such an approach, interference with the recall group's encoding strategy could be accomplished by selecting an auxiliary task that would be incompatible with forming associations among list stimuli, but still would allow subjects to attend to details of the individual stimulus. Along these lines, Fischler, Rundus, and Atkinson (1970) have required subjects to repeat the target stimuli aloud during learning. Schwartz and Humphreys (1974) found oral repetition to have a slightly enhancing effect on recognition performance.

It is also of interest to determine what effect instructions might have on memory test performance following single vs. multiple presentations of the learning material. If it is accepted that organization of ostensibly unrelated verbal stimuli is enhanced with increased study time (Tulving, 1962) and that study time not used to organize learning material does not facilitate recall performance (Tulving, 1966), recall and recognition instructions encoding differences should be more pronounced with multiple presentations of the learning material. The Miller et al. (Note 1) data support this hypothesis.

The intent of the present study was to examine encoding processes for recall and recognition as a function of both instructions and auxiliary task performance. Four major hypotheses were put forth: (1) instructions to recall or recognize would effect differences in the degree to which subjects organize verbal information during learning; differences in recall were accepted as evidence for differences in organization (e.g., Schwartz & Humphreys, 1974), and higher recall was predicted for subjects given recall instructions than for subjects given recognition instructions; (2) the auxiliary task would produce a more detrimental effect in the recall of recall-instructed compared to recognition-instructed subjects, and it was expected that task effects would be stronger following three list presentations as opposed to just one; (3) for the recognition data, it was hypothesized that the instructional variable would not affect performance; and (4) finally, it was predicted that the task variable would not significantly affect recognition.

METHOD

Subjects

Ninety-six male and female students from introductory psychology classes at the University of Wisconsin-Milwaukee served as subjects. Students received course credit for participating in the experiment. Subjects were assigned randomly to treatment conditions by order of their appearance at the laboratory. All subjects were tested individually.

Apparatus and Materials

Two 40-word lists and one 10-word practice list were constructed using nouns with A or AA ratings on the Thorndike-Lorge count. All words were five to eight letters long and were ostensibly unrelated. Three orders of the 40-word lists were formed by randomizing within four blocks of 10 words. Two random orders of the recognition test were also prepared. Both recognition tests consisted of the two 40-word lists intermixed and arranged in four columns of 20 words. The recognition test for the practice list was constructed in a similar manner using 10 unrelated words randomly intermixed with the 10 target words and arranged in two columns of 10 words.

Subjects sat in a dimly lighted room, 6 ft from a projection screen. Each word was individually presented on a 2 x 2 in. slide, using a Kodak Carousel projecter at a 3-sec rate timed externally by a Hunter interval timer (Model 124S).

Procedure

Prior to the presentation of the test list, each subject was given a practice list of 10 words to learn. The following instructions were read to recall-instructed subjects: "I am going to show you a list of words, one at a time, on the screen before you. After the list has been presented, you will be asked to write down as many of the words as you can, in any order you wish. We will do this twice, first with a short list, then with a longer list. Do you have any questions?" Recognition-instructed subjects were read the same instructions as recall subjects, except recognition subjects were informed their task would be to pick out the words presented from among others not presented. Subjects performing the oral repetition task were instructed to repeat each word aloud three times while that word was on the screen and before the next word appeared.

Immediately following the instructions, the 10-word practice list was presented at a 3-sec rate. After presentation, the experimenter reminded the subjects of their instructions and handed recall-instructed subjects a blank sheet of paper and recognition-instructed subjects the practice recognition test list.

Prior to presentation of the test list, all subjects were told that their task on the next list was the same as on the first list. Subjects receiving three presentations of the test list before recall or recognition were informed of this change, and subjects performing the oral repetition task were instructed to perform the task on all three presentations of the list. Test list items were presented in a different random order for each presentation of the test list, and seven blank slides separated successive presentations of the list.

After the list had been presented, all subjects were given both a recall and a recognition test, with list order balanced in each group. In conditions where the first test administered to subjects was consistent with their instructions, they were reminded of their previous instructions. When the first test was not consistent with previous instructions, subjects were informed of the change. A minimum of 1 min and a maximum of 2 min was allowed for completion of each test.

Design

The recall data were analyzed in a split-plot factorial design with instructions (recall or recognition), number of presentations (one or three), task condition (perform or not perform the auxiliary task), lists, and test order (recall first or second) as between-subjects variables and serial position as a within-subject variable. Thus, there were three subjects in each condition. The recognition data were analyzed in a 2^5 completely randomized factorial design.

RESULTS

Recall Test Performance

The mean number of words correctly recalled as a

Table 1
Mean Free Recall as a Function of Instructions, Number of Presentations, and Task Condition

	Presentations	Task Condition: Task	No Task
Recall Instructions	1	8.58	7.58
	3	11.67	18.08
	Mean	10.13	12.83
Recognition Instructions	1	7.25	5.75
	3	10.83	10.25
	Mean	9.04	8.00

function of instructions, number of presentations, and task condition are presented in Table 1. A split-plot analysis indicated significantly better recall with recall instructions compared to recognition instructions, and better recall with three presentations compared to one [$Fs(1,64) = 13.64$ and 45.40, respectively, $ps < .001$].

While the main effect of task condition was not significant ($p < .25$), the following interactions involving task were significant: Instructions by Task Condition [$F(1,64) = 5.44$, $p < .025$], Number of Presentations by Task Condition [$F(1,64) = 6.72$, $p < .025$], and Instructions by Task Condition by Number of Presentations [$F(1,64) = 4.09$, $p < .05$].

Simple effects tests to probe the three-way interaction indicated that, with one test list presentation, neither instructions nor task condition had a reliable effect. With three presentations of the list, the repetition task had little effect upon the performance of recognition-instructed subjects, but recall-instructed subjects who performed the task recalled significantly fewer words than those who did not [$F(1,64) = 9.47$, $p < .01$]. Under ordinary recall conditions (no oral repetition), the performance of recall-instructed subjects was significantly superior to that of recognition-instructed subjects (Tukey's HSD test, $p < .01$), but with repetition this difference was not significant.

Other significant effects were test order [$F(1,64) = 5.44$, $p < .025$], serial position [$F(3,192) = 7.30$, $p < .001$], and the Test Order by Serial Position interaction [$F(3,192) = 7.55$, $p < .001$]. These findings had no bearing on predictions and will not be discussed in the present report.

Recognition Test Performance

Separate analyses were conducted using the number of correct recognitions and the difference scores obtained by subtracting recognition errors (false alarms) from correct recognitions. Since neither lists nor recognition test form had an effect, the data were pooled over these variables.

Number of presentations yielded the only significant effect in the correct recognition data [$F(1,80) = 95.50$, $p < .001$]. With one presentation, recall-instructed subjects correctly recognized a mean of 22.29 words, while recognition-instructed subjects recognized 23.29 words. With three presentations, recall and recognition-instructed subjects recognized 33.25 and 32.04 words, respectively.

Difference scores are presented in Table 2. The analysis yielded a highly significant presentations effect [$F(1,80) = 84.69$, $p < .001$], a task condition effect [$F(1,80) = 4.14$, $p < .05$], and a Task Condition by Instructions interaction [$F(1,80) = 4.44$, $p < .05$].

From Table 2 it can be seen that, in the absence of oral repetition, recognition performance was better for recall-instructed than recognition-instructed subjects [$F(1,80) = 5.98$, $p < .025$]. This finding, together with no difference in the number of correct recognitions, indicated that recognition-instructed subjects made more recognition errors than did recall-instructed subjects.

The recognition performance of recall-instructed subjects was unaffected by task condition; however, recognition-instructed subjects repeating the words aloud had significantly better recognition performance than those who did not [$F(1,80) = 8.58$, $p < .005$].

DISCUSSION

Dual process models of recall and recognition (Anderson & Bower, 1972; Kintsch, 1970) posit that recall subsumes recognition and suggest that encoding items for recall would also permit efficient item recognition, but that encoding to recognize would not effect efficient recall. The recall data of the present experiment provide partial support for this assertion. In the no-task condition, recall-instructed subjects recalled more words than did recognition-instructed subjects. However, when required to perform the oral repetition task, recall-instructed subjects recalled as many words as recognition-instructed subjects, whose recall was not affected by oral repetition.

Although the free recall data of the present experiment support dual process models, recent data on recall-recognition differences (Tulving & Thomson, 1973), as well as evidence for contextual effects on recognition performance (e.g., Light & Carter-Sobell, 1970), show that retrieval is often necessary for recognition. In fact, demonstrations that retrieval can be important for recognition memory provided the impetus for Anderson and Bower's (1974) revision of their model of recall and recognition. However, Anderson and Bower (1974) also suggest that when recognition tests

Table 2
Mean Recognition Difference Scores as a Function of Instructions, Number of Presentations, and Task Condition

	Presentations	Task Condition: Task	No Task
Recall Instructions	1	20.75	20.92
	3	31.58	31.58
	Mean	26.16	26.25
Recognition Instructions	1	22.59	17.18
	3	31.50	28.33
	Mean	27.04	22.25

occur in the absence of special semantic contexts, the high reliability of access to target items is a "useful simplifying assumption" (p. 411). In this regard, the conditions of recognition testing in the present experiment would appear to minimize retrieval problems, since during both learning and testing, target items were presented singly, and the distractors used in the recognition test were not related to target items in any systematic manner. Rather than supporting a general statement about encoding differences in recall and recognition, the free recall data of the present experiment are interpreted as consistent with the notion that people encode information in a manner most consistent with retrieval demands of the expected memory test. Thus, the importance of testing conditions cannot be over-looked. As the model of Anderson and Bower (1974) suggests, testing conditions can be varied so that optimal encoding for recall and recognition overlap to a large extent.

The finding that oral repetition did not affect the recognition performance of recall-instructed subjects corroborated conclusions based on the recall data. However, the result that in the no-task conditions recognition-instructed subjects' recognition performance was inferior to that of recall-instructed subjects' and equivalent in the task conditions was unexpected (cf. Miller et al., Note 1). The fact that the auxiliary task effected equivalent recognition performance by subjects in the two instructional groups suggests that oral repetition might have provided an opportunity for better integration of the details of individual items than when no task was performed. While this explanation is post hoc, the levels-of-processing analysis of the incidental learning literature (Craik & Lockhart, 1972) does suggest that performance of "incidental" tasks during learning should facilitate memory test performance to the degree that these tasks are more consistent with retrieval demands than are encoding strategies that subjects use in the absence of task requirements.

The present experiment also found no effect for the task variable after one presentation in recall. These findings, however, are not consistent with those of Schwartz and Humphreys (1974), who found a decrement in recall performance with oral repetition. Their procedures, on the other hand, differed from those of the present experiment in several respects: (1) Subjects were not explicitly instructed to study for recall or for recognition, and (2) all subjects performed under four separate conditions.

In conclusion, the present research generally indicated that differential memory test instructions, recall and recognition, initiated different encoding processes. This study also demonstrated the utility of auxiliary tasks in the analysis of these processes. Further use of this technique, combined with manipulation of the number of times the test list is presented and the type of memory test administered may allow for a better understanding of memory storage processes.

REFERENCE NOTE

1. Miller, M. E., Maisto, S. A., & Rosinsky, R. W. *The effect of instructions on recall and recognition performance.* Manuscript in preparation.

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