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# Organizational Factors in Delayed Recall and Recognition

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ABSTRACT

A series of experiments investigating long-term retention is reported. Our earlier finding (McDaniel & Masson, 1977) that delayed recall of words is improved when subjects are instructed to learn during encoding was replicated. Delayed recognition was not affected by instructions to learn. The instructional effect did not appear in delayed recall of subjects who were given a recall test immediately after encoding. The effect did not occur when no organizational strategy was available to subjects, nor when both intentional and incidental learning subjects were able to perceive and use the taxonomic structure inherent in a word list. Optimal delayed recall seems to depend on organizational strategies while immediate recall may be based on memory for item-specific encoding episodes.

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In the past several years there have been numerous studies which have demonstrated that incidental semantic processing of verbal materials produces memory performance comparable to that produced by "intentional" rehearsal (Craik & Tulving, 1975; Jenkins, 1974). This kind of finding has lended support to, and urged acceptance of, processing theories of memory (e.g., Craik & Lockhart, 1972) which consider remembering to be a function of the degree to which an item is semantically processed. In other words, for these theories, the degree of semantic processing is seen as the primary variable in understanding memorial functioning.

Recently, however, we (McDaniel & Masson, 1977) found that, under certain conditions, long-term (24 hour) memory was better for subjects who were given instructins to learn a word list and performed various encoding tasks than for subjects who just performed the encoding tasks. Specifically, when a structured word list was used and the encoding procedure was such that a different type of encoding task was used for each word in a taxonomic category, intentional subjects recalled more words than incidental subjects. When the same structured word list was used and only one type of encoding task was required for the entire list, the level of recall for intentional and incidental subjects was comparable. Additionally, the lack of differences in recall between intentional and incidental subjects was due to incidental subjects improving relative to their performance in the multiple encoding procedure. This improvement in recall was correlated with an increase in the level of clustering.

These resuts imply that semantic processing of an item is by itself not <u>always</u> sufficient for good long-term retention. Instructions to learn apparently induce subjects to engage in some type of additional processing which proves beneficial to memory performance above that of semantic processing alone. This suggests that modifications are in order concerning the idea that memory performance is basically a function of semantic processing.

The results of the McDaniel and Masson study, however, do not allow one to conclusively specify the nature of this additional processing. The fact that incidental learners showed levels of recall comparable to intentional learners only when clustering was not broken up (via the encoding task), suggests that the additional processing necessary for good long-term retention may be organizational in nature. This hypothesis is consistent with the work of Bellezza, Richards, and Geiselman (1976) who maintain that semantic processing <u>and</u> organization must take place for optimal recall. On the other hand, we (McDaniel and Masson, 1977) reasoned that since clustering was not high for the intentional learners, organization was not a major factor in guiding their recall. Rather, we concluded that "intentional" processing allowed subjects to develop memory traces that were richer (cf. Lockhart, Craik, & Jacoby, 1976) or more elaborate (cf. Craik & Tulving, 1975) than those produced by semantic processing alone, and it was this richness or elaborateness of the trace that produced the good long-term retention for intentional learners. Clearly, additional experimentation is needed to clarify the nature of the differences underlying the long-term recall performance of incidental and intentional processing.

In addition to the implications for current processing theories of memory, such research is important for another reason. Our earlier results offered strong support for the idea that the processing that maximizes long-term retention may be different from that which maximizes short-term retention (cf. Lockhart et. al., 1976). Because intentional and incidental processing were comparable for immediate recall but not delayed recall, specification of the processing (other than semantic processing alone) induced by instructions to learn could be useful in identifying the different requirements for long- and short-term retention.

The present series of experiments was conducted to further explore the effects reported by McDaniel and Masson. Experiment 1 is a replication and extension of the previous study. We felt it necessary to provide replication of the long-term memory advantage for subjects given instructions to learn because of the controversial nature of such an effect and its theoretical impact. Experiments 2,3, and 4 systematically investigate this long-term memory advantage for subjects given instructions to learn compared to subjects performing incidental processing tasks. Their purpose is to specify when and why this effect occurs.

## Experiment 1

As replication of our earlier work, type of processing was manipulated by using different instructional conditions. In the first condition subjects performed an encoding task on each item and also were instructed to use any kind of rehearsal they felt would aid in remembering the words. Subjects in the second condition performed encoding tasks but were not forewarned about memory tests. Type of encoding task (2 semantic and 1 nonsemantic) was manipulated as a within-subjects variable and a structured word list was used.

Several features not included in the McDaniel and Masson study were added to the present design. All of the subjects received delayed recall and recognition tests, and half of the subjects also received an immediate recall test. The recognition test was added to see if the long-term retention differences betweeen intentional and incidental learners could also be observed for recognition. Belleza et al. (1976) found that organization boosted recall but not recogniton. Thus, finding instructional effects in recall but not recognition would support the idea that instructions to learn provide an advantage over incidental semantic processing because of organization. Finding instructional effects in both recall and recogntion, however, would imply that the advantage of instructions to learn is not due to organizational factors. The prior recall manipulation (immediate recall followed by delayed recall) was added to further investigate the boundary conditions of the instructional effect in delayed recall. We felt it would be important to see if the lack of differences commonly observed between instructional groups in immediate recall would persist when the same subjects were subsequently given a delayed recall test or if the delayed recall effect would occur regardless of whether or not subjects had undergone an immediate recall.

## Method

Subjects. Subjects were 72 male and female undergraduates at the University of Colorado, participating to fulfill an introductory psychology course requirement. There were 18 subjects in each cell of the design.

Materials. Stimuli were 30 concrete nouns, 3 in each of 10 taxonomic categories. Each noun in a category was a highly rated member of that category as determined by the Battig and Montague (1969) norms. Each noun was printed on a 35-millimeter slide with one of three letters, A, B, or C, printed beneath the word. Also each one of the 3 nouns in a category appeared with a different letter. Each of the letters corresponded to a particular encoding task. Subjects were provided a task-code card, which assigned a specific encoding task to each letter. Thus, each member of a particular category was assigned a different encoding task. A Latin square design was used to counterbalance the task-code assignments. The words were presented in a randomized list with the restrictions that no two members of the same category and no two identical encoding tasks occurred consecutively. Four additional words were added at the begining of the list and 4 were added at the end of the list to allow for primacy and recency effects. These 8 words were also concrete nouns but were unrelated to the 10 categories used.

*Procedure*. Subjects were randomly assigned to 1 of 4 different groups. Groups were defined by the factorial combination of two levels of an instructional variable and whether or not an immediate recall test was administered. The instructional manipulations concerned performance of encoding tasks and knowledge of subsequent recall. One set of subjects was informed that there would be a memory test and was required to perform encoding tasks. These subjects were instructed that after they completed each encoding task they should perform any mental operations that would help them to remember the words. This instructional condition was labeled *Intentional* to indicate the "intentional" nature of the memory task. The other set of subjects performed encoding tasks, but these subjects were not forewarned about the recall test. The label for this condition was *Incidental* to refer to the incidental nature of the memory task. Half of the Intentional and half of the Incidental subjects were given an immediate recall test prior to the delayed tests. These subjects were referred to as the *prior recall* group.

The three encoding tasks involved either writing on a sheet of paper either a category name, adjective, or rhyme word that was relevant to the noun currently presented. Previous research (reviewed by Jenkins, 1974) indicated that the category name and adjective encoding tasks would involve semantic processing, while the rhyme word encoding task would be nonsemantic processing. Each subject was given one of three task-code cards that assigned a particular task to a particular letter. Thus, every subject performed all three encoding tasks.

One to four subjects from 1 of the 4 groups participated in each experimental session. Before the test list was presented, subjects were given a practice list of three words to familiarize them with the encoding tasks and presentation rate. The test words were presented for one second each with a Kodak Carousel slide projector. The presentation of each word was followed by a 9-second interstimulus interval, during which nothing was shown and subjects were to record their responses.

After the presentation of the word list, the prior recall group was asked to recall as many of the words in the list as they could. Then both groups of subjects were given a preliminary recogntion test with the target items being the 8 buffer words and distractors being semantically related to the buffer words. The preliminary recognition test was incorporated into the procedure to reduce suspicions about a possible memory test in the next day's session, especially for the no prior recall and Intentional conditions. Twenty-four hours after being shown the word list, subjects returned to the laboratory and were given a free recall test followed by a yes-no recognition test. For the recall test, subjects were allowed a maximum of 10 minutes to write down as many of the words from the previous day's list as they could remember. They were given 5 minutes for the recognition test which consisted of the 30 original stimuli plus 30 additional distractor nouns, each taxonomically related to one of the target words. Following the recognition test, subjects were asked whether they had expected the recall test and whether they had consciously rehearsed the test items. This postexperimental subject feedback determined that a few subjects had rehearsed the list during the retention interval. These subjects were therefore replaced. This criterion was used in all experiments, although very few subjects were replaced, and approximately equal numbers of Intentional and Incidental subjects were replaced.

## Results and Discussion

Recall. The rejection level for statistical tests in all experiments was set at .05. The mean number of words recalled in each condition are shown in Table 1. The recall results were analyzed using three analyses of

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Insert Table 1 about here

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variance. Each analysis involved one between-subjects factor (instructions) and one within-subjects factor (encoding task). One analysis was performed for the group with no prior recall, one for the immediate recall of the group with prior recall, and one for the delayed recall of the group given prior recall. To facilitate comparisons between our previous findings and this study, the results of the immmediate recall and delayed recall without prior recall analyses are first reported and discussed.

Instructions had no effect on immeciate recall, but for delayed recall, Intentional subjects recalled more words than Incidental subjects, $F(1,34)=8.43$, $MSe=4.78$. These analyses also showed that there was an encoding task effect for immediate recall only, $F(2,68)=16.09$, $MSe=2.02$. This effect held regardless of instructions and was due to the semantic encoding tasks producing better recall than the nonsemantic encoding task, $F(1,68)=31.36$, $MSe=2.02$ (this comparison accounted for 97% of the encoding task effect). These results replicate our previous finding that Intentional subjects show higher levels of recall than Incidental subjects on a 24-hour delayed recall test but not on immediate recall. Clearly this effect is quite reliable and warrants further exploration.

The encoding task effects, however, were not quite as consistent. Where our previous study found a marginal encoding task effect for delayed recall, there was none here. It appears that an encoding task effect on delayed recall is difficult to obtain, probably because of floor effects for the Incidental subjects, and a tendency for Intentional subjects to not show such an effect when they have had no prior recall. We also found that there was no encoding task effect for Intentional subjects on immediate recall in the previous study, but such an effect was found in the present results. More research is needed to explain why Intentional subjects show the encoding task effect in one study and not another, but we suspect it depends to some extent on whether Intentional subjects use retrieval techniques based on organizational strategies. That is, some Intentional subjects apparently can better utilize interitem associations across encoding conditions than others. The encoding task effect may well depend on the particular mixture of subjects in the group.

For delayed recall of subjects in the prior recall condition, the effects mirrored those for immediate recall. There were reliable effects of encoding task, $F(2,68)=9.36$, $MSe=1.56$, but not instructional effects. As before, words that were assigned semantic encoding tasks were better recalled than words that were assigned a nonsemantic task, $F(1,68)=18.49$, $MSe=1.56$. Thus, whatever causes the particular pattern of results in immediate recall seems to be reinstated for subsequent recall tests once immediate recall has been completed.

Recognition. The mean d′ recognition scores are shown in Table 2.[1] Analyses of variance similar to those performed on the recall data were performed on the results of the delayed recognition test of subjects in the

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Insert Table 2 about here

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prior recall condition and the delayed recognition test of subjects not given an immediate recall test. There were no differences between Intentional and Incidental subjects for recognition, regardless of whether recall was tested during the first session. The encoding task effect was significant: for recognition in the no prior recall condition, $F(2,68)=3.45$, $MSe=.26$, and for recognition in the prior recall condition, $F(2,68)=11.16$, $MSe=.20$. Again, words that were assigned semantic encoding tasks were better retained than words that were assigned a nonsemantic task: for recognition in the no prior recall condition, $F(1,68)=5.92$, $MSe=.26$, and for recognition in the prior recall condition, $F(1,68)=21.73$, $MSe=.20$. For recognition in the no prior recall condition, eventhough there was no interaction, subsequent analyses showed that the encoding effect was significant only for the Incidental subjects, $F(2,34)=3.96$, $MSe=.26$. The Intentional subjects demonstrated no such encoding task effect ($F<1$).

Conclusions. Our interpretation of this pattern of results centers around the retrieval or reconstruction process. While Incidental subjects recalled fewer words than Intentional subjects on delayed recall when no immediate recall test was given, they showed high levels of delayed recognition comparable to those shown by Intentional subjects. Thus, for both instructional groups the words were about equally available but not equally accessible (Bellezza et al., 1976). This interpretation is further supported by the delayed recall results of subjects in the prior recall condition. When subjects undergo an immediate recall test, the words become more readily accessible on the final recall, and no differences are observed between Intentional and Incidental subjects. That the words were more readily accessible after immediate recall is evident when comparing delayed recall of subjects in the prior recall and no prior recall conditions. Delayed recall is reliably higher after an immediate recall test than without such a test, $F(1,68)=14.50$, $MSe=5.15$. Also a percent retention score (the percent of words recalled on the immediate recall test that were also recalled on the

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delayed recall test), shown in Table 3, indicates that once an item had undergone a retrieval, it was retained almost equally well for both Intentional and Incidental subjects. An analysis of variance confirmed this impression and also indicated that nonsemantically processed words were retained at least as well as semantically processed words, given initial recall ($ps>.15$). The implications of this latter result will be dealt with in the General Discussion, as they are not directly relevant to the primary goals of this experiment.

The question still remains, though, for delayed recall without prior recall as to why Intentional subjects showed higher levels of recall than Incidental subjects. According to our interpretation, instructions to learn are inducing subjects to do something more than just semantic processing that is beneficial for retrieval or reconstruction of the item. One explanation that was discussed in the introduction is an organization factor. Perhaps Intentional subjects are able to use the structure of the list as a retrieval plan or as a guide for reconstructing the list. The fact that there were differences between Intentional and Incidental subjects on delayed recall when no immediate recall was given, but not on delayed recognition, supports this idea since Bellezza et al. (1976) found that organization improves recall but not recognition.

To more directly examine organization, the mean number of words recalled per category recalled for each subject was computed. The words per category measure was used because it reflected how many taxonomically associated words were recalled, regardless of whether they were clustered on the recall protocols. Buschke (1977) maintains that subjects do review what they have recalled in an attempt to remember other words, and that this represents organization to which the more typical clustering measures are not sensitive. Analyses of variance indicated that there were no differences between Intentional and Incidental subjects on the words per category scores for immediate recall (1.67 for Intentional versus 1.50 for Incidental) and for delayed recall after immediate recall (1.54 for Intentional versus 1.41 for Incidental). For the delayed recall of subjects in the no prior recall condition, however, Intentional subjects had reliably higher words per catergory scores than Incidental subjects (1.41 and 1.15, respectively), $F(1,34)=10.13$, $MSe=.06$.

This patttern of results is strongly suggestive of the notion that the observed differences in delayed recall between Intentional and Incidental subjects is due to differences in the degree to which these subjects can utilize the structured properties of the list. Delayed recall with no prior recall is the only condition for which Intentional subjects show better recall than Incidental subjects, and it is also the only condition for which Intentional subjects have higher words per category scores than Incidental subjects. Yet higher words per category scores for Intentional subjects do not necessarily indicate that Intentional subjects are demonstrating higher recall than Incidental subjects due to organizational factors. It may be that the words per category differences were simply an artifact of the recall differences caused by some, as yet, unidentified factor.

Experiment 2 was an attempt to more directly test the idea that instructions to learn produce better delayed recall (when no immediate recall test is given) than does semantic processing alone because the instructions enable subjects to utilize the structured nature of the list. In other words, the contention is that Intentional subjects are able to acquire organizational knowledge that the Incidental subjects cannot or do not acquire. This implies that if the Intentional subjects for some reason cannot acquire organizational knowledge, then their performance ought to be no better than that of the Incidental subjects. Following this line of reasoning, we designed Experiment 2 to make it very difficult for Intentional subjects to attain organizational knowledge. Experiment 2 is essentially the same as Experiment 1, except that the word list is unstructured. With no obvious taxonomic categories, no obvious strategy for organizing list items is available, and the expectation is that the instructional effect for delayed recall will be eliminated.

## Experiment 2

### Method

Subjects. Subjects were 48 undergraduates at the University of Colorado, participating to fulfill an introductory psychology course requirement. There were 12 subjects in each cell of the design.

Materials. Stimuli were 30 concrete nouns, each having no obvious taxonomic relation to the others. As in Experiment 1, four additional words were added at the beginning and four were added at the end of the list to allow for primacy and recency effects. These words were unrelated to each other and to the 30 target items. Each noun was printed on a 35-millimeter slide for presentation purposes. Two randomized list orders (for the 30 target items) were constructed, and presentation of each particular list was counterbalanced across groups.

Procedure. Subjects were randomly assigned to 1 of the 4 different groups described in Experiment 1. Since the comparison of interest focused on recall performance between subjects given instructions to learn and subjects performing incidental semantic processing, the present experiment had subjects perform only one encoding task on the entire list of words. This task was writing down an adjective that was relevant to the nouns presented, a task which has been shown to be semantic in nature (Jenkins, 1974).

The procedure used in Experiment 1 was followed here, with one exception. Because there was only one encoding task, only one (instead of three) practice word was presented for encoding task and presentation rate familiarization. Again a preliminary recognition test with the 8 buffer words as target items was given upon completion of the acquisition phase. Also the final recognition test, as before, consisted of 30 original stimlui plus 30 distractor nouns, each distractor being semantically related to one of the 30 target items.

Results and Discussion

Table 4 shows the recall and the recognition results. As in Experiment 1, separate analyses of variance were computed for the immediate recall, delayed recall, and recognition data. These analyses showed no instructional effects for recall or for recognition, regardless of whether

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testing was immediate or delayed or whether subjects had or had not undergone prior recall. The only reliable effects were that delayed recall and recognition levels were higher in the prior recall condition than in the no prior recall condition, $F(1,44)=10.47$, $MSe=15.76$ and $F(1,44)=5.25$, $MSe=.45$, for recall and recognition, respectively.

These results support our hypothesis that Intentional subjects show higher levels of delayed recall than Incidental subjects because Intentional subjects are able to use the structured nature of the list to aid in reconstruction or retrieval of the items. When Intentional subjects cannot assimilate any organizational knowledge about the word list because there is no list structure, their level of delayed recall (without prior recall) drops to that displayed by Incidental subjects.

Although it would appear to be less plausible, there is another interpretation of these results. The present experiment differed from Experiment 1 not only in the nature of the word list but also in the number of encoding tasks used. It could be that the encoding task change was responsible for eliminating the instructional effect on delayed recall (cf. McDaniel and Masson, 1977, Experiment 2). Experiment 3 was conducted to test this possibility.

## Experiment 3

In this experiment we used three encoding tasks as in Experiment 1, but retained the unstructured word list of Experiment 2. Since our primary interest was in delayed retrieval and since we did not expect to find instructional differences on the delayed tests there would be no need to demonstrate a lack of differences on an immediate retrieval test. If the use of a multiple encoding task procedure is the key to the effects of instructions to learn on long-term retention, then the present experiment should result in an instructional effect. On the other hand, if we are correct in our claim that the instructional effect is closely related to organization of list items, no instructional effect should be observed. As in Experiment 2, the lack of an easily observable list structure among the target items should reduce subjects' ability to organize the items.

### Method

*Subjects*. The subjects were 24 students drawn from the same population as that used for the first two experiments. Twelve subjects were randomly assigned to each of the two groups in the experiment.

*Materials*. The word list was the same as that used in Experiment 2, except that only one random list order was employed. Assignment of encoding tasks to words was done by typing a code letter under each word as in Experiment 1.

Procedure. A multiple encoding task procedure identical to that employed in Experiment 1 was used. Half of the subjects were given intentional learning instructions as well as encoding task instructions, and the remaining subjects were given only encoding task instructions. After presentation of the list, subjects left the laboratory and were not given any preliminary retrieval test, but were led to believe that we were primarily interested in their encoding task responses. Upon their return next day, subjects were given a recall test and then a recognition test identical to that used in Experiment 2. Other aspects of the retrieval tests were patterned after the tests used in the first two experiments.

Results and Discussion

The mean number of items recalled and mean recognition performance (d′) are presented in Table 5. Analysis of variance of the recall data yielded no significant effects. As in Experiment 2, instructions to learn

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Insert Table 5 about here

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did not improve delayed recall, and as in Experiment 1, subjects with no recall task on the first day did not exhibit an encoding task effect. Once again, floor effects may be responsible for the lack of an encoding task effect. Lack of an instructional effect, however, is probably not best explained as a floor effect. The level of recall for Incidental subjects in this experiment is about the same as that of Incidental subjects not given a prior recall test in Experiment 1. Intentional subjects in the present experiment had a much lower level of recall than subjects in the same condition in Experiment 1. We argue that this is a consequence of the nature of the word list used in the present experiment. It seems that the unstructured nature of the list failed to provide Intentional subjects with an opportunity to organize the items for an expected memory test. Without the advantage of being able to organize the list items, Intentional subjects' recall was no better than that of Incidental subjects.

The analysis of recognition data also failed to reveal any differences between instructional conditions, replicating the results in Experiments 1 and 2. Surprisingly, the recognition data did not represent a significant effect of encoding tasks, although a trend is evident among Incidental subjects. In Experiment 1, encoding task effects were observed in the recognition data for all subjects except those Intentional subjects who were not given an immdeiate recall test. We suggested that this was due to the use of the organizational properties of the list in recognition as well an in recall among Intentional subjects not given an immediate recall test. It is not likely that the present lack of encoding task effects is due to the same process. Instead, the nature of the distractor items used in the recognition test may have differentially reduced d' scores associated with items assigned a semantic encoding task as compared to items assigned the nonsemantic task. In the current experiment, the distractor items used were reasonably close associates of the target items (e.g., target: AUNT; distractor: UNCLE), instead of being only taxonomically related to targets (e.g., target: HORSE; distractor: GOAT) as in Experiment 1. It has been shown that a great degree of semantic similarity between targets and distractors reduces recognition performance of items encoded under semantic conditions, but has a lesser effect on recognition of nonsemantically encoded items (e.g., Coltheart, 1977).

Despite the fact that this experiment produced no statistically significant effects, it offers at least one result that is directly relevant to our investigation of the effects of instructions to learn on long-term retention. Specifically, no recall differences between Intentional and Incidental conditions were observed. This result, combined with the findings of Experiment 2 implies that the effect of instructions to learn on long-term retention found in our earlier work (McDaniel & Masson, 1977) and in Experiment 1 was due to a combination of two related factors. The first is the structured nature of the word list, and the second is the opportunity or lack of opportunity to make use of that structure. When a structured word list is presented to subjects who are instructed to learn, they make use of the relationship between the words in the list to aid retrieval. On the other hand, subjects who are prevented from using organizational strategies (either through the use of an unstructured list or multiple encoding tasks in conjunction with incidental learning instructions) have less of this kind of information which seems beneficial for long-term retention. It should be emphasized that this explanation does not confer any special status to instructions to learn. It only implies that such instructions induce subjects to interrelate list items, even when related items are encoded under different processing tasks.

If our hypothesis is correct, it should be possible for Incidental subjects to demonstrate relatively high long-term recall, provided they, too, are able to use some of the organization properties of a word list. The last experiment in this series was designed to test this idea.

## Experiment 4

We have claimed that the effect of instructions to learn on long-term retention observed in Experiment 1 was due to Intentional subjects being able to make use of the list structure during recall. The present experiment was designed to be similar to Experiment 1 with the exception that Incidental subjects should also be able to make use of the list structure. This was accomplished by assigning the same encoding task to each member of a particular taxonomic category. Such a procedure is expected to have at least three effects which would differ from those observed in the earlier experiments. First, and most important, we predict that Intentional and Incidental subjects will not differ in their performance on a delayed recall test. Unlike, Experiments 2 and 3, this lack of difference is not expected to be a result of lower recall performance of Intentional subjects, but rather an increase in delayed recall among Incidental subjects. Second, equal delayed recall performance of Intentional and Incidental subjects should be accompanied by equal and high words per category scores for both groups. These two effects would indicate that both groups of subjects were using list structure during the delayed recall test. Finally, an encoding task effect is expected for both the recall and recognition tests, even for Intentional subjects. This is anticipated since items assigned the rhyming task will not be semantically related to items assigned a semantic encoding task. In Experiment 1, for each target item assigned the rhyming task, there were two other members of the same taxonomic category assigned the semantic tasks. Intentional subjects were able to overcome the encoding task differences between items of a particular category so that recall was improved and so that no encoding task effect appeared in recognition or recall. In the present experiment, however, no words assigned the rhyming task had taxonomic counterparts that were assigned a semantic encoding task. Thus, retrievability of items assigned the rhyming task should suffer. This would be at least partly due to greater difficulty in discovering the taxonomic relationship between items temporally separated and assigned an encoding task that was nonsemantic.

## Method

Subjects. Twenty-four subjects from the same population used in the previous experiments were randomly assigned to one of two instructional conditions (Intentional or Incidental), 12 subjects per condition.

Materials. The target words were the same as those used in Experiment 1, except that only nine categories were used for a total of 27 items. Each stimulus word was prepared as in Experiment 1, except that the same letter was typed under each word belonging to a particular category. Three categories were assigned the letter A, three B, and three C. Thus, all members of a particular category were assigned the same encoding task, and each task was assigned to three different categories. The assignment of tasks to categories was counterbalanced as in Experiment 1.

Procedure. The procedure used in Experiment 1 was followed here, except that the preliminary recognition test of buffer items was the only test given on the first day of the experiment. Items were presented in a random order, with the constraint that no two items from the same category occur consecutively. The target and disctractor items for the delayed recognition test were the same as those used in Experiment 1, except for the deletion of targets and associated distractors belonging to the category not presented at encoding.

<u>Results and Discussion</u>

The mean number of items recalled and mean recognition performance (d′) are presented in Table 6. The d′ analysis of recognition data was identical to that used in Experiment 1. An analysis of the recall data indicated that there was no effect of instructions, but the encoding task

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effect was highly reliable, $F$ (2, 44) = 20.42, MSe = 2.43. Subsequent analyses of this effect showed that items assigned a semantic encoding task were recalled more frequently than items assigned the rhyming task, $F$ (1, 44) = 35.30, MSe = 2.43. This comparison accounted for 88% of the encoding task effect. It was also found that the category task led to better recall than did the adjective task, $F$ (1, 44) = 4.49, MSe = 2.43, accounting for the remaining 12% of the encoding task effect. The mean words per category scores for Intentional and Incidental subjects were identical and rather high (1.54 for both groups).

These results are quite consistent with our predictions. Instructions to learn did not produce an improvement in recall despite the fact that a structured list and a multiple encoding task procedure were used. The assignment of the same encoding task to all members of a particular taxonomic category allowed even Incidental subjects to make use of the list structure. Consequently, recall and words per category scores were high for both Intentional and Incidental groups. As expected, equal recall performance of Intentional and Incidental subjects was due to an improvement in recall by Incidental subjects (as compared to Experiments 1-3) and not to lower recall by Intentional subjects, as was found in

Experiments 2 and 3 when a clear list structure was not present. Moreover, a strong encoding task effect obtained, and likely was the result of subjects failing to perceive the semantic relationships between items of a category assigned the rhyming task. This interpretation is reinforced by the finding that the optimal task for realizing the taxonomic relationship among items of a category (category naming task) produced the highest level of recall. These results are in close agreement with our hypothesis about the instructional effects and lack of encoding task effects among Intentional subjects not given an immediate recall test in Experiment 1. The effects were due to those Intentional subjects using the list structure as a source of general information about items in the list and specifically to help relate items assigned the rhyming task to their taxonomic counterparts which were assigned (semantic) tasks more beneficial for recall. In the present experiment there was no such relationship between an item assigned the rhyming task and an item assigned a semantic task. As a result, few words assigned the rhyming task were recalled.

The recognition results also supported our predictions. There was no effect of instructions, but the encoding task effect was reliable, $F\ (2, 44) = 12.89$, $MSe = 0.30$. The advantage of the semantic tasks over the rhyming task accounted for nearly all (97%) of the effect, $F\ (1, 44) = 25.14$, $MSe = 0.30$. As in recall, the Intentional subjects conformed to the usual encoding task effect. The evidence indicates that this occurred because of the lack of a connection across words assigned semantic and nonsemantic tasks. In Experiment 1, where Intentional subjects not given an immediate recall task displayed no encoding task effect on recall or recognition, there was such a connection whereby instructions to learn seemed to induce subjects to organize items within categories, regardless of encoding task differences. By contrast, in the present experiment subjects only had the opportunity to organize items into categories within encoding tasks. This resulted in the association between taxonomically related words being readily observed when the words were assigned a semantic encoding task, but not being readily associated when the words were assigned the nonsemantic task. Thus, unlike Experiment 1, even for Intentional subjects words assigned a semantic task were retrieved more often than words assigned the nonsemantic task.

## General Discussion

The present series of experiments was designed to investigate the conditions under which instructions to learn will improve long-term retention and to investigate the reason for any improvement. The first experiment replicated our earlier finding (McDaniel & Masson, 1977) that instructions to learn benefit long-term retention when the target items are semantically related. The importance of the relatedness of the target items for this effect was demonstrated in Experiments 2 and 3. When no inherent structure characterized the word list, long-term recall performance was poor for all subjects, regardless of encoding instructions. In contrast, when the list was structured and when this structure was made apparent to both intentional and incidental learning subjects (Experiment 4), all subjects were able to utilize the list structure and evidenced relatively good long-term retention in recall and recognition tests.

The importance of list structure was not only demonstrated by differential recall performance as a function of presence or absence of list structure, but also by the differential use of list structure in recall by subjects in different instructional conditions. Even when structured word lists were involved, as in Experiments 1 and 4, retrieval was quite good only when experimental manipulations allowed subjects to observe the interitem associations. In Experiment 1 the assignment of a different encoding task to each member of a taxonomic category prevented incidental learning subjects from realizing or making full use of the list structure. Subjects instructed to learn the items were able to overcome the disadvantage of performing a different encoding task on each member of a category. This was reflected by higher words per category scores on delayed recall for Intentional subjects as compared to Incidental subjects; for Intentional subjects recall of one category member was more likely to be correlated with recall of other items in the same category. In Experiment 4 the same encoding task was assigned to each member of a category, allowing even Incidental subjects to utilize the list structure; their recall and words per category scores were high and comparable to those of Intentional subjects.

These results emphasize the importance of organization for long-term retention and are in agreement with other recent research. Bellezza et al. (1976) and Bellezza, Cheesman, and Reddy (1977) have shown that organization of items can improve recall beyond the improvement that accrues with increases in semantic elaboration. Furthermore, Broadbent and Broadbent (1975) have suggested that recall strength is increased by the linking of target items to other items in the list. In the present experiments the list structure was semantically based and proved to be beneficial for delayed recall. Luek, Cicala, and McLaughlin (1976) provided evidence for the idea that an optimal organizational strategy should be semantically based. They found that although subjects who spontaneously clustered items on a semantic basis did not differ on immediate recall from subjects who clustered the same items alphabetically, the former group had superior delayed recall.

The Luek et al. (1976) results parallel our own in that recall differences due to semantic organization are confined to delayed recall tests, but do not appear on immediate recall tests. The reason why the effects of organizational strategies seem to be confined to delayed recall is not yet clear, but there are some results that suggest a possible explanation. Puff, Murphy, and Ferrara (1977) found that clustering in an immediate recall test was significantly less than the amount of clustering that occurred when recall was delayed a few minutes. Thus, it appears that organization of list items is not as important for immediate recall as it is for recall tests that are delayed. A likely candidate for the basis of immediate recall of an item is information about the activities that occurred during encoding of that item. Kolers (1975) has emphasized this type of information in discussions of memorial processes. Also, Russo and Wisher (1976) have demonstrated that processing details are retained in memory and can be effective retrieval cues. If immediate recall can be characterized as dependent upon the recovery of information about encoding details, then organizational factors should not greatly affect immediate recall. Our results and those of Luek et al. (1976) conform to this expectation.

The idea that memory for the encoding procedures formed at least part of the basis of immediate recall in our studies is supported by the effects of immediate recall tests on delayed recall. Delayed recall by subjects who were not given an immdediate recall test in Experiments 1 and 4 showed evidence of the use of organizational strategies when such strategies were apparent to the subjects. However, if a delayed recall test was preceded by an immediate recall test (Experiment 1) the use of organization was less apparent. Specifically, Intentional and Incidental subjects who had been given an immediate recall test performed similarly on the delayed recall tests. Both groups exhibited strong encoding task effects, indicating that they had not used the list structure to overcome encoding task differences so that recall of words assigned a rhyming task could be improved. Only Intentional subjects not given an immediate recall test failed to show an encoding task effect in their delayed recall, suggesting that the use of list structure was most extensive among those subjects. Why was this not the case for Intentional subjects given the immediate recall test? We suggest that since immediate recall probably was based on remembering encoding details, immediate recall of an item led to a modification of the memory trace which emphasized encoding details. A similar type of effect was obtained by Bartlett (1977). He found that an immediate test of target items affected performance on a delayed test. The nature of retrieval information used on the immediate retrieval test affected subsequent retrieval. For example, initial retrieval of items based on semantic information improved recall and recognition of those items over items initially retrieved on the basis of input position information.

In our first experiment it appears that the retrieval of items by Intentional and Incidental subjects on the immediate test affected the retrieval processes used on the delayed test. Rather than using information about the relatedness of the items, subjects probably based their delayed retrieval on their memory of encoding details of the items. These memories received a strong rehearsal trial when the immediate recall test was given. Thus, delayed recall was generally superior for subjects who were given an immediate recall test. There were no instructional effects on immediate recall since organizational strategies were not needed for optimal recall and, as many previous studies have shown (e.g., Hyde & Jenkins, 1973; Till & Jenkins, 1973; Walsh & Jenkins, 1973), instructions to learn have no effect on total recall in such situations. This lack of an instructional effect carried over to the delayed test. Instructional effects appeared in delayed recall only among subjects not given an immediate recall test. This probably was because Intentional subjects in the no prior recall condition were able to use list structure to guide and improve recall, while Incidental subjects had to rely on relatively impoverished memories of encoding details.

Another result of importance was that the likelihood of delayed recall of an item, given immediate recall of that item (the percent retention measure), was the same regardless of whether that item was assigned a semantic or a nonsemantic encoding task. The levels of processing framework (Craik & Lockhart, 1972) might lead one to expect higher percent retention for items assigned a semantic encoding task than for items assigned a nonsemantic task, since semantic codes should be more durable. The failure to confirm this expectation is not satisfactorily explained by a lack of statistical power since the data did not even follow the predicted ordering: percent retained was slightly higher for the rhyming task among both Intentional and Incidental subjects.

Equal percent retention across encoding tasks might lead one to argue that, in fact, memory traces of semantically and nonsemantically encoded items are equally durable. However, this argument depends on the assumption that retrieval processes used on the immediate recall test were semantic in nature for the items assigned a semantic encoding task, while retrieval processes were nonsemantic in nature for items assigned a nonsemantic encoding task. This probably is not a reasonable assumption when a free recall test is the retrieval task. Instead, it could be argued that a recall task is semantically based (Arbuckle & Katz, 1976). This notion not only leads one to reject the hypothesis that the percent retention results demonstrate that semantic and nonsemantic memory traces are equally durable, it suggests an alternative explanation of the percent retention results. If we assume that in our first experiment immediate recall was based primarily on semantic elements and that recalled words had their memory traces altered to include and emphasize the information used in that retrieval episode, then the resultant traces of the retrieved items would be generally similar regardless of the original encoding task. As a consequence, encoding task differences would lead to differences in number of semantically versus nonsemantically encoded words recalled but not in percent retention. Thus, the finding that percent retention was comparable across encoding tasks may suggest that the kind of retrieval used for recall can significantly change the nature of the memory trace.

If recall processes are primarily semantic then superior recall of items assigned a semantic encoding task may at least partly be due to a bias in the retrieval strategy. That retrieval of items assigned a rhyming encoding task can be improved and can supass retrieval of items assigned a semantic encoding task when the retrieval test is based on rhyming information has been shown by Fisher and Craik (1977) and by Morris, Bransford, and Franks (1977). Thus, qualitatively different memory traces will be differentially retrievable depending on the type of retrieval task. If memory traces can be modified so as to become more similar, as when a recall test is given, original encoding differences may be reduced and subsequent recall tests will indicate that traces of previously retrieved items are equally durable.

The recognition data of Experiment 1 also merit discussion, particularly concerning the subjects who were not given an immediate recall test. There was an instructional effect in the delayed recall data of these subjects, such that Intentional subjects recalled more items that Incidental subjects. However, this effect did not appear in the recognition data. The recognition performance of Intentional subjects was equal across encoding tasks as was their recall performance. Therefore, it appears that organizational strategies were operative for Intentional subjects even during recognition. Knowledge about the characteristics of the list's structure appears to have been used during recognition. The use of organizational information during recognition has also been noted by other researchers (e.g., Mandler & Boeck, 1974; Rabinowitz, Mandler, & Patterson, 1977; Toglia, Barrett, & Lovelace, Note 1). The use of list structure was not necessary for good recognition performance, however, as Incidental subjects had an encoding task effect in their recognition data but their overall recognition performance was as good as that of Intentional subjects. Apparently, on recognition tests, there is sufficient information available to guide reconstruction of an item's encoding episode (cf. Lockhart, Craik, & Jacoby, 1976) to make the use of information about list structure of secondary importance. This conclusion is consistent with the finding of Bellezza et al. (1976) that recall but not recognition performance was optimized by the use of an organizational strategy.

The results of the experiments reported here have served to replicate our earlier finding of an instructional effect on long-term retention, and have provided some insight into the reasons for this effect. The optimization of long-term retention is dependent on organizational strategies when retention is measured by recall but not when measured by recognition. We have also been able to formulate some hypotheses about why the type of processing necessary for optimal retrieval depends both on the retention interval and on the type of retrieval test.



## Reference Note

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Footnotes

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[1] In calculating d′ scores in all experiments, when a hit rate of 1.0 or a false alarm rate of 0.0 was encountered the more realistic estimate 1-(1/2N) or 1/2N, where N is the maximum number of hits or false alarms possible, was used for the hit or false alarm rate, respectively.

Table 1

Mean Immediate and Delayed Recall

(Experiment 1)

| | | Encoding Task[a] | | | | | |
|---|---|---|---|---|---|---|---|
| | | Immediate Recall | | | Delayed Recall | | |
| Prior Recall | Instructions | C | A | R | C | A | R |
| Yes | Intentional | 4.3 | 4.6 | 2.9 | 3.8 | 4.1 | 3.1 |
| Yes | Incidental | 4.3 | 3.9 | 2.3 | 3.6 | 3.4 | 2.1 |
| No | Intentional | - | - | - | 3.2 | 2.5 | 2.7 |
| No | Incidental | - | - | - | 1.8 | 1.7 | 1.2 |



Table 2

Mean Recognition Performance (d′) After 24-Hour Retention Interval

(Experiment 1)

| | | Encoding Task | | |
|---|---|---|---|---|
| Prior Recall | Instructions | Category | Adjective | Rhyme |
| Yes | Intentional | 2.09 | 2.29 | 1.68 |
| Yes | Incidental | 2.11 | 2.08 | 1.70 |
| No | Intentional | 2.05 | 2.02 | 1.88 |
| No | Incidental | 1.62 | 1.89 | 1.40 |

Table 3

Percent of Items Recalled After 24-Hour Retention Interval

Given Recall on Immediate Test

(Experiment 1)

| | Encoding Task | | |
|---|---|---|---|
| Instructions[a] | Category | Adjective | Rhyme |
| Intentional | 74.1 | 77.2 | 83.3 |
| Incidental | 63.1 | 72.4 | 77.8 |



Table 4

Mean Recall and Recognition (d′) Performance

(Experiment 2)

| Prior Recall | Instructions | Immediate Recall | Delayed Recall | Delayed Recognition |
|---|---|---|---|---|
| Yes | Intentional | 12.2 | 10.2 | 2.97 |
| Yes | Incidental | 11.0 | 8.6 | 2.77 |
| No | Intentional | -- | 5.3 | 2.41 |
| No | Incidental | -- | 6.0 | 2.43 |

Table 5

Mean Recall and Recognition (d′) Performance

(Experiment 3)

| Instructions | Recall | | | Recognition | | |
|---|---|---|---|---|---|---|
| | Encoding Task[a] | | | | | |
| | C | A | R | C | A | R |
| Intentional | 2.1 | 1.2 | 1.4 | 1.75 | 1.50 | 1.47 |
| Incidental | 1.4 | 1.5 | 1.2 | 1.97 | 2.21 | 1.68 |



Table 6

Mean Recall and Recognition (d′) Performance

(Experiment 4)

| Instructions | Recall | | | Recognition | | |
|---|---|---|---|---|---|---|
| | Encoding Task[a] | | | | | |
| | C | A | R | C | A | R |
| Intentional | 4.0 | 3.2 | 0.9 | 2.06 | 2.08 | 1.34 |
| Incidental | 3.5 | 2.3 | 0.9 | 1.88 | 1.63 | 1.09 |