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ABSTRACT

When 112 fifth- and sixth-graders were observed for their use of one of two possible rehearsal strategies in verbal discrimination learning tasks, the strategy in which the children generated a functional explanation of the word showed a positive influence on simple frequency discriminations. Data analyses also indicate that under this strategy both the children's ability to discriminate frequency and their ability to discriminate their previous rehearsal activity are positively correlated with discrimination learning performance. As a result of these findings, a number of theoretical implications may be seen. (RL)

Technical Report No. 370

MORE ABOUT REHEARSAL STRATEGY EFFECTS IN CHILDREN'S DISCRIMINATION LEARNING

by

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Report from the Project on
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the same basic mechanism (frequency discrimination) underlies performance in both strategy and normal (i.e., without strategy instructions) verbal discrimination contexts.

A second hypothesis stated that strategies result in subjects encoding information concerning their rehearsal activity during study (cf. Zechmeister & Gude, 1974). This information (which, following Underwood's, 1969, "memory attribute" arguments, we termed an "activity" attribute) is then called upon during the test <u>instead of</u> frequency information. The <u>supplant</u> hypothesis, therefore, directly challenges a frequency-theory account of strategy effects.

Finally, a less drastic version of the <u>supplant</u> hypothesis asserted that the activity cues produced by rehearsal strategies, while independent of frequency, are utilized to supplement the frequency cues which obtain in the usual verbal discrimination task. Thus, the <u>supplement</u> hypothesis retains, but expands on, a basic frequency mechanism.

The evidence produced by the Ghatala, Levin, and Subkoviak (1975) procedure (see the Method section for a description of this procedure) clearly supported the <u>supplant</u> hypothesis in the case of both imagery and pronunciation strategies. That is, instructions to employ either of these strategies in a verbal discrimination task led subjects to abandon the frequency cue (which was the dominant cue for subjects not receiving strategy instructions) in favor of the activity cue generated by the strategy.

The finding that frequency theory is not sufficient to account for imagery and pronunciation effects in verbal discrimination learning

I

INTRODUCTION

This study represents a continuation of research into the functional components of rehearsal strategies in children's verbal discrimination learning. Recently, Ghatala, Levin, and Subkoviak (1975) demonstrated that the adoption of Underwood's (1975) individual differences crucible can provide a powerful analytical tool with which to attack this problem. In the initial study, Ghatala, Levin, and Subkoviak (1975) utilized this methodological technique to test three rival hypotheses concerning the mechanism(s) underlying the known facilitative effects of imagery and pronunciation strategies in children's verbal discrimination learning (e.g., Levin, Ghatala, DeRose, Wilder, & Norton, 1975; Levin, Ghatala, Wilder, & Inzer, 1973).

One hypothesis attempted to extend Ekstrand, Wallace, and Underwood's (1966) frequency theory to account for rehearsal strategy effects in verbal discrimination learning. The theory ascribes successful performance in the task to a subjective frequency differential between each correct and incorrect pair member. Accordingly, the hypothesis asserted that rehearsal strategies facilitate learning because they supply frequency information, thereby making the differential more apparent. That is to say, under the <u>supply</u> hypothesis, was not unexpected, given the (since replicated) observation that neither imagery nor pronunciation instructions have any influence on subjects' accuracy in frequency judgment tasks (e.g., Ghatala, Levin, & Wilder, 1973). However, recent research (Rowe, 1974) suggests that imagery and pronunciation strategies may be representative of only one class of strategies (i.e., those which do not influence simple frequency processes), and that there may exist strategies which do influence frequency judgments.

The obvious question raised by this latter finding is whether the results obtained by Ghatala, Levin, and Subkoviak (1975) in the case of strategies which do not influence frequency processes can be generalized to strategies which do. Will, for example, the supplant hypothesis hold even for a strategy which can be shown reliably to enhance subjects' frequency discriminations? Or, in this case, will the supplement (or even the supply) hypothesis better describe the operation of the strategy in verbal discrimination learning? In the present experiment we sought the evidence necessary to resolve these questions.

REHEARSAL STRATEGY SELECTION

The first requirement was to identify strategies which influence both discrimination learning and frequency judgment performance (in contrast to imagery and pronunciation strategies, which have been found to affect only the former). Starting with some leads furnished by the literature (e.g., Rowe, 1974) and some research of our own, we found that requiring subjects to generate a rhyme for the correct item in a discrimination pair facilitated performance (likely for reasons alluded to later), though not as much as did requiring subjects to generate a <u>function</u> for it (i.e., to tell what the object referent of the correct item does). Similarly, both strategies seemed to have an effect on frequency judgment performance per se, though in opposite directions: highly positive for the function strategy and slightly negative for the rhyme strategy. Given this desirable state of affairs (namely, that we were able to identify strategies which affected both discrimination learning and frequency judgment performance), we ventured into the Ghatala, Levin, and Subkoviak (1975) paradigm with the rhyme and the function strategies.

THE TASKS AND ANTICIPATED OUTCOMES

At the beginning of this paper we outlined three alternative hypotheses concerning the mechanism(s) underlying rehearsal strategy effects in children's verbal discrimination learning. This experiment was designed to determine which of these alternatives accounts for the effects of each of the two strategies under present consideration. Recall that two mechanisms, frequency discrimination and activity discrimination, have been postulated as the likely functional components of rehearsal strategy effects. The three hypotheses differ in the role they assign to each mechanism. The <u>supply</u> hypothesis states that only frequency discriminations are involved; the <u>supplement</u> hypothesis asserts that both frequency and activity cues are involved; and, the <u>supplant</u> hypothesis states that only the activity cue is utilized by strategy subjects.

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As in the Ghatala, Levin, and Subkoviak (1975) study, we administered tasks measuring each of these components to each subject. Thus, one task (relative frequency judgment task) measured subjects' ability to make frequency discriminations among verbal items; another task (strategy identification task) measured subjects' ability to discriminate between verbal items for which they had and had not previously applied a strategy. Performance on each of these tas' then related to verbal discrimination learning under either strategy or no strategy instructions. Four different conditions were created, based on the particular version of the strategy identification and of the verbal discrimination task administered to a subject. In the Rhyme-Control condition, the strategy identification task consisted of subjects' discriminating between items for which they had previously produced rhymes and items for which they had not produced rhymes. The verbal discrimination task was administered to these control subjects in the absence of any explicit rehearsal strategy. Subjects in the Rhyme-Strategy condition received the same strategy identification task as just described but, in addition, during the verbal discrimination task these subjects were instructed to generate a rhyme for the correct response. Function-Control and Function-Strategy conditions paralleled each of the rhyme conditions, in that subjects in these conditions discriminated items for which they had previously produced functions from those for which they had not in the strategy identification task, and strategy subjects (but not control subjects) were instructed to gererate a function for the correct response during verbal discrimination learning.

The predictions concerning inter-task relationships in the two control conditions are based on certain assumptions. First, given the evidence (e.g., Underwood & Freund, 1970) that frequency is the predominant attribute in verbal discrimination learning under normal (here, control) circumstances, a substantial correlation between the relative frequency judgment and the verbal discrimination task would be expected. Second, given the additional assumption that the strategy identification task measures something other than frequency discrimination ability, there should be little relationship between this task and verbal discrimination learning in the control conditions. Both of these predictions were confirmed in our previous study (Ghatala, Levin, & Subkoviak, 1975).

On the other hand, if the two strategy conditions are considered, different inter-task correlations would be anticipated as being consistent with each of the three previously specified hypotheses. In particular, if strategies operate solely through a frequency mechanism (the supply hypothesis), then the task intercorrelational patterns should be comparable in control and strategy conditions. However, if strategies produce discriminative cues which are independent of frequency, then some relationship between the strategy identification task and verbal discrimination learning would be expected. According to the supplement hypothesis, the relationship between the relative frequency judgment task and discrimination learning should also remain high (as it is in the control conditions); whereas according to the supplant hypothesis, this relationship should diminish or disappear.

The rhyme strategy, which yields discriminative activity cues but does not enhance (and possibly even interferes with) frequency discriminations, might be expected to conform to the supplant hypothesis as was the case for imagery and pronunciation strategies (Ghatala, Levin, & Subkoviak, 1975). In contrast, the function strategy (which yields discriminative activity cues but also enhances frequency discriminations) could yield results fitting any of the three hypotheses.

II

METHOD

SUBJECTS

The subjects were 112 fifth and sixth grade children attending two elementary schools located in Ogden, Utah. Children were randomly assigned to the four conditions in order of their appearance at the testing room located within the school building. Thus, 28 children (nearly equally divided between grades) participated in each of the four conditions: Rhyme-Control, Rhyme-Strategy, Function-Control, and Function-Strategy.

MATERIALS AND TASKS

From an initial pool of 256 concrete nouns, 80 words were selected for use in the relative frequency judgment task and 80 for the strategy identification task. The verbal discrimination list used in the Rhyme-Strategy and both control conditions consisted of 24 pairs and thus required 48 items. The list used in the Function-Strategy condition consisted of 48 pairs and hence required an additional 48 words. Within each condition, the length of each task was chosen (based on previous research and pilot work) such that comparable performance variation from one condition to the next would be obtained. The items included in the pool were words for which, in the authors' judgment, children would easily be able to give both a function and a rhyme response--a judgment that was confirmed in pilot research. The words were randomly assigned to tasks with the restriction that words which might elicit one another as rhymes or functions were assigned to different tasks. As far as was possible (given the large number of words involved) the items were selected to minimize such occurrences.

The four sets of materials were comparable on Thorndike-Lorge (1944) frequency. The average number of occurrences per million was 51.6 for the relative frequency judgment task; 60.7 for the strategy identification task; 59.0 for the 24-pair verbal discrimination list; and 49.2 for the 48-pair verbal discrimination list.

Relative Frequency Judgment Task

In this task, items presented a differing number of times during study were paired on the test trial and subjects were required to choose the more frequent member of each pair. On the test trial there were ten 1 versus 2 pairs (i.e., subjects were required to discriminate between items presented once and items presented twice during study). There were also ten 1 versus 3 pairs; ten 2 versus 3 pairs and ten 2 versus 4 pairs on the test. Achieving the necessary induced frequencies required 180 study presentations: 20 words were presented once; 30, twice; 20, three times; and 10, four times. All words were randomly assigned to the four presentation frequencies.

The ordering of the words across the 180 study positions was random, subject to the restriction that those with multiple occurrences appeared equally often in each equal-sized section of the list. The same word never occurred in adjacent positions. The words were typed on 5 x 8 inch plain white cards which were fastened into a ringed binder.

The four types of test pairs were constructed by randomly pairing items from the four frequency categories. The order of the pairs on the test was random. The words in the test pair were typed side by side, on 5 x 8 inch cards which were fastened into a notebook. The more frequent words appeared equally often in the left- and right-hand positions across pairs.

Strategy Identification Task

Of the 80 words presented (individually) for study, 40 were randomly selected as strategy items. The subjects were instructed to apply the appropriate rehearsal only to those items that were underlined on the study trial. That is, subjects in the rhyme conditions were instructed to give rhymes for these items, while subjects in the function conditions were instructed to give a function associated with the underlined word's referent (i.e., to "tell what each thing can do or what you can do with it"). On the test trial, none of the words was underlined, and subjects were required to indicate for each word whether or not they had previously applied the rehearsal strategy. Different random orders of the words were utilized on study and test trials.

Verbal Discrimination Task

For the Function-Strategy condition 96 words were randomly paired to form a 48-pair list with the correct member of each pair being determined by the flip of a coin. The 24-pair list used in all other conditions was obtained by randomly eliminating half of the pairs in the longer list. For both lists, the word pairs were typed on

5 x 8 inch cards which were placed in a Rolodex file. The task consisted of one anticipation-study (i.e., no guess) trial followed by one anticipation-test trial. On the feedback portion of each trial, the correct item in each pair was designated by a plus sign underneath it. A different random order of the list was used on the two trials. The spatial position of correct and incorrect items within pairs was arranged such that (1) on each presentation of the list, correct and incorrect items occurred equally often in the left and right positions; and (2) for half of the pairs the position of the correct item changed from the study to the test trial.

PROCEDURE

All subjects received the relative frequency judgment task first followed seven days later by the verbal discrimination task and, finally, after another seven-day interval, the strategy identification task. The subjects were individually tested and were informed that they would participate on three different occasions and that the tasks would be unrelated. The particular order of tasks, the instructions, and the seven-day intervals were employed to minimize reactivity among the tasks. Note that the particular sequence of tasks assures that the "criterion" task (i.e., verbal discrimination learning) is temporally equidistant from the two "predictor" tasks (i.e., relative frequency judgments and strategy identification).

The procedure for the relative frequency judgment task was identical in the four conditions. The subjects were not informed about the precise nature of the task but were told to pay close attention to the words because later they would be asked questions about them. The words were presented for study at a 3-second rate. The same rate was used on the test trial, with subjects pointing to the more frequent word in each pair and guessing if uncertain.

The procedure for the verbal discrimination task varied as a function of condition. Subjects in the two control conditions received the usual verbal discrimination instructions for the anticipation method. In addition to these instructions, subjects in the Rhyme-Strategy group were instructed to give a rhyming word for the correct item during the feedback portion of the study trial. Subjects in the Function-Strategy condition were instructed to give a function for the referent of the correct word in each pair on the study trial. (Prior to the task, sample rhymes and functions were provided for subjects in the two strategy conditions.) On the test trial, all subjects were required to point to the correct member of each pair (guessing if uncertain) during the anticipation phase. Subjects did not employ the strategies on the test trial. A 5:5-second rate was utilized on the test trial in all conditions. Control subjects received a 5:5-second rate on the study trial. Subjects in the strategy conditions who had not responded after 5 seconds were prompted by the experimenter. An effective prompt for the function subjects was the question, "What can you do with a _____?" As determined from pilot work, Rhyme subjects who took longer than 5 seconds appeared to have blocked on the word and needed a stronger prompt. For these subjects, the experimenter gave the initial letter sound for a common rhyming word. If subjects in either condition had not produced a response within 10 seconds, the experimenter provided a response which they repeated aloud. (It should be noted that a majority of responses in both conditions were given within 5 seconds, and very few responses in either condition had to be provided by the experimenter.)

In the strategy identification task, subjects in the Rhyme-Control and Rhyme-Strategy conditions were required to give a rhyme for each of the 40 designated (underlined) strategy items. In the Function-Control and Function-Strategy conditions, the subjects were told to give a function for these items. (Once again, prior to the task, all subjects were provided with sample rhymes or functions.) No further instructions concerning the nature of the task were given to subjects. The words were presented at a 5-second minimum rate with the prompting procedure used as needed. For every strategy item on which a subject took longer than 5 seconds, the experimenter lengthened the presentation time for the next nonstrategy item by a corresponding amount of time (in order to eliminate exposure time per se as a potential discriminative cue). On the test, the same words were presented with none underlined. The subject said "yes" if he thought he had previously applied the rehearsal strategy to a particular word and "no" if he thought he had not previously applied it. Subjects were required to respond for every item, guessing if uncertain. The test proceeded at a 3-second rate.

For all tasks, the experimenter presented the materials by turning cards. Thus, the above rates of presentation are approximate. However, the experimenter was well practiced and a stopwatch was used to check rates periodically throughout the course of the experiment. During the study trial of the relative frequency judgment and strategy identification tasks and during the anticipation phase of the study trial in the verbal discrimination task, the experimenter pronounced the words aloud for all subjects.

III

RESULTS

ANALYSIS OF MEAN PERFORMANCE

As was done in the Ghatala, Levin, and Subkoviak (1975) study, prior to inspecting the inter-task correlations associated with the four experimental conditions a number of "validity" checks were conducted (in order to verify the adequacy of the random assignment procedure, the presumed effectiveness of rehearsal, and the absence of carryover effects associated with treatments). Concerning random assignment, performance on the first task, relative frequency judgments, was homogeneous across the four conditions--as it should be since subjects performed the same task in all cases--with the means ranging from 29.5 to 30.4 out of 40, $F(3,108) = 1.28$, $p > .10$.

Concerning strategy effects in the verbal discrimination task, producing rhymes (mean of 19.7 out of 24) clearly facilitated performance relative to the Rhyme-Control group (mean of 14.2), $t(54) = 6.67$, $p < .001$, thereby confirming our pilot results. This finding is interesting inasmuch as researchers of the Craik and Lockhart (1972) persuasion have been inclined to regard strategies of this genre as relatively nonsemantic and, *a fortiori*, nonfacilitative or even interfering in a number of learning tasks. Differences between previous paradigms and what was involved here will be addressed in the Discussion section.

The function strategy also produced the expected very large facilitative effect in the discrimination learning task. However, no direct assessment of the effect may be made since the list employed in the Function-Strategy condition was twice as long as that in the three other conditions (48 pairs versus 24 pairs)--a circumstance dictated by pilot research, given the major correlational bent of this study. Nonetheless, even with the much longer list, Function-Strategy subjects correctly discriminated 91 percent of the pairs on the average, as compared to 82 percent in the Rhyme-Strategy condition and about 61 percent in the two control conditions.

Finally, concerning carryover effects, there is some evidence that subjects who had earlier employed a rhyming strategy in the verbal discrimination task performed somewhat better on the strategy identification task than those who did not: means were 61.9 and 57.9 out of 80 respectively, $t(54) = 2.14$, $p < .05$. However, given the to-be-reported patterns of inter-task correlations in these conditions (which reproduce the Ghatala, Levin, and Subkoviak, 1975, results in which no carryover effects were obtained), it is difficult to offer a plausible rival account of the correlational data that depends upon the carryover effect noted here. Moreover, no such improved strategy identification performance was associated with the function strategy: means were 71.5 and 73.3 out of 80 in the Function-Strategy and Function-Control conditions respectively, $t(54) = -1.22$, $p > .10$. It should also be noted in this context that just as our pilot work had indicated that frequency is more stably encoded with a function strategy in comparison to a rhyming strategy, so the present data indicate that the function strategy enables the subject to make more accurate activity discriminations: pooled strategy identification performance of 90 percent and 75 percent accuracy was obtained in the function and rhyming conditions respectively, $t(108) = 10.36$, $p < .001$.

EXAMINATION OF THE CORRELATIONAL PATTERNS

The correlations between each memory attribute task and verbal discrimination learning, as well as the correlations between the two memory attributes, are presented in Table 1 for the four experimental conditions. In the two control conditions, the Ghatala, Levin, and

TABLE 1

INTER-TASK CORRELATIONS IN THE FOUR CONDITIONS

	Rhyme			
	Control		Strategy	
	RFJ	SI	RFJ	SI
SI	.13	---	.04	---
VDL	.46**	.13	.12	.76**

	Function			
	Control		Strategy	
	RFJ	SI	RFJ	SI
SI	.19	---	.03	---
VDL	.35*	.18	.40*	.40*

Note: RFJ = relative frequency judgment task; SI = strategy identification task; VDL = verbal discrimination task. All probabilities are one-tailed.

* $p < .05$
**$p < .01$

Subkoviak (1975) result is completely substantiated in that frequency judgment ability is significantly related to verbal discrimination learning, whereas strategy identification ability is not. Moreover (1) both frequency judgment-discrimination learning correlations are in the neighborhood of .40, the value obtained by Ghatala, Levin, and Subkoviak; and (2) frequency judgment ability and strategy identification are seen to be statistically uncorrelated, a result also obtained by Ghatala, Levin, and Subkoviak (1975).

In the two strategy conditions quite different correlational patterns may be observed with respect both to the control conditions and to each other. Specifically, in the Rhyme-Strategy condition, the <u>supplant</u> pattern revealed in the Imagery-Strategy and Pronunciation-Strategy conditions of Ghatala, Levin, and Subkoviak (1975) emerges once again. That is to say, here frequency judgment ability has been supplanted by strategy identification ability as the prime predictor of verbal discrimination performance, with the magnitude of the correlation comparable to (actually slightly higher than) that reported by Ghatala, Levin, and Subkoviak (1975) for imagery and pronunciation strategies.

The Function-Strategy condition exhibits a novel, and highly interesting, correlational pattern. In particular, the correlation between frequency judgment ability and discrimination learning on the one hand, and between strategy identification ability and discrimination learning on the other, offers strong support to the <u>supplement</u> hypothesis inasmuch as the typical frequency judgment-discrimination learning correlation of .40 is supplemented by a strategy identification-discrimination learning correlation of the same magnitude. Moreover, since the two memory attributes are uncorrelated, each may be regarded as an independent predictor of discrimination learning (in a partial correlation sense). This may be seen more clearly in Table 2, which presents the multiple correlations associated with the four experimental conditions. For each condition, the correlation between

TABLE 2

MULTIPLE CORRELATIONS IN THE FOUR CONDITIONS

	Rhyme-Control	Rhyme-Strategy
Variable	R	R
RFJ	.461**	.116
SI	.466	.760**
RFJ x SI	.481	.760

	Function-Control	Function-Strategy
Variable	R	R
RFJ	.355*	.403*
SI	.372	.562*
RFJ x SI	.374	.702**

Note: RFJ = relative frequency judgment task; SI = strategy identification task. All probabilities are one-tailed.

* Increment in R is significant with $p < .05$.

** Increment in R is significant with $p < .01$.

frequency judgment ability and verbal discrimination learning was considered first, followed by the addition of strategy identification ability to the prediction equation. Further, in order to determine the joint influence of these two memory attributes (in an analysis-of-variance interaction sense), the product of the separately standardized frequency judgment and strategy identification variables was entered as a third predictor in each condition.[1] (What is of interest here is the increment in R as each new predictor is added.) As may be seen, the only significant predictor in the case of the two control conditions is the relative frequency judgment task. In contrast, for the two strategy conditions, this is not true. For the rhyming strategy, only the strategy identification task significantly predicts verbal discrimination learning. And for the function strategy, both frequency judgment ability and strategy identification ability are significantly related to discrimination learning, as was found with the zero-order correlations. But something else is also apparent here: this is the one condition where the frequency judgment-strategy identification product is significantly related to discrimination learning performance, beyond that which is obtained from the two abilities separately.

Thus, an interaction is hinted at in the Function-Strategy condition. To get a better feel for its interpretation, subjects in this condition were cross-classified according to whether their

[1]We are indebted to Jeremy D. Finn for a discussion of the rationale underlying this particular interaction approach.

performance on each of the two predictors (frequency judgment and strategy identification tasks) was above or below the median for their group. The resulting 2 x 2 classification is presented in Table 3, and summarizes subjects' performance on the verbal discrimination task. Even according to this crude breakdown, the nature of the significant interactive term in the multiple correlation analysis is readily apparent: The two abilities appear to be less than additive for predicting discrimination learning, in that subjects above the median on either ability are as good at learning verbal discriminations as those above the median on both abilities. Moreover, all three subgroups appear to be better discrimination learners in comparison to subjects below the median on both abilities.

TABLE 3

VERBAL DISCRIMINATION PERFORMANCE AS A FUNCTION OF RELATIVE FREQUENCY JUDGMENT AND STRATEGY IDENTIFICATION ABILITY

		Relative Frequency Judgment Task: Above the Median	Relative Frequency Judgment Task: Below the Median
Strategy Identification Task	Above the Median	$\bar{X}$ 44.50 SD 2.83 n 8	$\bar{X}$ 45.71 SD 2.61 n 7
	Below the Median	$\bar{X}$ 44.67 SD 3.56 n 6	$\bar{X}$ 40.28 SD 5.12 n 7

IV

DISCUSSION

Clearly this study serves to clarify (and at the same time, to raise) a number of important issues, some of which will be considered here. Moreover, since the Ghatala, Levin, and Subkoviak (1975) study was virtually identical to the present one in every respect (i.e., design, procedures, subject populations, and the like)--apart from the particular rehearsal strategies investigated--the conclusions and speculations presented here represent a composite picture derived from the two studies.

In short, the results of our research indicate that whether or not verbal discrimination learning depends on frequency discrimination per se is a function of the particular instructional conditions under which the task is administered. When the task is administered in the absence of explicit rehearsal strategy instructions, the task consists largely of simple frequency discriminations. This statement is true at least for the elementary school-aged children that we have tested through four independent replications. Whether the same conclusion would be reached for adult subjects who are likely to employ effective rehearsal strategies spontaneously in the verbal discrimination task (e.g., Rowe & Cake, 1974) is a question for further investigation.

Regarding the role of frequency in the usual (control) version of the task, one might wonder why, if frequency is the dominant discriminative attribute (as we have been inclined to argue), the consistently obtained .40 correlation between frequency judgment ability and discrimination learning is not higher. Certainly it does not rival the .60 to .70 correlations between strategy identification ability and discrimination learning in the strategy versions of the task. Two explanations can plausibly account for the lower control correlation. First, as was pointed out by Ghatala, Levin, and Subkoviak (1975), the relative frequency judgment task was not as reliable as the two other tasks employed (as determined from internal consistency estimates) and, consequently, any correlations involving this task are shrunk the most. Indeed, correcting the Ghatala, Levin, and Subkoviak (1975) frequency judgment-discrimination learning correlations for attenuation substantially increases the values (to greater than .75). A second explanation is that even though frequency is materially involved in both tasks, the kind of frequency encoding required of subjects differs for each. In the relative frequency judgment task, subjects are uninformed as to what will later be expected of them, whereas in the discrimination learning task what will later be expected of them is made quite explicit. Thus, if subjects are encoding item frequencies, they are doing so in a purely incidental manner in the former situation and in a much more intentional manner for the latter situation. While it is true that a number of previous researches have found that explicit instructions to encode frequency do not seriously affect the mean of adults' frequency judgment performance (in comparison to performance under nonexplicit instructions), there may well be individual differences with respect to subjects' ability to encode frequencies purposefully, as opposed to incidentally, which would be reflected in a correlational analysis (though not necessarily in a comparison of means). An obvious implication that follows is that the correlation would increase were the relative frequency judgment task administered under intentional instructions.

It is equally plausible that--just as was found when a function rehearsal strategy was employed in the discrimination learning task--attributes other than frequency are involved. That is to say, we have noted that strategy identifications such as imaging, pronouncing, rhyming, and producing functions are not related to control verbal discrimination performance. But it is important to note that this conclusion is based on the forced usage of a fixed strategy. If different subjects tend to employ different (likely idiosyncratic) covert strategies in the discrimination task, there is no reason to anticipate a correlation between strategy identification ability based on any specified strategy and discrimination learning. On the other hand, if subjects were encouraged to adopt whatever unspecified strategy they wanted to in a strategy identification format, performance under this condition might be expected to predict control discrimination learning.

In contrast to the control version of the verbal discrimination task, which we have seen to consist almost exclusively of frequency discriminations (but see the immediately preceding paragraph), when an effective rehearsal strategy is added to the task, frequency discriminations are modified by what we have called activity discriminations. A <u>supplant</u> modification is associated with strategies such as imagery, pronunciation, and rhyming--strategies which do not positively affect frequency discriminations per se--whereas a <u>supplement</u> modification is associated with the function strategy which does positively affect frequency discriminations.

Let us consider the <u>supplant</u> type of modification first. The <u>supplant</u> strategies (imagery, pronunciation, and rhyming) share an important commonality, namely that since they do not positively affect frequency discriminations (e.g., Ghatala et al. 1973; Rowe, 1974) their positive influence on discrimination learning performance must be due to discriminative processes other than frequency. And, indeed our so-called activity attribute emerges as a likely candidate. Specifically, in the case of each strategy subjects are quite capable of making reliable activity discriminations; moreover, the degree to which they are capable of doing so is substantially related to their level of discrimination learning.

In this regard, a few interesting findings will be further discussed. First, generating a rhyme (which on the surface would seem to comprise a rather ineffectual strategy) apparently does produce a usable discriminative cue in the discrimination learning task, a task which measures a form of subjects' recognition memory (cf. Ghatala & Levin, in press). As was mentioned earlier, subjects' ability to discriminate their rhyming activity (an average of 75 percent accuracy) is well above chance and, in fact, is quite comparable to that obtained by Ghatala, Levin, and Subkoviak (1975) for a simple pronunciation strategy (about 81 percent accuracy). Given that both rhyming and pronunciation: (a) do not positively affect frequency judgments (e.g., Ghatala et al., 1973; as well as the pilot work mentioned in the introduction); and (b) produce comparable mean levels of strategy identification performance (with the latter task being similarly related to discrimination learning for both strategies), it might be expected that the rhyming and pronunciation strategies would result in comparable mean levels of discrimination learning. And based on a comparison with the Ghatala, Levin, and Subkoviak (1975) data, as well as our pilot work mentioned in the introduction, this has in fact been the case. The similarity in effectiveness (and processes) of the two strategies may be traced to any of a combination of variables, including attentional responses, articulatory cues and acoustic feedback. It is not our purpose to choose among these here; rather it seems likely that such variables would be represented in both literal and acoustically similar pronunciations of the stimulus. What may be crucial is that the orthographic unit is well integrated (in a Bousfield, 1961, "representational response" sense). Given any number of activities which do result in integrated units of this kind, subjects may then rely on activity discriminations in performing subsequent recognitions. If, on the other hand, the rehearsed unit is not well integrated, activity discriminations (and, hence, subsequent recognitions) are likely to suffer, as was found in

Zechmeister and Gude's (1974) rehearsal condition wherein subjects were instructed to visualize the <u>spelling</u> of each word--see also Ghatala, Levin, and Wilder (1975).

Let us now consider the function strategy. Concerning subjects' mean level of discrimination learning, this strategy is clearly superior to the three others already discussed (as determined from our pilot work as well as our across- and within-experiment comparisons). From a strict frequency theory point of view (Ekstrand et al., 1966) this result is certainly not unexpected inasmuch as the function strategy is the only one of the four that enhances situational frequency discriminations and, because of this, should produce the best discrimination learning. But we have also seen that the function strategy yields very reliable activity cues (also the best of the four strategies)--which, from a non-frequency theory point of view would similarly be expected to produce the best discrimination learning. Thus, subjects capitalizing on either frequency or activity cues (or both) in the strategy version of the discrimination learning task would be expected to perform best of all with the function strategy (where such cues are most discriminable)--which they do--according to either the frequency or the non-frequency theory position.

Concerning the function strategy and its correlational pattern, since frequency comprises a useful cue in the discrimination learning task, some subjects are likely to utilize this attribute in performing the task in addition to (or instead of) the very reliable activity attribute which is also at their disposal (and which is likely utilized by other subjects as the primary discriminative cue). Because of the opportunity in this situation for individual differences in attribute selection (either frequency or activity) to come into play, it should not be surprising that the correlation between activity discriminations per se and discrimination learning is not as high (.40) as it is in the three other strategy conditions (around .70). At the same time, the finding that the frequency judgment-discrimination learning correlation is no lower in the function condition than in the control version of the task may be attributed to the explanations offered earlier in the discussion.

This study and that of Ghatala, Levin, and Subkoviak (1975) have succeeded in beginning to specify the functional components associated with discrimination learning under various strategy conditions. We further anticipate that something akin to the present combined experimental/correlational approach will exhibit its utility in resolving process issues in similar problem areas--just as Underwood (1975) has said it would.

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