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NOTE

1. In all statistical tests, a predetermined alpha level of 0.05 was used. All results are therefore reported as statistically significant at or beyond the 0.05 level or as statistically nonsignificant.

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Instruction effects in recognition memory*

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Ninety-six Ss listened to a list of 200 common nouns after receiving instructions to study various portions of the list by repeating each word as it was presented (REP), producing associations to the study items (ASSOC), thinking of the "dictionary meaning" of each word (DM), and visualizing the spelling of each word (VS). One-half of the Ss were tested for forced-choice recognition of the nouns; the other half of the Ss were asked to identify for each study item the particular study strategy that had been used. Contrary to expectations of the frequency theory of recognition memory, recognition errors were significantly fewer under ASSOC or DM instructions than under REP instructions. However, retention of the kind of encoding activity indicates that Ss have available other information than frequency by which to make a recognition decision.

Light & Selhorst (1971) and Hall & Pierce (1972) have reported that recognition memory for common words was more accurate after Ss received instructions to produce associations to items at the time of study than after Ss were instructed to repeat study items or received neutral instructions. These results are in apparent conflict with predictions derived from the frequency theory of recognition memory (Underwood & Freund, 1970). The rationale for this contradiction is as follows.

The frequency theory states that situational frequency is the dominant attribute mediating discrimination of "old" and "new" items in a recognition task. According to the theory, frequency accrues from both covert and overt representations of the item at the time of encoding, as well as from the addition of frequency units contributed by implicit associative responses (IARs) which are that word. When high-frequency words are presented for study and later test, IARs elicited during study may augment the frequency of other study items or may give frequency to new test items. Incrementing the situational frequency of old items via IARs should facilitate recognition performance, while incrementing the frequency of distractor items should inhibit performance. However, "since adding an additional frequency unit to an old word produces a relatively small increase in discriminability . . . the negative effect (of IARs) should be greater than the positive effect [Underwood & Freund, 1970, p. 345]." Since fewer IARs would be expected for low-frequency items, this reasoning provides a theoretical accounting in frequency terms for the empirical observation that recognition is poorer for high- than for low-frequency words (e.g., Gorman, 1961). When only high-frequency words are used, the same rationale would lead the frequency theory to predict poorer recognition as the likelihood of eliciting IARs during study is increased. At a minimum, if only a

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Table 1
Distribution of Strategy Identification*

Strategy	ASSOC	DM	REP	VS	N
	Identification				
ASSOC	*.50*	.21	.18	.11	960
DM	.18	*.54*	.18	.11	960
REP	.16	.14	*.48*	.21	960
VS	.15	.13	.36	*.36*	960

Italics through diagonal indicates correct identification.

frequency attribute is considered, the theory must predict better subsequent recognition under a set to repeat study items than under a set to produce associations.

While suggesting that the dominant attribute governing recognition memory performance is a frequency cue, proponents of the frequency theory have not held that frequency is the only cue which may be utilized. For example, Underwood (1972) has recently suggested that associations may play a "supporting role" in a recognition decision. When instructions require Ss to produce associations to each study item, it is likely that recognition may be aided by Ss' retention of this activity. The present experiment assessed the relative effectiveness of various instructional sets on subsequent recognition when instructions were varied within a list. Since any one S was asked to process items under each of four different study strategies, it was possible to examine Ss' retention of the strategy which was used to process a specific study item. To the extent that differences in recognition memory performance are associated with differential memory for the kind of encoding activity, it may be assumed that Ss do in fact have available information other than frequency by which to make a recognition decision.

METHOD

Materials

The study list consisted of 200 high-frequency nouns randomly sampled from the Spreen & Schulz (1966) norms. Restrictions were that no word be less than four letters in length and that no homophones be included. The list was recorded for aural presentation, with each word read twice in a 5-sec interval and with a 15-sec pause after every 25 words. Two 80-item test lists were constructed by twice randomly sampling, without replacement, 10 words from each of eight blocks of 25 study items. For each test list, 5 of the 10 items from each study block were placed in the first half of the test list, and 5 were placed in the second half. Also, the test lists were constructed such that there were 10 blocks of 8 words, each block containing one item from each of the 8 study blocks. Order of the items within a test block was determined randomly. Two sets of 80 distractors were selected randomly, with replacement, from the Spreen and Schulz list and paired with the 80 study items in each of the test forms. Position of the old and new words in the test pairs was balanced. Both forms were used equally often and each was presented on standard paper with two columns of 20 words on two sheets.

Design and Procedure

All Ss received instructions concerning each of four different study strategies. These included instructions to repeat each word as it was presented (REP), produce associations to the study items (ASSOC), think of the dictionary meaning of the word (DM), and to visualize the spelling of each word as it was read aloud (VS). An example of each strategy was given. All Ss were then given an eight-page booklet, which listed each of the four study strategies, each two times. The order of the strategies was one of four sequences resulting from the combination of two consecutive Latin squares. For any one sequence, all four strategies appeared once before any were repeated, and the two occurrences of the same strategy were not contiguous. Further, the second occurrence of a strategy was preceded and followed by a different strategy than its first occurrence. Across sequences, all strategies appeared once in each of eight study blocks.

All Ss were instructed to use only the particular study strategies that had been explained to them, and in the order in which the strategies appeared in their booklets. After the presentation of each 25 items, a bell sounded which Ss understood as a signal that they were to turn the page of their booklets and get ready to study the next set of items under the strategy named on the new page. After presentation of the study list, one-half of the Ss were immediately given a forced-choice recognition test. The other half of the Ss were given the 80 old items in the same order as in the recognition task and asked to identify for each item which of the four study strategies they had used. The abbreviations of the strategies were listed after each of the 80 items. For both the recognition and strategy identification tasks, the Ss also rated confidence in their answers, using a 5-point scale, where 5 denoted greatest surety. Testing was self-paced. After completing the recognition task, Ss were given the strategy identification task, using the same 80 items as in the recognition test. Finally, all Ss, upon completion of the experimental tasks, were asked to reconstruct from memory the sequence of study methods that had been followed in the pages of their test booklets.

Subjects

A total of 96 introductory psychology students served as Ss as part of a course requirement. All Ss were tested in small groups, and assignment of Ss to conditions was through a block randomization in which the possible combinations of tasks and the four sequences comprised the blocks.

RESULTS AND DISCUSSION

Mean recognition errors made on the 20 items which had been studied under each of the four encoding strategies were: 2.08, DM; 2.50, ASSOC; 4.21, VS; 4.62, REP. The differences were reliable, $F(3,141) = 18.78$, $p < .01$. A Newman-Keuls test showed that errors were significantly fewer under ASSOC or DM instructions than under either VS or REP instructions. Neither ASSOC and DM nor VS and REP conditions differed between each other. Analysis of variance of the mean confidence ratings for correct items also showed a significant effect for variations in encoding instructions, $F(3,141) = 57.07$, $p < .01$. Mean confidence ratings were greatest for items studied under ASSOC (4.44) and DM (4.39) instructions and least for VS (3.83) and REP (3.53) instructions. Contrary to expectations of the frequency theory, instructions which presumably enhance situational frequency of old items (i.e., REP), were significantly less effective in a forced-choice recognition task than instuctions which encourage the production of associations (ASSOC) or semantic relations (DM) to old items. Further, since only a portion of the input list was studied in this manner,

Table 2
Distribution of Strategy Identification for Correct and Incorrect Items in the Recognition Task*

Strategy	Identification								N	(N)
	ASSOC		DM		REP		VS			
ASSOC	*.59*	*(.27)*	.15	(.24)	.15	(.29)	.11	(.20)	840	(120)
DM	.24	(.15)	*.49*	*(.21)*	.17	(.37)	.10	(.27)	860	(100)
REP	.22	(.15)	.16	(.15)	*.43*	*(.48)*	.19	(.23)	738	(222)
VS	.15	(.15)	.13	(.14)	.33	(.43)	*.39*	*(.27)*	758	(202)

**Figures outside parentheses are for items correct in recognition; figures inside parentheses are based on incorrect recognition items. Italics through diagonal indicates correct identification.*

these results imply that the beneficial effects of associational or semantic sets are peculiar to those items processed in this manner.

Table 1 presents the distribution of strategy identification for those 48 Ss tested only for strategy identification. Strategy identification was substantially different from chance for each of the four instruction conditions, with identification of VS being the poorest. While Table 1 shows that Ss were apparently only little better at identifying items as having been studied under ASSOC or DM instructions than under REP instructions, the data indicate that correct identification of items associated with REP instructions is overestimated due to a guessing bias. It can be seen that errors associated with DM and ASSOC strategies do not suggest a significant confusion of these two strategies. On the other hand, discrimination between REP and VS strategies was evidently difficult, as evidenced by the obvious confusion of these strategies for items studied under a VS strategy. Further, a Newman-Keuls analysis indicated that confidence ratings associated with correct strategy identification were significantly greater for ASSOC (3.98) and DM (3.79) items than for either VS (2.97) or REP (2.34) items. Mean confidence ratings associated with the latter two instructions were also significantly different from each other.

Table 2 shows the distribution of strategy identification by those Ss previously tested for recognition. Strategy identification was obviously greater for correct (proportions outside parentheses) than for incorrect recognition items (proportions inside parentheses). Since strategy identification was required of items not recognized as having been in the experimental list, proportion identification of these items will approximate Ss' guessing pattern. It can be noted that for items incorrect in recognition Ss in general tended to indicate REP when they erred. It can be concluded that the proportion correct identification associated with this instruction for results found in both Tables 1 and 2 is substantially inflated due to a response bias.

It might be suggested that if Ss remember that an item was presented early in the list and also recall that a particular strategy was used early in the study series, correct strategy identification may be made on this basis. Of the 96 Ss who participated in the experiment, only 7.2% were able to correctly reconstruct the order in which the strategies were presented. Further, of those Ss receiving only the identification task, no significant difference was obtained between the overall identification scores of the 13 Ss showing, respectively, the best and the poorest order construction.

While the present results are compatible with interpretations of the encoding process which place some value on a semantic or meaningful emphasis per se (e.g., Cermak, Schnorr, Buschke, & Atkinson, 1970), it is clear that memory for the implicit activity at the time of encoding may be part of the memory for a word and could serve to support a recognition decision which is based chiefly on a frequency cue. However, there exist a number of alternatives to account for the present findings. For example, requirements to produce semantic relations or associations to a study item may cause the distribution of implicit rehearsals of an item. Apparent frequency under these conditions may not be the same as when repetitions are massed or are rattled off in a rote manner. Further, since there is a definite limit to the advantage of increased repetition, it is likely that covert rehearsal does not add, beyond some hypothetical ceiling, to the apparent frequency of an item. Finally, it is obvious that the present interpretation assumes that there may be some retrieval of information in a recognition task.

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