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Retrieval processes in recognition*

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Retrieval processes in the long-term recognition of well organized material showed the expected organizational effects on "slow" recognition responses. Ss sorted 100 words into two to seven categories until a stable organization was achieved. The data showed the usual correlations between organization (number of categories used) and recall and recognition. Recognition tests a week after the sorting task revealed no differences between Ss using many or few categories for the "fast" recognition responses, defined as the faster 50% of each S's latency distribution. The organizational effect was clearly evident for the "slow" 50% of the responses. The data support the retrieval check hypothesis in recognition under the assumption that retrieval operations take additional time during the recognition process.

The belief that recognition of an event and its retrieval or recall involve fundamentally different memorial processes has characterized the mainstream of psychological research and, as recently as 1970, Kintsch stated that the "familiarity value of an item together with the subject's decision criterion completely determine the recognition response [1970, p. 243]." When retrieval factors have been admitted as relevant variables, they have been considered sporadic in their effect, which in turn has been described as minor and unimportant. However, the notion that recognition is usually based only on some familiarity value or on occurrence information can be shown to be empirically inadequate and also intuitively inappropriate. The usual response to one's inability to recognize a face or a name that one has "surely met before" is to search one's memory under the appropriate and possible categories and contexts.

Following the demonstration that recall of lists of words is a linear function of the *number* of categories into which the words are categorized (Mandler & Pearlstone, 1966; Mandler, 1967), Mandler, Pearlstone, and Koopmans (1969) also showed that recognition is similarly a function of the categorical organization of the input material. At that time and in a subsequent elaboration (Mandler, 1972), we presented a theoretical framework for the interaction of recognition and retrieval processes, called a postrecognition retrieval check. For the purposes of this presentation, the important aspect of this theory is the notion that during recognition items are either recognized quickly on the basis of familiarity or occurrence information or items have weak occurrence information (and receive low confidence ratings), in which case they undergo a retrieval check.

The retrieval check (in the case of categorized material) involves the identification of the appropriate category of the to-be-recognized item and a comparison between that item and a draw of approximately five items (the number usually available in retrieval) from the stored category. If there is a match, the item is called "old"; if not, it is called "new." Given an input list of constant size, the more categories used to divide the list, the smaller the categories will be and the more likely the retrieval check will provide a match and a correct "old" response. The general notion that retrieval strategies are applied to items of low confidence, weak occurrence information, or insufficient event markers has subsequently been incorporated into several theoretical treatments (Anderson & Bower, 1972; Atkinson & Juola, 1974; Atkinson, Herrmann, & Wescourt, 1974). In addition, Lesgold and Goldman (1973) have obtained empirical evidence supporting our theoretical viewpoint.

One of the obvious qualitative deductions that can be drawn from such a treatment, and one that is also intuitively appealing, is the prediction that the relationship between recognition accuracy and retrieval (organizational) factors should occur for recognition responses that have a slow latency and should be absent for responses that are made relatively quickly. The additional retrieval check makes substantial demands on processing time, while decision based on unequivocal familiarity and occurrence information should be relatively rapid and independent of retrieval or storage variables. The present experiment addresses the simple question of whether or not retrieval variables are associated with slow recognition responses and irrelevant to recognition responses with relatively fast latencies.

METHOD

The basic design of this study is similar to our previous work (Mandler et al, 1969). Ss sorted 100 words into two to seven categories, with the choice of number of categories left to the Ss. On the basis of prior evidence and in order to accentuate organizational effects, only 11 Ss who used three or four categories (Group 34) and 10 who used six or seven categories (Group 67) were used. The problem of S selection involved in this procedure has been extensively discussed in Mandler (1967). Since the category-recall relationship can be demonstrated either

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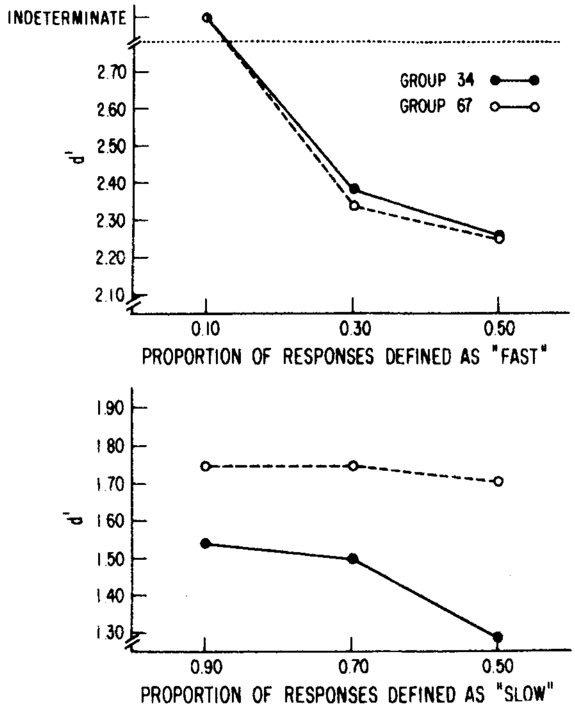

Fig. 1. Median d′ values for recognition responses for three divisions of latency distributions into "fast" and "slow." The SDs for Group 34 at .90, .70, and .50 proportions of "slow" responses were .40, .42, and .52. The corresponding values for Group 67 were .39, .35, and .27. Standard deviations could not be calculated for the "fast" proportions due to the indeterminate d′ values.

by assigning categories or by letting Ss select the number they choose and since the relationship can be shown to hold in within-S designs (Mandler, 1968), one can now safely use whatever method is most appropriate and be certain of the generality of the effect across or within Ss.

Two sets of 100 words with a Thorndike-Lorge frequency of AA were selected. Thirteen of the Ss sorted one set of words, eight Ss sorted the other, and the final recognition task consisted of all 200 words. In Session 1 Ss were presented with a deck of 3 x 5 in. cards with the 100 words and seven bins. They were instructed to sort the words into any number of categories up to seven by putting words together that semantically "belonged together." After each sort, the deck was thoroughly shuffled and returned to the S. Sorting was continued until two consecutive sorts showed a 95% overlap in the category assignment of the words. The Ss were then asked to return for a different experiment in 1 week's time. At the start of Session 2, Ss were told that they would be given a variety of tasks, all of which required making yes/no judgments. Two initial tasks involving trigram recognition and a simple arithmetic task were given to familiarize the Ss with the apparatus. They are not relevant to the present analysis. For the recognition task which followed, the Ss were told that they were going to be presented with 200 words, one at a time, and they were required to respond YES if it was a word that they had sorted in Session 1 and NO if it was not. Ss faced a VR-12 video display with two response boxes in front of them. One box had two buttons labeled YES and NO and a READY button. The second box had three buttons labeled VERY SURE, FAIRLY SURE, and NOT SURE. A PDP-12 computer controlled the display, recorded responses, and measured response latencies to the nearest hundredth of a second. A ***READY*** appeared on the screen and remained on until the S pressed the READY button, and 1.5 sec later a test item was displayed. Once the S had made the YES/NO choice, the item was replaced with the instruction INDICATE YOUR CONFIDENCE and, as soon as they had done that, the ***READY*** signal appeared again. The order of items was randomized for each S, and Ss could take a brief rest any time ***READY*** was displayed on the screen. After the recognition task, all Ss were given a written recall of all the words they had sorted in Session 1.

RESULTS AND DISCUSSION

As far as final recall was concerned, previous findings were replicated (Mandler, 1967). The correlation between number of words recalled and number of categories used was .63 ($p < .05$), the slope of the function was 5.3 (words per category), and the intercept was 8.6.

The mean hit rate (calling OLD items "old") and the mean false alarm rate (calling NEW items "old") for Group 34 were .83 (SD = .09) and .31 (SD = .06), and for Group 67 they were .86 (SD = .06) and .23 (SD = .08). The mean d′ measure of discriminability, which takes response biases into account, was 1.53 (SD = .38) for Group 34 and 1.94 (SD = .36) for Group 67 ($p < .05$). The correlation between number of categories used and d′ was .49 ($p < .05$), which is the same low but significant correlation found previously (Mandler et al, 1969).

The major prediction based on the retrieval check theory was that recognition performance would be significantly different for the slow latency responses. These presumably involve the retrieval check which would be more successful for Group 67. Fast latencies should show no differences between the two groups. Since there is no a priori definition of "slow" and "fast" latencies, we successively defined portions of each S's latency distribution as "fast" or "slow" responses, moving from the fastest 10% of the distribution to 30% and 50%; this procedure correspondingly defines as "slow" responses 90%, 70%, and 50% of each S's distribution. Figure 1 shows the median d′ values for the two experimental groups for each of the subsets of the latency distribution. Median values were used because the performance of some Ss on their "fast" responses (i.e., 100% hit rate and/or 0% false alarms) yielded indeterminately high d′ values. Clearly, recognition is better for "fast" than for "slow" responses overall. However, and in keeping with the prediction, the two groups' recognition performance is indistinguishable for all three definitions of "fast," while for the slow responses a Mann-Whitney U test showed significant or near significant differences ($p < .10$ for 90%, $< .05$ for 70%, and .05 for 50% slow responses). As a first approximation, the boundary between a simple decision process and a retrieval check can be assumed to be at the 50% point of each S's distribution of latencies. Another argument for a qualitative difference between slow and fast recognition processes is a low and nonsignificant rank order correlation of .19 between Ss' d′ values on the fast 50% and the slow 50% of responses.

Table 1 shows the mean confidence ratings (giving high, medium, and low values of 1, 2, and 3,

Table 1
Mean Confidence Ratings and Standard Deviations for Each Combination of Stimulus and Response for the "Fast" and "Slow" Responses

	OLD Items				NEW Items			
	Called OLD		Called NEW		Called OLD		Called NEW	
	M	SD	M	SD	M	SD	M	SD
	Fast .50 Responses							
Group 34	1.26	.28	1.97	.38	1.78	.40	1.68	.44
Group 67	1.10	.18	1.81	.39	1.55	.30	1.36	.39
	Slow .50 Responses							
Group 34	1.79	.33	2.47	.30	2.32	.43	2.06	.38
Group 67	1.43	.33	2.16	.38	1.99	.38	1.83	.27

respectively) for all four stimulus-response combinations, segregated by groups and "fast" and "slow" latencies. Group 67 has higher confidence ratings than Group 34, with the "slow" "old" response to OLD stimuli the only statistically significant comparison. The ratings for "fast" responses are always more confident than for the "slow" responses, with seven out of eight comparisons statistically significant. Figure 2 shows the mean latencies for each of the four stimulus-response

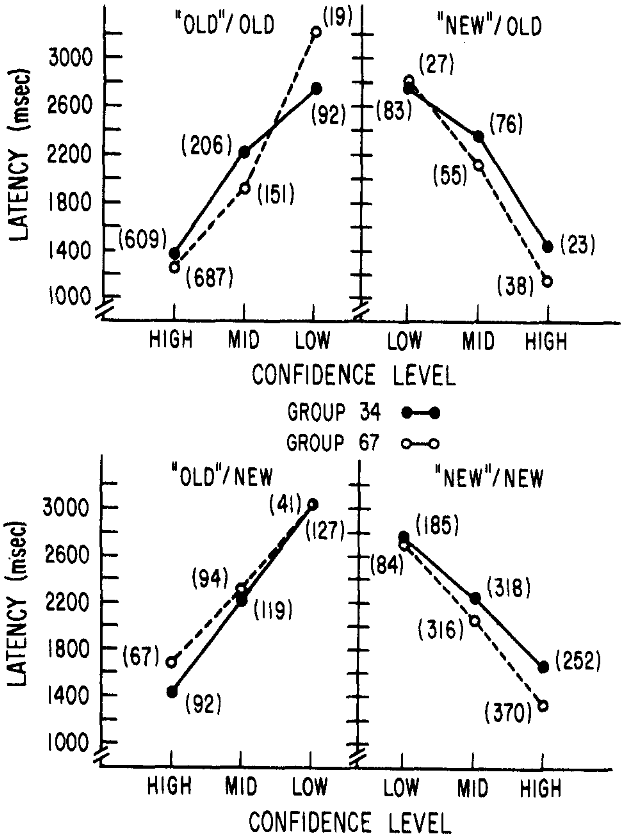

Fig. 2. Mean latencies as a function of confidence levels for both experimental groups and each stimulus-response type. The top two panels show responses to OLD stimuli, the lower two to NEW stimuli. Numbers in parentheses show the number of observations for each data point. Overall mean latency for Group 34 was 2,030 msec, with a SD of 490 msec; the corresponding values for Group 67 were 1,670 msec and 390 msec.

combinations by groups and confidence levels. Following Murdock and Dufty (1972), each pair of panels can be seen as corresponding to either OLD or NEW stimuli on a continuum from high confidence "old" to high confidence "new" responses. The data are of interest because they show functions that are highly similar to those found by Murdock and Dufty in short-term memory recognition. They also indicate the negative correlation between confidence and latency not previously demonstrated in detail for long-term memory recognition. In fact, confidence level clearly accounts for much more of the latency variance than either type of response or stimulus.

The previously found superiority in recognition for Ss who use a larger number of categories (e.g., Group 67) can now be assigned to the slower half of the recognition responses. This finding is in full agreement with the retrieval check hypothesis and the influence of organizational retrieval factors on a substantial part of recognition responses. The notion that retrieval factors have only a small or sporadic influence on recognition seems to be in error; these factors are important not only in natural settings but also in restricted laboratory situations. More detailed studies are necessary to show that these retrieval operations are performed only or primarily on certain items, as most theoretical treatments have assumed. The confidence ratings we have obtained only provide evidence on confidence levels *after* the check has been performed, but the small number (shown in parentheses) of low confidence "old" responses to OLD stimuli in Fig. 2, particularly by Group 67, is consistent with the hypothesis.

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