Recognition and recall of high frequency words following serial learning¹

ROY LACHMAN, KENNETH R. LAUGHERY AND WILLIAM H. FIELD

STATE UNIVERSITY OF NEW YORK AT BUFFALO

A set of 50 words relatively devoid of sequential dependencies (in random order) were administered with degree of training varied for independent groups of Ss. A single test of recall or recognition followed. For most of the range of training, recognition was superior to recall; but with a sufficiently large number of trials, recall surpassed recognition. The results, taken together with previous data, suggest that studies comparing different retention measures by simple ordering are likely to become exercises in futility. Implications were briefly examined for the hypothesis of a unitary construct underlying recognition and recall.

Recognition measures of memory have generally yielded higher retention scores than free recall measures following identical conditions of training. More recently, the superiority of recognition to recall was found only at early stages of serial verbal learning. At later stages, recall was superior to recognition (Lachman & Field, 1965). The training material in that experiment was an "English paragraph" consisting of 50 different high frequency words in syntactical order. Thus, a fixed list at a high approximation to English (AE) was administered for varying series of trials prior to a single retention test. The test was either conventional free recall or binary recognition (Lachman & Tuttle, 1965) containing a random order of the training words intermixed with distracter words. Both sets of words were selected from a population of high frequency lexical units, the distracters were selected randomly. The test words, during recognition, were sorted into old or new categories at the rate of one word per 1.5 sec. Pacing of recognition was designed to preclude contamination of the recognition measure by implicit serial recall. Perfect recall was obtained after 16 trials. Approximately 80% of the training words were correctly recognized at all levels of training, including 128 trials (see Fig. 1).

Waugh (1961) has demonstrated that free recall instructions yield a higher absolute number of words recalled after moderate mounts of training than do serial recall instructions. On later trials, the total number recalled is greater for serial recall than for free recall. Perhaps serial recall instructions induce the Ss to organize and to learn the words on a serial basis such that recall is materially facilitated on later trials by a given word cueing the next word in the sequence. Lachman and Field specifically instructed their Ss to attempt to learn the training words in sequence. A high AE list, such as the "prose" material used in that experiment, provides the sequential dependencies that make serial organization the most ef-

Fig. 1. Mean percentage correct (above) and false positive errors (below) as a function of number of training trials and type of retention test. Clear circles represent data from the present experiment; the curves connecting the black circles are from Lachman & Field (1965).

ficient encoding strategy provided that retention is tested by recall. Recognition, including the binary recognition test, is typically insensitive to serial organization. The contextual cues provided by sequence and chaining are, therefore, useless. Accordingly, recall surpassed recognition in the Lachman and Field study after the sequential dependencies were strengthened by sufficient training.

Barring sampling accidents, a random set of words initially is devoid of sequential dependencies. Training with a fixed order of presentation, however, probably induces a serial learning strategy such that sequence associations start developing. In any case, if S is directed to a serial learning strategy, recall may once again surpass recognition after sufficient training. The present study compares recognition and recall after various degrees of training with a randomly ordered list of words (low AE).

Method

The present experiment consisted of a training phase followed by either a free recall or recognition test. It was identical in all respects to the Lachman & Field (1965) experiment, except for the order of training words. Ten different random orders of the previous training list were employed, one such order for each of the 10 Ss in a given treatment. The training list consisted of 50 different words selected from the 1000 most frequent English words (Thorndike & Lorge, 1944). A training trial consisted of one exposure of the entire list. Independent groups of Ss received 1, 2, 4, 8, 16, 32, 64, and 128 trials. The intertrial interval was 60 sec. Ss in the 32, 64, and 128 trial groups were given a 5 min. rest between trials 16

and 17. The 64 and 128 trial Ss, however, were trained for two and four consecutive days, respectively, with 32 trials administered each day. Each word was printed on a separate IBM card. The Ss exposed one word and covered the previous word every 1.5 sec. by turning the cards in time with clicks from a tape recorder.

Prior to training all Ss were directed to try to learn the words in the fixed order of presentation. Immediately after training, the assigned testing procedure was described and Ss in the free recall condition wrote down all words remembered. Word order on the test was optional and no time limit was imposed. Ten sets of 50 new words were sampled from the same language population for the recognition test. These distracter words were mixed randomly with the training words. One card containing one word was sorted every 1.5 sec. into "recognize" or "don't recognize" categories. The Ss were 149 Introductory Psychology students; four additional Ss were discarded.

Results

The results including Mann-Whitney U-tests are presented in Table 1. Each mean represents the scores for an independent group of 10 Ss with the exception of the 128 trial conditions. These nine Ss (one S was lost due to illness) were tested first for recognition followed immediately by free recall. This order of testing intentionally biases the data against free recall: unpublished parametric data indicate that in general the second retention test, whether recognition or recall, yields a lower score compared to the score obtained when it is administered first. The results are presented graphically in Fig. 1 along with Lachman and Field's data. Percentages of words correctly recalled and recognized are plotted against training trials in the upper section of the graph. False positive errors, words not on the training list that were recalled or recognized, are plotted at the bottom as a proportion of the number of training words, 50. This is merely a convenient method of description, no inference is intended.

Discussion

The results indicate that recall ultimately surpasses recognition even with training materials consisting of words in random order. Apparently, sequential dependencies develop relatively slowly during serial learning of a low AE list such as the present set of randomly ordered words. The crossover of recognition and recall

occurs considerably later with a low AE list as compared to a high AE list (see Fig. 1), but it does occur. These findings suggest that comparisons of different retention measures that consist of simple orderings of scores may be meaningless. This conclusion is not compromised by the present procedure of "setting" the S for serial learning. In matter of fact, the conclusion is strengthened. For, if the relative efficiency of recall and recognition depends on learning instructions administered to S, then simple orderings of retention measures are even more vacuous. The suggestion that instructions may differentially influence various retention measures is not mere fancy but is soundly based on data. Eagle & Leiter (1964), in an incidental learning experiment, have demonstrated that a proper orienting task will enhance recognition over recall where recall was superior to recognition for intentional learners. This would further suggest that recognition and recall are *not* more or less sensitive indicators of an underlying unitary construct. Rather, it is likely that recognition and recall are differentially influenced by implicit and explicit learning patterns, by which we mean, second order habits in S-R language, strategies in cognitive language, or program control in an informational science oriented language. If these processes prove to be central to complex human learning, then computer simulation is likely to become more important for modeling these processes.

Although the present experiment and the Lachman & Field (1965) study were conducted with an interval of one college semester, a cautious comparison may be of interest. Figure 2 would seem to indicate that recognition memory is invariant with respect to order of AE. Of the eight different degrees of training for which data is available, all but two show virtually identical means for high and low AE. It might be tempting to conclude that superior word recognition for high AE material after one training trial is best attributed to random variation. However, Lachman & Tuttle (1965) consistently rejected this hypothesis for a variety of training conditions. The data presented in Fig. 2 suggest that degree of training interacts with order of AE to influence recognition memory in a fashion that warrants intensive investigation.

References

- Eagle, M., & Leiter, E. Recall and recognition in intentional and incidental learning. *J. exp. Psychol.*, 1964, 68, 58-63.
- Lachman, R., & Field, W. H. Recognition and recall of verbal material as a function of degree of training. *Psychon. Sci.*, 1965, 2, 225-226.
- Lachman, R., & Tuttle, A. V. Approximations to English (AE) and short-term memory: Construction or storage? *J. exp. Psychol.*, 1965, 70, 386-393.
- Thorndike, E. L., & Lorge, I. *The teacher's word book of 30,000 words*. New York: Bureau of Publ., Teachers College, Columbia University, 1944.
- Waugh, N. C. Free versus serial recall. *J. exp. Psychol.*, 1961, 62, 496-502.

Note

1. Supported by MH-10764.

Table 1. Mean words correct and Mann-Whitney U Test for $n_1=n_2=10$

Trial	Mean words correct		U	p
	Recognition	Recall		
1	34.4	7.3	0	<.001
2	35.6	12.0	0	<.001
4	37.6	16.6	1	<.001
8	40.1	30.5	18	<.02
16	42.0	34.2	23	=.05
32	45.0	35.5	24	--
64	44.8	36.2	49	--
128	45.6	49.7	†	<.001

* Randomization test for matched pairs, $n=9$