The effects of overt intralist retrieval on subsequent free recall*

OVID J. L. TZENG†, HELEN I. SNYDER, and DAISY L. HUNG
The Pennsylvania State University, University Park, Pa. 16802

Twenty Ss learned five 12-word lists. Following the immediate free recall of the fifth list, the Ss were asked to recall and recognize all the 60 words in the previous lists. The Ss in the experimental group were instructed to study each presented word carefully and, after the presentation of every 3 words, to overtly recall the preceding 3 words. Although this intralist retrieval procedure provides a basis for grouping, it has a detrimental effect not only on item accessibility, but also on item availability. A "removal property" of short-term memory was proposed as the locus of this effect. In addition, examination of the response pattern of the final free recall shows that the differential rehearsal interpretation proposed by Cohen (1970) is inappropriate.

A compartmental storage system characterizes current human memory models (Norman, 1970). The main concern of this approach is to identify how input information is encoded and transferred from short-term memory (STM or primary memory) to long-term memory (LTM or secondary memory) and what variables are responsible for its retrieval. Although different models have different assumptions and different predictions, there is a common aspect in both Waugh & Norman's (1965) model and Atkinson & Shiffrin's (1968) model, i.e., the longer the input item stays in STM, the higher is the probability that it will be transferred to LTM and the higher is the probability that it will be recalled in a later test. If an item is immediately recalled while still in STM, it will be removed from STM and the length of its stay in STM will be reduced, and thus there is less chance of its being recalled in a later test. Craik (1970) employed this assumption to interpret the observed negative recency effect. This interpretation had been challenged by Cohen (1970), who suggested that the locus of the parameter responsible for the negative effect should be in the differential amount of rehearsal given to each serial position, and by Madigan & McCabe (1971), who claimed that the removal notion was totally wrong and that the locus of the parameter should be in the different processing strategies used over the serial positions. Nevertheless, the notion of removal is itself interesting and is generally overlooked. As Waugh

(1969) has pointed out, pairs of items that are consistently retrieved from STM gain little representation in LTM of the kind produced for pairs retrieved from LTM. The implication is that they are not rehearsed further or encoded. Or, in other words, those items which are retrieved from STM leave no copies in the "rehearsal buffer" and therefore no further encoding is possible. Thus, the removal notion suggests another distinction between STM and LTM. That is, when an item is retrieved from STM, it leaves no copy in STM. However, when an item is retrieved from LTM, it leaves a copy in the store by definition and by everyday observation. The former can be termed as the "removal property" of the STM. It should be noted that this distinction is based on the differential retrieval notion (Tulving, 1968) rather than on the differential storage notion (Glanzer & Cunitz, 1966).

The following experiment employed an intralist recall procedure. Twelve items were presented one by one at a 1-sec rate. The S was instructed to study each item and, after the presentation of every three words, to recall the preceding three words overtly according to their presentation orders at a 1-sec rate. It was assumed that this procedure would ensure that those items were in STM at the time of the overt intralist retrieval. If the removal notion is correct, then the intralist retrieval of the just presented words should prevent these words from being processed further and thus reduce their recall probability relative to that of the words in the ordinary free recall procedure. Furthermore, the processing of the subsequent words should not be affected by the preceding words which were presumably removed from the buffer and therefore would not share "rehearsal time" with newly arriving inputs. The present study attempted

to test these hypotheses.

METHOD

The 80 nouns constituting the experimental word pool were selected randomly from among Thorndike-Lorge words whose frequency of occurrence was between 50 and 100 times per million words. For each S, five lists of 12 words per list were constructed from the word pool. Each word was printed on a 3 x 5 in. index card and was presented to the S manually by E at a 1-sec rate paced by a "click" monitored from a Lafayette interval timer. The Ss in the experimental group were instructed to study the presented words and, after the presentation of every three words (a pilot study showed that four words were too many to be correctly recalled), to call out the preceding three words at a 1-sec rate in time with the "click." The Ss in the control group were simply instructed to study "silently" a list of 12 words. This procedure was patterned after the study by Fischler, Rundus, & Atkinson (1970) in an attempt to minimize the verbal effect in the control group. In order to equate the duration of a trial for the two groups, the interval between items was 1 sec in the latter group. For both groups, an immediate free recall (IFR) was initiated after the complete presentation of the 12 words. Upon the completion of the fifth IFR, the Ss were instructed to recall all the 60 words from the five lists. The Ss were allowed 3 min for this final free recall (FFR). Following FFR, all the 80 words in the pool were presented randomly on a paper sheet and the Ss were instructed to circle the words they had seen in the five lists. For each group, two practice lists of the same length, but using digits, were studied under conditions corresponding to those already described.

Twenty undergraduate students were assigned alternately to each of the two groups according to the order of their appearances at the laboratory.

RESULTS AND DISCUSSION

The results, summed over all five lists, for the experimental and control groups are presented in Fig. 1. The data from the control group were used as the reference points for the experimental group's data. It should be noted that the IFR curve in the control is comparable to the curve obtained by Fischler, Rundus, & Atkinson (1970) in their silent condition.

Except for the last three input positions, the probability of correct recall or recognition was lower in the experimental group than in the control group for every position and across the three curves. That is, the overt intralist retrieval by the present procedure had

*The authors wish to express their thanks to Dr. Charles N. Cofer for his critical reading of the first draft of the present paper.

†Reprint requests should be sent to: Ovid Tzeng, 201 Social Sciences Building, Pennsylvania State University, University Park, Pa. 16802.

Fig. 1. Mean percent of recall on IFR, FFR, and recognition as a function of serial positions for both experimental and control groups.

a detrimental effect not only on item availability, but also on item retrievability. In order to make clear that this effect was not attributable to the possible confounding of the list differences, the means and standard deviations for the number of correct responses for the first two blocks (three words per block) vs the last two blocks in IFR have been presented as a function of lists in Table 1. It should be clear that the response patterns over the five lists were very comparable to one another for both experimental and control groups. It is of particular importance to look into the locus of this detrimental effect.

One aspect of the results apparent from Fig. 1 is that the curves for the first two blocks of input positions completely depart from the ordinarily observed serial position curve (Murdock, 1962; control group in the present study). This departure occurs with IFR, FFR, and recognition. In no way could one possibly speak of a primacy effect. The statistical analysis (within-S design) showed that the mean recall probabilities of the words in the first and second blocks are essentially the same across IFR, FFR, and recognition. All F values were less than 1. This finding suggests that the immediate retrieval of the preceding words relieved the Ss from having to share their "rehearsal time" between previous inputs and those arriving subsequently; thus, they avoided the recall decrement which is usually observed in the case of the "subsequent arrivals" (Rundus & Atkinson, 1970). If the primacy effect observed in the ordinary serial position curve is attributed to the greater

amount of rehearsal on earlier items, then one must assume that, at the time of processing the incoming items, those earlier items are still available in the store and share the "rehearsal time" with the incoming items. Since the recall probabilities for the words in the second block were not lower than those for the first block, one must assume that, in this case, rehearsal was mainly devoted to the words in the second block. In a sense, the preceding items were removed from the STM by the intralist retrieval procedure. At the time of processing the subsequently presented items, the "box" had no copies of the preceding items and thus S's ability to process information was reset to its initial state. Such a result confirms the hypothesis that overt intralist retrieval removes items from STM. In addition to the other distinctions between STM and LTM (see Kumar, 1972), one may then add another distinction. That is, retrieval from STM leaves no copies of the original items, but retrieval from LTM does. Therefore, the locus of the detrimental effect of the intralist retrieval in the experimental group,

relative to the control group, seems to have been due to the prevention of further rehearsal for those items retrieved immediately.

This line of reasoning seems to support a two-store hypothesis. However, a difficulty arises if one examines the curves for the last two blocks. In the present experimental group, all the words in each of the blocks have been overtly retrieved, and therefore further rehearsal was presumably impossible. The recall probability of the items within each block should have been determined prior to intralist retrieval. Accordingly, one would expect the curves for the last two blocks to be the same as those for the first two blocks. That is, if the items in the last two blocks are removed from the STM at the time of IFR, then the obvious recency effect in the present study must have been caused by something else.

Traditionally, primacy and recency effects have been assumed to represent evidence for two different stores (Glanzer & Cunitz, 1966), with the former being associated with LTM and the latter with STM. However, this is not a view which is shared by all memory theorists. Tulving (1968) has always argued that the recency effect in the serial position curve simply shows that more effective cues are available for the most recently presented items at the time of IFR. He accepts the LTM/STM distinction but argues for two retrieval processes rather than for two different stores. Thus, the primacy and recency effects represent two kinds of organization—so-called secondary and primary organization. The former organization is based on more stable cues than the latter, which is based mainly on temporal or auditory cues. The results of the present study seem to agree with this formulation. Since the auditory and/or the temporal information produced in the overt intralist recall was readily accessible for IFR, Ss may have tended to use these cues regardless of the storage procedure. The trouble with this strategy is that, in FFR, these cues were no longer available, and thus the recall probability dropped. On the

Table 1
Means and Standard Deviations (in Parentheses) for the Numbers of Correct Responses for the First Two Blocks Vs the Last Two Blocks in IFR as a Function of Lists

	Experimental Group					Control Group				
	Number of List					Number of List				
	1	2	3	4	5	1	2	3	4	5
First Two Blocks	2.6 (1.4)	1.9 (1.1)	2.2 (1.3)	1.9 (1.8)	1.8 (1.7)	4.1 (1.1)	3.4 (1.2)	3.4 (1.1)	3.5 (1.1)	3.8 (1.7)
Last Two Blocks	4.4 (1.2)	4.7 (1.3)	4.5 (1.8)	5.0 (1.0)	4.4 (1.4)	3.6 (1.7)	4.2 (1.3)	4.3 (0.8)	3.8 (0.9)	4.8 (1.2)

other hand, for the items in the first two blocks, the auditory information generated in the intralist recall was not available at the time of IFR, therefore, the recall of these items had to depend on other cues which were not subject to the effect of the retention interval. Hence, more or less stable cues seem to have been used across IFR, FFR, and recognition. The consistency in response patterns across the three curves in the first two blocks supports this interpretation. The main parameter in the first two blocks was the presentation order of words within each block, and its effect was consistent across IFR, FFR, and recognition [$F(2,18) = 14.9$, $F(2,18) = 5.79$, $F(2,18) = 12.36$, respectively; all $ps < .01$]. There were no interactions. The stability of cues upon which the recall is based explains why earlier input items are not subject to the effect of output interference (Tulving & Arbuckle, 1963).

The result of FFR in the experimental group can be interpreted as being contrary to Cohen's (1970) rehearsal interpretation, in which he suggests that the curve for FFR is to be accounted for by the amount of rehearsal connected with each serial position. Since overt intralist retrieval can be viewed as an experimental control for rehearsal in which S might normally engage (cf. Palmer & Ornstein, 1971), a rehearsal interpretation would predict a consistent response pattern over the four blocks in FFR. The present results clearly failed to be in accord with such an expectation.

The most plausible explanation for the results which were obtained in the present study would seem to imply that Ss relied upon a "control process [Madigan & McCabe, 1971]." The procedure of the intralist recall may not only have prevented the immediately retrieved items from being processed further, but may also

have provided the Ss with a basis for grouping which functionally separated the items in a list into four blocks so that the "removal property" of intralist retrieval enabled the Ss to devote all their rehearsal activity to a given block. However, such a grouping strategy would not lead one to expect a consistent response pattern over the four blocks. Along the temporal dimension (i.e., retention interval between item presentation and IFR), the Ss may have encoded the items in terms of the most effective cues. Once a certain kind of cue had been generated and used in IFR, the recall probability of FFR would come to depend on the extent to which the Ss still maintained these cues. An "encoding specificity" principle (Thomson & Tulving, 1970) such as this one would account for the two distinctive response patterns obtaining for the three curves. In the first two blocks, the three curves were parallel to one another, indicating the stability of retrieval cues over different retention intervals and across different retention measures (i.e., recall vs recognition). However, in the last two blocks, the trends in the three curves are heterogeneous in character, reflecting the fact that different retrieval cues may have been responsible for IFR, FFR, and recognition.

In sum, the locus of the recall decrement produced by overt intralist retrieval seems attributable to the removal of these items from STM, thus making them unavailable for further processing. Accordingly, one is led to postulate that the distinction between STM and LTM may be less a matter of differential storage than it is a matter of differential retrieval.

REFERENCES

ATKINSON, R. C., & SHIFFRIN, R. M. Human memory: A proposed system and its control processes. In K. W. Spence and

J. T. Spence (Eds.), *The psychology of learning and motivation: Advances in research and theory*. Vol. II. New York: Academic Press, 1969.

COHEN, R. Recency effect in long-term recall and recognition. *Journal of Verbal Learning & Verbal Behavior*, 1970, 9, 672-678.

CRAIK, F. I. M. The fate of primary memory items in free recall. *Journal of Verbal Learning & Verbal Behavior*, 1970, 9, 143-148.

FISCHLER, I., RUNDUS, D., & ATKINSON, R. C. Effects of overt rehearsal processes on free recall. *Psychonomic Science*, 1970, 19, 249-250.

GLANZER, M., & CUNITZ, A. R. Two storage mechanisms in free recall. *Journal of Verbal Learning & Verbal Behavior*, 1966, 5, 351-360.

KUMAR, V. K. The structure of human memory and some educational implications. *Review of Educational Research*, 1972, 41, 379-417.

MADIGAN, S. A., & MCCABE, L. Perfect recall and total forgetting: A problem for models of short-term memory. *Journal of Verbal Learning & Verbal Behavior*, 1971, 10, 101-106.

MURDOCK, B. B., JR. The serial position effect in free recall. *Journal of Experimental Psychology*, 1962, 64, 482-488.

NORMAN, D. A. *Models of human memory*. New York: Academic Press, 1970.

PALMER, S. E., & ORNSTEIN, P. A. Role of rehearsal strategy in serial probed recall. *Journal of Experimental Psychology*, 1971, 88, 60-66.

RUNDUS, D., & ATKINSON, R. C. Rehearsal process in free recall: A procedure for direct observation. *Journal of Verbal Learning & Verbal Behavior*, 1970, 9, 99-105.

THOMSON, D. M., & TULVING, E. Associative encoding and retrieval: Weak and strong cues. *Journal of Experimental Psychology*, 1970, 86, 255-262.

TULVING, E. Theoretical issues in free recall. In T. R. Dixon and D. L. Horton (Eds.), *Verbal behavior and general behavior theory*. Englewood Cliffs, N.J.: Prentice-Hall, 1968. Pp. 2-36.

TULVING, E., & ARBUCKLE, T. Y. Sources of intertrial interference in immediate recall of paired-associates. *Journal of Verbal Learning & Verbal Behavior*, 1963, 1, 321-324.

WAUGH, N. C. The effects of recency and repetition on recall latencies. *Acta Psychologica*, 1969, 30, 115-125.

WAUGH, N. C., & NORMAN, D. Primary memory. *Psychological Review*, 1965, 72, 89-104.