Erasure or partitioning in short-term memory[1]

W. STANLEY MUTHER[2]
STANFORD UNIVERSITY

Abstract

The possibility of erasure or partitioning in short-term memory was studied by instructing Ss to retrieve by free recall only 10 relevant letters embedded in a sequence of 20 visually presented letters. In the pre-cuing condition, irrelevant letters were indicated by a preceding blank, while in the post-cuing condition, irrelevant letters were indicated by a following blank. There was no difference in free recall under pre-cuing and post-cuing conditions, although free recall in both was better than chance. Free recall in a cueless control condition with irrelevant letters removed was better than in either pre- or post-cuing conditions. Analysis of errors suggests that irrelevant items were treated by partitioning or tagging in both cuing conditions, rather than by erasure, because cued-out letters occurred as errors of commission significantly more often than did letters which were not presented.

Problem

Short-term memory storage presumably provides a stage in which preliminary processing of information may occur prior to long-term storage. One aspect of such preliminary processing is the treatment of irrelevant input, in view of the limited capacity of the short-term storage (Miller, 1956). In order for short-term storage to function effectively, there should be a way in which irrelevant items can be eliminated or differentiated from relevant ones (Hodge, 1959; Erlick, 1962). This could be achieved by erasing irrelevant items, by storing irrelevant items separately, or by differentiating these items from one another within the same storage, either by grouping or tagging. This paper presents data which show that irrelevant items can be effectively excluded in free recall, and that this is more probably due to partitioning than to erasure.

Method

Twelve Ss, all college students paid for their participation, retrieved relevant items by free recall immediately after presentation under four conditions, which were counterbalanced in a 4 by 4 Latin Square design. In each condition, there were 12 lists of randomly selected letters, visually presented in random sequence at a rate of one letter per second by means of an I.E.E. Bina-View Display Unit. The display unit was controlled by a pre-programmed teletype tape-reader. Ss were asked to recall relevant letters from each list, and were allowed 15 sec. after the presentation of each list to make their responses. The experiment was conducted in a soundproof IAC acoustical chamber (ACT 1202A), which isolated presentation equipment from S. Ss responded verbally through an inter-com device, and E recorded the responses outside the experimental room.

TABLE I Total Number of Correctly Recalled Letters Out of Total Number of Responses

Subject	Condition			
	Pre-cuing	Post-cuing	Short Non-cuing	Long Non-cuing
1	57/66	63/70	72/79	80/95
2	85/102	83/88	83/89	125/127
3	69/74	63/70	96/104	112/117
4	76/87	61/77	89/95	106/119
5	73/77	55/63	89/93	91/97
6	91/98	71/80	86/88	134/178
7	81/92	89/95	111/112	128/133
8	70/84	74/79	86/90	88/95
9	72/91	68/82	98/102	135/141
10	95/111	79/89	90/93	127/134
11	69/73	72/86	91/93	101/103
12	67/77	66/76	76/80	90/94
Mean	75.5/86.0 (120 poss.)	70.3/79.6 (120 poss.)	88.9/93.2 (120 poss.)	109.9/119.4 (240 poss.)

All experimental lists were composed of 30 spaces. In the *pre-cuing* condition, 20 of the spaces were occupied by randomly selected and ordered letters, while the remaining 10 spaces were filled by blank white fields. Ss were asked to recall freely only those letters which were *not preceded* by blanks. The first letter in each list was always to be recalled. In the *post-cuing* condition, lists from the first condition were reversed, and Ss instructed to recall only those letters *not followed* by blank spaces. The last letter in each list was relevant in this case. Lists for the *short non-cuing* condition were identical to those of the previous conditions, except that irrelevant letters were replaced by blank spaces. These lists, therefore, contained only 10 letters, all of which were to be recalled. Lists for the *long non-cuing condition* were identical to the lists of the cuing conditions, but all letters were relevant in this case. Ss were asked to recall all 20 letters in this condition. The length of each list was not disclosed, and Ss were not required to respond with any specified number of letters.

Results and Discussion

Table I gives the total number correct and the total number of responses for each condition. The major results are (1) Ss performed significantly better than chance in both pre- and post-cuing conditions, as well as in the short non-cuing condition ($z > 5$ in all cases, $p < .001$); (2) no significant difference between pre- and post-cuing conditions was found; (3) free recall in the short non-cuing condition was significantly better than in the pre- and post-cuing conditions ($t = 3.7276, p < .01$; $t = 6.7886, p < .001$, respectively). Free recall in the long non-cuing condition was not significantly different from chance ($p > .20$). The same relationships hold if significance levels are calculated from total correct responses minus response errors.

TABLE II Frequencies of Each Type of Error

Subject	Pre-cuing Condition			Post-cuing Condition		
	Cuing	Intrusion	Miss	Cuing	Intrusion	Miss
1	7	2	63	6	1	57
2	12	5	35	4	1	37
3	5	0	51	5	2	57
4	9	2	44	14	3	59
5	3	1	47	7	1	65
6	5	2	29	8	1	49
7	10	1	39	5	1	31
8	13	1	50	5	0	46
9	17	2	48	11	3	52
10	14	2	25	9	0	41
11	4	0	51	13	1	48
12	9	1	53	8	1	54
Total	108	19	535	95	15	596
Mean	9.00	1.58	44.58	7.92	1.25	49.67

These results show that Ss can exclude from free recall irrelevant items which are either preceded or followed by visual cues. This suggests that, for pre-cuing, irrelevant items are either disregarded (not stored), erased from short-term storage, partitioned within the storage into a class distinguishable from the class of relevant items, or sent into a different storage. For post-cuing, only the latter three cases are possible. An analysis of errors may help to distinguish between these possibilities. Errors may be of two types: errors of commission (false alarms), or errors of omission (misses). Table II gives the total number of each type of error in the pre- and post-cuing conditions. In these conditions, a false-alarm consists of either recalling a letter which should have been eliminated (a "cuing" error), or recalling a letter which did not appear in the sequence presented (an "intrusion"). There are 10 possible cuing errors and 6 possible intrusions in each list. In the pre-cuing situation, if irrelevant letters were simply disregarded, then these letters would be no more available than those not presented. Then no more than 57.5% (10/16) of the false-alarms should be of the cuing type. However, cuing errors constituted 85% of the false-alarms in the pre-cuing condition. This value is significantly greater than 57.5% [illegible]00, $p < .0001$), indicating that Ss did not disregard most irrelevant items. If irrelevant items were erased, again only a chance number of cuing errors would be expected. However, as has already been shown, this was not the case in the pre-cuing condition. The same finding is also true of the post-cuing condition, where 86.4% of the false alarms were cuing errors. This shows that, in both conditions, some cued letters were not erased, and therefore were more available than the letters not presented. If irrelevant items were treated by a partitioning process, then items perceived would be retained in storage, or in separate storages. Cued items would be differentiated from non-cued items by tagging or by grouping. Incorrect classification of items or inefficient retrieval would result in more cuing errors than intrusions, as was found in the present data.

It has been shown that Ss are able to exclude cued items from free recall, regardless of whether the tags precede or follow the items. While both erasure and partitioning might account for this finding, an analysis of errors suggests that partitioning is the more likely alternative.

References

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Notes

1. This research was supported in full by USPHS Grant MH-08556 from the National Institute of Mental Health to Dr. Herman Buschke.

2. Present address: Department of Psychology, University of California, Berkeley, California.

3. Reprints may be obtained from Herman Buschke, M. D., Division of Neurology, Stanford University School of Medicine, Palo Alto, California.