

## THE RECALL OF SINGLE PAIRED ASSOCIATES WITH AN A-B, A-Br SEQUENTIAL PARADIGM<sup>1</sup>

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A sequential A-B, A-Br paradigm was adopted in a short-term memory task to test the possibility that novel combinations of the same stimulus and response items would result in proactive interference (PI) in the recall of paired associates. No definite evidence of increasing PI was found, thus supporting the notion of a "limited capacity" hypothesis as an explanation for short-term memory behavior.

It is a well established fact that some sort of interference is an important source of forgetting in short-term recall tasks (Keppel & Underwood, 1962). The only apparent exception has been reported by Murdock (1964) who published evidence suggesting that the immediate recall of single paired associates is impervious to proactively interfering influences. To be sure, his data are not free of progressive deterioration of performance. The percentage of recall at each stage of practice is 13.7%, 21.3%, 17.9%, 14.5%, and 14.5%. That is, although initial recall is quite poor, the trend after the second stage of practice is quite clear: the drop may not have reached statistical significance, but the fact is, it is there. Now Murdock gave each S six trials and used a different list at each stage of practice. We wondered if the same outcome would have been observed if only one list had been used throughout, but with a different re-pairing of stimulus and response terms each time in order to obtain what amounts to a sequential A-B, A-Br paradigm, a paradigm which is known to produce negative transfer in studies of learning (Underwood, 1966). We reasoned that, if proactive inhibition (PI) indeed fails to attend the immediate re-

call of single paired associates, as Murdock claims, then it would make no difference whether different lists are used for each trial, or whether the same list is used again and again but utilizing different combinations of stimulus and response terms each time. The experiments reported below were designed to test the adequacy of this line of reasoning.

### METHOD

#### *Subjects*

One-hundred-eight (108) male college students enrolled at the Ateneo de Manila University served as Ss. Three groups of 36 Ss each were formed, and each group was used for a different experiment as explained below. About 60% of the Ss were enrolled in an introductory course on Experimental Psychology and the rest were volunteers enrolled in other courses in the University. All Ss, however, were at the time naive about this kind of experiment.

#### *Material*

We utilized six paired-associates lists, each list containing six pairs. Unlike Murdock (1964), who used 72 English words to form 36 pairs, we used only 12 English words selected on the basis of an earlier pilot study. Six words (OBVIOUS, NATURE, ANGLE, OBJECT, CANDLE, OFTEN) were used as stimulus terms exclusively, while six additional words (SINCE, INDEX, LETTER, RECENT, DISTANT, FOCUS) were used as response terms, also exclusively; 36 pairs were formed by simply pairing every word from the stimulus-term cluster with every word of the response-term group. From these 36 pairs we derived six lists, taking care that no stimulus term and no response term occurred twice within the same list. Every list was composed of six pairs. Every pair was typed individually on 3" x 5" white index cards,

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and the pairs were arranged so that no stimulus term and no response term occurred twice in the same serial position across lists. Then the lists were numbered 1-6 and six different orders of presentation were arranged (654132, 546321, 465213, 312564, 231645, and 123456) making sure that every list occurred equally often at each stage of practice. To prompt recall of the critical response term, a probe technique identical to that used by Murdock (1964), was enforced here, and, although in practice we could not always avoid occasional repetitions for both stimulus and response terms in a previously occupied serial position, we did make sure that no *S* was asked to recall the same response term more than once. Finally we also made sure that all serial positions were exploited equally often at every stage of practice. Six arrangements were worked out (216534, 123456, 362145, 451263, 534621, and 645312) to establish the position of the probe target. Both order of presentation of lists as well as target position were further manipulated to introduce as much variety as possible in the way they were combined. As an instance, the following arrangement, (6, 2), (5, 1), (4, 6), (1, 5), (3, 3), and (2, 4) indicates that for some subject the first list to be given was list 6 while the position of the target was 2; the second list was 5, and the position of the target was 1. And so on.

#### Procedure.

All *Ss* were tested individually. Prior to the experimental session, they were informed that they were about to participate in a short-term memory experiment, but the purpose and expectations of the experiment were in no manner revealed to them. The instructions were read to each from a printed card and went as follows:

I am going to show you cards with words typed on them. Every card has a pair of words on it, such as this one (a sample card was shown). You will notice that here we have typed the words DOG-CAT. There will be several trials, and in every trial I will show you six different cards. Study the pair of words on each card carefully, and try to remember it. At the end of the series, I will show you a card that contains only the first member of one of the pairs. For instance, after seeing the pair DOG-CAT, I may show you a card that has, DOG ———, typed on it, and, of course, you will write down, CAT as the correct answer. Remember, study each pair carefully because you will not know in advance which pair you will be tested on. You are to write down what you think is the correct word on the appropriate space of the answer sheet. If you are not sure of your answer, write down your best guess. Ready?

Care was taken that *S* understood well the nature of the task; and then the experimental session was initiated. Time of exposure for each card was approximately 1 se-

cond. The same experimenter<sup>1</sup> tested all the *Ss*. Three experiments were conducted. The main difference between them consisted of the fact that for Experiment II the *Ss* were made to memorize the response terms prior to the experiment, while in Experiment III they were made to memorize both stimulus and response terms, as a single list, not in their final paired-associate form. No previous exposure to the recall material was given in Experiment I. Otherwise the conditions of the experiments were as similar as it was practically possible. The decision to introduce different degrees of pre-experimental exposure obeyed the following reasoning: An *S* who is given repeated presentations of basically the same recall material will end up learning something about it. Thus, whatever *S* loses because of progressive interference — assuming that it occurs — he may gain because of growing familiarity with the list-units, yielding an apparent absence of either gain or loss. But if *S* is familiarized with the material beforehand, then the responses obtained will be purified of their learning contents and will yield information more clearly indicative of relatively uncontaminated recall. The amount of correctly recalled material could have been treated as percentages but we decided to fit the expected data (see Table 2) by means of the transformation  $\sqrt{x + 1/2}$  for the purpose of analysis.

#### RESULTS AND DISCUSSION

The data collected in all three experiments were assessed in terms of a complete classification of all responses at each stage of practice (Table 1). Incorrect responses were placed into three categories: Intrusions A were, (a) any word belonging to the response-term group given incorrectly as the answer for the pair in question; (b) grammatical variants of the response terms whether correctly or incorrectly given as answers (e.g., "distance" for "distant"). Responses of the latter sort were few and occurred mostly during the early stages of recall. Intrusions B were words taken from the stimulus-term group, and Intrusions C were extra-list responses (e.g., reflex, light, and word).

The data presented in Table 1 do not differ much from the data published by Murdock (1964). This is particularly true of the distribution of correct answers. Our expectation that some degree of learning would confound the results of Experiment I seems to be partially supported by a slight increase in the number of Intrusions B correlated with stage of practice. Notice that this type

<sup>1</sup> L. S.

TABLE 1  
 FREQUENCY AND TYPE OF RESPONSE AT EACH STAGE OF PRACTICE.<sup>a</sup>

Type of response	Stage of practice						Total
	1	2	3	4	5	6	
Correct	13	14	13	14	10	15	79
Intrusions A	18	21	20	16	22	15	112
Intrusions B	2	1	3	6	4	5	21
Intrusions C	3	0	0	0	0	1	4
Omissions	0	0	0	0	0	0	0
<b>TOTAL (I)</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>216</b>
Correct	13	15	13	10	12	11	74
Intrusions A	19	16	17	21	22	18	113
Intrusions B	4	3	5	5	2	6	25
Intrusions C	0	2	1	0	0	0	3
Omissions	0	0	0	0	0	1	1
<b>TOTAL (II)</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>216</b>
Correct	17	12	16	14	13	13	85
Intrusions A	12	20	13	16	17	18	96
Intrusions B	6	4	6	6	6	4	32
Intrusions C	1	0	0	0	0	0	3
Omissions	0	0	0	0	0	0	0
<b>TOTAL (III)</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>216</b>

<sup>a</sup> The three levels represent Experiments I, II, and III respectively.

of response becomes stabilized in Experiments II and III, presumably due to previous familiarity with the recall material. What is of interest in the data of Table 1 is the fact that the expected deterioration of recall as a function of stage of practice did not materialize despite the use of a sequential A-B, A-Br paradigm—which invariably yields negative transfer in studies of learning—and in spite of the neutralization of learning effects by allowing the Ss to know the contents of the recall material prior to the experiment.

Table 2 has the information gathered from the three experiments further broken down in terms of correct responses at each stage of practice cross-classified with serial position. This analysis shows in greater detail how our findings are comparable with those of Murdock's. We also obtained an evident deterioration for serial positions (SP) 1 in all experiments; performance for SP 2-5 either remained variable without a specific trend, or improved, with SP 5 showing the largest improvement. It is debatable whether SP 6 can be considered here as a measure of original learning but the fact is entirely irrelevant to our purpose, just the same.

The observations made so far grow out of the outcomes reported in Tables 1 and 2, and they are substantiated, in essence, by the analysis of variance of Table 2 which indicates that the only significant effects were obtained from SP effects ( $F(5,50) = 16.375, p < .01$ ) with recall in the last two positions superior to all others. This fact is in itself uninformative out of being so obvious. Otherwise, there are no interactions of importance and the  $F$  ratio for stage-of-practice effects ( $F(5,50) = .5035, p > .05$ ) is not significant at all.

#### SUMMARY

We have subjected Murdock's conclusions (Murdock, 1964) to a further and necessary test to determine whether the immediate recall of single paired associates is indeed indifferent to the progressive influence of interference processes in STM, and our results, obtained under different conditions, tend to support his notion that, at least in a situation involving paired associates, the STM mechanism may be made to behave as a limited-capacity system. Additional evidence in support of this conclusion has been found (Murdock 1965). It is

TABLE 2

FREQUENCY OF CORRECT RESPONSES AT EACH STAGE OF PRACTICE CROSS-CLASSIFIED WITH SERIAL POSITION\*

Serial position	Stage of practice						Total
	1	2	3	4	5	6	
1	1	4	3	2	1	1	12
2	4	1	2	1	0	2	10
3	1	1	2	2	1	2	9
4	2	0	2	2	1	2	9
5	0	2	2	1	3	4	12
6	5	6	2	6	4	4	27
TOTAL (I)	13	14	13	14	10	15	79
1	3	3	1	2	0	0	9
2	1	1	1	0	1	0	4
3	0	1	3	1	1	0	6
4	3	2	0	1	2	3	11
5	1	1	2	1	3	3	11
6	5	7	6	5	5	5	33
TOTAL (II)	13	15	13	10	12	11	74
1	3	1	1	1	1	1	8
2	2	1	2	1	0	3	9
3	2	1	3	2	2	1	11
4	1	2	3	1	1	1	9
5	3	2	2	4	3	1	15
6	6	5	5	5	6	6	33
TOTAL (III)	17	12	16	14	13	13	85

\* The three levels represent experiments I, II, and III respectively.

still a matter of interest, however, that PI, having been abundantly demonstrated as an ubiquitous phenomenon in STM since the first efforts of Keppel and Underwood (1962), remains foreign to the short-term recall of single paired associates under the conditions defined by Bennet B. Murdock.

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