Asymmetry in stimulus-term and response-term recall following paired-associate training¹

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Abstract

Following paired-associate training, R-term recall exceeded S-term recall. This difference was accentuated by an increased amount of paired-associate training.

Introduction

A proposed explanation for the superiority of S-R over R-S recall following paired-associate training (Asch & Ebenholtz, 1962; Newman, 1961) is that S learns more R-terms than S-terms. This experiment supports other findings (Asch & Ebenholtz, 1962, Experiment I, p. 139; Newman & Gray, 1964) consistent with that explanation. It also shows more gain in R-term than in S-term recall from 8 trials to 24 trials of S-R training.

Three predictions were tested:

1. Following paired-associate training, more R-terms than S-terms will be recalled.
2. The number of R-terms recalled following 24 trials will exceed the number recalled following 8 trials.
3. The number of S-terms recalled following 24 trials will exceed the number recalled following 8 trials.

Method

Half the Ss were exposed to a list of 8 pairs of nonsense syllables with association values of 53% (Glaze, 1928); the other Ss saw a reversed list. The S-terms of the first list were the R-terms of the second, and vice-versa. Each S-term appeared on a memory drum for 2 sec. and was followed by a 2 sec. exposure of the S-R pair. Intertrial interval was 4 sec. Lists were presented to each S in four different orders. After the Ss had completed the 8, 16, or 24 trials designated for their group, half were tested for S-term recall and then R-term recall; the others were tested for R-term recall first. Each test was 45 sec. long. Data reported under "Results" are inter-S comparisons with first recall scores unless otherwise indicated.

Predictions were tested by sequential analysis, using Fiske & Jones' procedure (1954, p. 270) with difference scores. For Prediction 1, the S-term recall score in each treatment combination was subtracted from the R-term recall score of the same treatment combination and the same replication; for Predictions 2 and 3, analogous differences were taken between 8 and 24-trial Ss. Null hypotheses specified a mean difference of zero. Alpha was set at .05 and beta at .10. Error variances were taken from a similar unpublished experiment by Ward (cf. Cunningham, 1961, pp. 92-99) comparing R-term and S-term recall, both of which followed S-R training (8, 16 or 24 trials), S-R recall and R-S recall.

Ss were 36 male undergraduates. Twenty-four were

used to reach a decision on Prediction 1. Two lists, 3 trial numbers (8, 16, and 24), and direction of recall (S- or R-term) gave 12 treatment combinations, each with two replications. The experiment continued, ignoring the 16-trial and the S-term group, leaving four treatment combinations to test Prediction 2 and adding one replication (four Ss) to the data accumulated under Prediction 1. The experiment continued further ignoring both the 16-trial and the R-term group and adding two replications (eight Ss) to the S-term group, until sequential analysis determined a conclusion about Prediction 3.

Results

Paired-associate training. Analysis of variance of S-R learning scores over 8 trials and on the eighth trial itself gave no significant differences ($p > .05$) in learning scores between groups whose later S-term and R-term recall scores were compared to test the three hypotheses.

Prediction 1. The alternative hypothesis, H_a , specified a mean difference of 1.6 terms, taken from Ward's results (1960) comparing S-R and R-S recall. After two replications, the observed sum of differences (39.00) was found to exceed the value (11.85) necessary to reject H_0 . (It could also have been rejected after one replication, but it had been decided beforehand to complete at least two.) Table 1 presents the means. Table 2 presents a summary of the sequential analysis for each prediction.

Of the 24 Ss, 23 recalled more R-terms than S-terms. The average intra-S difference, 3.2, was almost exactly the same as the average inter-S difference. Order of recall (whether S-terms or R-terms were recalled first) made no difference; the mean R minus S differences under the two orders were identical to the first decimal place.

Table 1. Mean Recall Scores: Predictions 1, 2, and 3

Term	Cell n	Trials			All groups
		8	16	24	
Prediction 1					
R	4	3.5	5.0	6.0	4.8
S	4	1.3	1.3	2.3	1.6
Predictions 2 and 3					
R	6	3.4	--	5.8	
S	8	1.4	--	1.6	

Table 2. Values of Σd Necessary to Reject H_0 ($p < .05$) and H_a ($p < .10$) and Observed Σd Values

Prediction 1: R-term versus S-term recall. Sequential analysis values. Inter-S comparisons, first recall scores. Variance estimate: 1.25

	Replication number ^a	
	1	2
Σd^{b} H_0	> 7.05	> 11.85
Σd H_a	< 3.04	< 7.84
Observed Σd value	22.00	39.00

Prediction 2: 8 trials versus 24 trials, R-term recall. Inter-S comparisons, first recall scores. Variance estimate: 2.17

	Replication number ^c		
	1	2	3
Σd H_0	> 5.88	> 7.28	> 8.68
Σd H_a	< -2.09	< -0.69	< 0.71
Observed Σd value	5.00	10.00	15.00

Prediction 3: 8 trials versus 24 trials, S-term recall. Inter-S comparison, first recall scores. Variance estimate: 2.12

	Replication number ^c			
	1	2	3	4
Σd H_0	> 5.78	> 7.18	> 8.58	> 9.98
Σd H_a	< -2.01	< -0.62	< 0.78	< 2.18
Observed Σd value	-2.00	4.00	4.00	2.00

^a One replication contained the first recall scores of 12 Ss and gave 6 difference scores.

^b The sum of the difference between R-term and S-term recall scores is called Σd .

^c Each replication contained the first recall score of 4 Ss and gave 2 difference scores.

Prediction 2. The alternative hypothesis specified a mean difference of 1.4 terms, taken from Ward's (1960) results for S-R recall. After two replications, the observed sum of differences (10.00) exceeded the value necessary to reject H_0 (7.28), but a third replication, which yielded exactly the same mean difference and decision, was performed following a computational error in analyzing the first two. Table 1 presents the means, Table 2 the sequential analysis.

Prediction 3. Effects on S-term recall were evaluated against the same H_a value used for R-terms. Sequential analysis dictated two additional replications in the S-term groups beyond those accumulated in testing

Prediction 1, making four replications and 16 Ss in all. The null hypothesis was accepted, with $\beta = .10$ that the mean number of S-terms correctly recalled after 24 trials did not exceed by 1.4 the mean number after 8 trials. The two observed means were almost identical (Table 1). The sequential analysis appears in Table 2.

Summary and Conclusions

Asymmetry between unaided forward and backward recall appeared (Prediction 1). Tripling the number of training trials increased R-term recall (Prediction 2) but not S-term recall (Prediction 3). Thus, asymmetry was accentuated by an increased amount of paired-associate training.

A proposed sufficient condition for a superiority of S-R over R-S recall following paired-associate training is a corresponding asymmetry in R-term over S-term recall (Newman, 1961; Asch & Ebenholtz, 1962). The results of this experiment confirm those previously cited that such a condition exists.

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Notes

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