Paired-associate learning: Similarity among stimulus terms¹

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A paired-associate verbal learning experiment was conducted and replicated. Intralist similarity of stimulus elements was varied and the position of these similar elements was varied. The stimulus terms (CVC trigrams) had either one or two elements in common and occurred in either the initial or final position of the trigram. The experimental design involved three variables: number of elements in common among the stimulus terms (1 vs. 2); position of common elements (Final vs. Initial); and, replication (I vs. II). An analysis of the results revealed no significant interaction of any of the variables and no significant main effects of replication or position of common elements (.05 level). A significant main effect of number of shared elements was found. When the stimulus terms of a paired-associates task have two letters in common, then the task is more difficult than when there is only one element in common. This finding was pronounced in both replications involving different letters.

Intralist similarity has been shown to have an effect on verbal learning (Underwood & Postman, 1962). In a paired-associate task, intralist similarity can be manipulated within the stimulus terms, the response terms, or both. Furthermore, similarity can be viewed from several different definitions. The terms can be synonyms, homonyms, or the terms can have varying elements (letters) in common (Newman & Taylor, 1963). Newman & Taylor (1963) found that a group of college students performed less well on a High Sharing list (all stimulus terms constructed from only four consonants) than did a group who had a Low Sharing list (all stimulus terms constructed from 10 consonants).

In the present experiment, consonant-vowel-consonant trigrams (CVC) were used as stimulus terms and single digits as response terms. The number of shared elements among the stimulus terms and the position of these shared elements were both varied. In addition, the experiment was replicated using different CVC trigrams.

Method

The entire population of a residential institution was given the Peabody Picture Vocabulary Test. A pool of 128 Ss was formed by taking all Ss who had scored between IQ 63 and 85, inclusive, on this test. From this pool of Ss, eight random samples of 12 Ss each were selected. Replacements, when necessary, were randomly drawn from the remaining pool of 32 Ss. Prior to the experiment all Ss were shown the numbers to be used as response terms and asked to identify them. If, after 10 trials of practice with the numbers, the S could not identify them without errors on two successive

trials, he was dropped from the experiment. Thus, any S who participated in the experiment could identify the numbers without error. An analysis of variance revealed no significant differences among the groups in terms of CA, MA, and IQ.

The paired-associate lists were typed on punched tape and presented with a Lafayette Memory Drum, Model 303B.

The experimental design was a 2 by 2 by 2 factorial; the number of common elements among the stimulus terms was varied (1 vs. 2), the position of the common elements was varied (beginning of word vs. end of word, or Initial vs. Final), and the experiment was replicated with different letters (Replication 1 vs. Replication 2). The Ss were assigned randomly to the eight independent groups. The ordering of the paired-associate lists in Table 1 portrays the experimental design. Columns 1 and 2 are Replication 1 and Columns 3 and 4 are Replication 2. Columns 1 and 3 have one common element among the stimulus terms and Columns 2 and 4 have two common elements among the stimulus terms. Row 1 represents the common element(s) as being at the beginning of the word (Initial) and Row 2 represents the common element(s) as being in the final position in the word (Final).³

In setting up the paired-associate lists the words in List A were paired randomly with the numbers 4, 5, 9, 2, and 1. For the other lists the same consonants received the same number pairing. For example, POD was paired randomly with 4 in List A; hence, in list B, PAD was paired with number 4. The pairings for Replication 2 were made in the same manner but with the numbers 3, 4, 5, 6, 8. To avoid or minimize serial

Table 1.
The Experimental Design and the Eight Lists of Paired-Associates

	Replication 1		Replication 2	
	1 Letter	2 Letters	1 Letter	2 Letters
Initial	List A	List B	List E	List F
	PEN 9	PAN 9	MIC 3	MEC 3
	PAT 2	PAT 2	MOT 8	MET 8
	PIL 1	PAL 1	MUL 5	MEL 5
	POD 4	PAD 4	MAB 4	MEB 4
Final	List C	List D	List G	List H
	PUC 5	PAC 5	MED 6	MED 6
	TOP 2	TAP 2	DEM 6	DEM 6
	LAP 1	LAP 1	CIM 3	CEM 3
	NIP 9	NAP 9	BOM 4	BEM 4
	DEP 4	DAP 4	TAM 8	TEM 8
	CUP 5	CAP 5	LAM 5	LEM 5

effects, eight different random orders of the items within a list were constituted. The order of these random lists was determined from a table of random numbers and the lists were presented to every S in the same order. If more than eight trials were required to reach criterion, then the order of the lists was repeated.

Each S was escorted into the experimental room and told that he could earn the money on the table (3 cents) if he did well on the task. The task was first demonstrated with a folded index card, S being required to look at the CVCs and say the numbers when they were exposed. Then the task was presented on the memory drum for the remainder of the experiment. Early in the session the S was encouraged to guess the number before it appeared in the aperture and occasionally told that he was doing a good job and would win the money if he kept doing well.

The stimulus terms were each exposed for 4 sec. and then the shutter exposed the response term with the stimulus term for 4 sec. The drum then required approximately 1 sec. to move to the next stimulus term. The intertrial interval was approximately 8 sec.

A learning criterion of two consecutive correct trials through the list (five paired-associates) was established prior to the experiment. An arbitrary limit of 75 trials was imposed. If a S did not have two consecutive correct trials by the 75th trial, then the session was terminated and the S given a score of 75.

Results and Discussion

The means and SDs of the trials to criterion (two successive correct trials) for the various groups are given in Table 2. The number of children within each group who were terminated and given a score of 75 when they reached the arbitrary upper limit of 75 trials is given in Table 3.

An analysis of variance (2 by 2 by 2) was applied to the data summarized in Table 2. None of the interactions were significant at the .05 level and there was no evidence for a difference attributable to replication or position of shared elements (Initial vs. Final). The effect of number of shared elements was significant

Table 2. Trials to Criterion for the Various Subgroups

		Replication 1	
		One Letter	Two Letters
Initial	Mean	39.33	54.08
	SD	23.97	25.91
Final	Mean	32.17	43.08
	SD	15.42	26.53
		Replication 2	
Initial	Mean	32.08	52.08
	SD	21.01	24.50
Final	Mean	29.33	45.58
	SD	19.17	26.14

Table 3.
Number of Subjects Who Reached the Upper Limit of 75 Trials

	Replication 1	
	One Letter	Two Letters
Initial Position	3	7
Final Position	0	4
	Replication 2	
	One Letter	Two Letters
Initial Position	2	6
Final Position	1	4

at the .01 level ($F=9.05$, $df=1/88$) with significantly more trials required to learn the lists in which the stimulus terms shared two elements in common. This finding is consistent with previous experimentation using both serial and paired-associates verbal tasks.

Within a language training session involving a paired-associate task (e.g., vocal responses to printed words), what groupings of elements among words will facilitate learning and what groupings will retard correct performance? From the results of the present study it appears that such learning can be retarded when there is a great deal of commonality of elements among the stimulus terms, i.e., the printed words. The results suggest that the proficiency of language can be improved by using classroom programs which are relatively free of intralist similarity among the stimulus terms. These results, however, apply to a single learning session and additional experimentation is needed to determine how such learning progresses over several sessions.

References

- Newman, S. E., & Taylor, L. R. Context effects in paired-associate learning as a function of element sharing among stimulus terms. *J. verbal Learn. verbal Behav.*, 1963, 1, 243-249.
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Notes

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- In List G of Table 1 the last stimulus term should have been LUM instead of LAM. This error, which occurred on the original memory drum tape, was discovered after the study was completed. It can be contended that the error is not too serious if one compares the means found in Table 2. The mean trials to criterion for this group was 29.33, whereas, for the corresponding group in Replication 1, the mean is 32.17. Had the effect of the error been pronounced one would expect the group in which the error occurred to have taken more trials than the corresponding group in Replication 1. In addition, the difference between the means of the Final-One Letter group and the Final-Two Letters group of Replication 1 is about the same as the corresponding difference in Replication 2.