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## A Comparison of Forward, Backward, and Conventional Training in the Learning of a List of CVC Trigrams

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SYNOPSIS. Ss were instructed to learn a list of 10 CVC trigrams by either the conventional serial anticipation method, backward

conditioning or forward conditioning. The F ratio failed to show a significant difference between the three experimental groups. The results contradict previous results which shown that forward training is more efficient than the other two methods.

INDEX DESCRIPTORS: Trigram learning, forward training, backward training, conventional training.

B. F. Skinner (1957, 1963) has made the point that verbal behavior can be interpreted within the framework of operant conditioning. As such, verbal behaviors would also seem to be affected by contingencies of reinforcement. The reinforcement in verbal learning frequently is mediated by other humans in such responses as a smile or control of stimulus materials which provide feedback information as to the propriety of a response. One might therefore interpret serial learning as a special case of the chain of operant behavior. In a response chain the response (R) becomes the discriminative stimulus (SD) for the next R in the chain (Millenson, 1967). Thus the possibility exists that rote learning performance might be improved by utilization of the animal laboratory shaping procedures.

Johnson and Senter (1965) have reported results from three experiments which in general favor forward conditioning procedures over that of backward conditioning which is normally used in shaping an operant chain. By forward conditioning was meant starting with the first item in a list to be learned in a rote fashion. On each new trial an additional item was added to the end of the list until the subject had been exposed to all items on the list. In backward conditioning training began by starting with the last item in the list and working backward by adding a new item to the front of the list. The final result in both procedures was a complete list of stimulus items normally learned by the serial anticipation method (conventional method).

The Johnson and Senter study can be criticized at several points. First, the instructions for the three experimental groups were not identical. The Ss were run as a group with the results possibly biased by uncontrolled environmental conditions. The Ss were not trained to mastery; thus there is some question if the experiment adequately represents the chain of operant behavior. The purpose of our experiment was to further investigate the effects of the three methods of learning on the memorization of a serial list of CVC trigrams. An attempt was made to correct for the possible biasing factors discussed above. In addition a different criterion was employed in an attempt to make the serial learning task more analogous to a response chain.

### METHOD

*Subjects.* The Ss were obtained from an introductory psychology class. The forty-five men and women volunteers were

randomly assigned to one of the three experimental groups. Eight women were assigned to each of the groups.

*Apparatus and Materials.* Ten consonant-vowel-consonant (CVC) trigrams having an association value of 25% or less (Archer, 1960) were randomly selected from a list of all possible combinations. Each CVC trigram was projected on a wall before the subject by means of a Kodak carousel projector. The equipment noise was masked by means of white noise and headphones. The slides were arranged in the carousels so that they could be advanced manually or electronically at a constant rate of 4 seconds. *E* monitored the time base signal recorded on tape in order to time changes accurately whenever recycling of a sequence was required. Otherwise the slides were advanced by the signal recorded on the tape.

*Procedures.* A three randomized groups design was employed with Ss being randomly assigned to one of the three experimental conditions. Environmental variables were controlled by running blocks of three Ss individually according to an ABCABC order. The training was conducted in a semi-darkened room by the same *Es*. The exposure duration for each CVC trigram was 4 seconds less the time required for the projector mechanism to change a slide. Since interslide time is a part of the presentation time (Bugelski, 1962; Keiss, 1968), the total study time was approximately 4 seconds.

Identical instructions were given to all Ss. The instructions briefly described the aim of the experiment, explained what was expected from the S, and instructed the S on the experimental procedures. The Ss attempted to anticipate the CVC trigram by pronouncing the syllable aloud. Each S continued in the training until all the CVC trigrams had been correctly anticipated without error for two trials. It is important to note that this criterion was applied at all stages of practice for the forward and backward conditioning groups (See Table 1). From time to time it was necessary for *E* to recycle the CVC trigrams within the 4 second period at various stages of learning in both backward and forward chaining procedures. Otherwise the next slide was advanced electronically by the tone programmed at 4 second intervals on the magnetic tape. In forward and backward conditioning a new element was added to the chain only after the criterion of 2 errorless trials had been met for that segment of the chain. The score for each S was based on the number of exposures to each item in the chain. The experiment was terminated after all 10 CVC trigrams had been learned to the criterion.

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TABLE 1  
METHODS OF CVC TRIGRAM PRESENTATION

Conventional Slide No.	Item	Forward Slide No.	Item	Backward Slide No.	Item
1	VYT	1	BEGIN	1	BEGIN
2	VOJ	2	VYT	2	WUB
3	YIJ	3	START	3	START
4	RYQ	4	VYT	4	WUB
5	ZAH	5	START	5	START
6	TYH	6	VYT	6	ZYT
7	XEZ	7	LOJ	7	WUB
8	GYJ	8	START	8	START
9	ZYT	9	VYT	9	ZYT
10	WUB	10	LOJ	10	WUB

NOTE.—In all but the conventional method, 2 trials of errorless performance were required before a new item was added. Thus

if the CVC in slide 4 were missed, E returned to the first slide. If item 10 were missed, then E returned to slide 5.

RESULTS

An analysis of variance was run on the data obtained from the three randomized groups. The results are summarized on Table 2. The F ratio of 1.83 was not statistically significant. It was concluded that none of the rote learning methods was superior to the other procedures studied.

TABLE 2  
ANALYSIS OF VARIANCE

Source	df	MS	F	p
Between groups	2	2,947.822	1.828	<.10
Within groups	42	1,612.254		
Total	44			

DISCUSSION

The present experimental results did not replicate the Johnson and Senter findings. They found that forward conditioning was superior to backward and conventional training. However, the mean exposures to stimulus items of 180.67, 153.87, and 174.40 for conventional, forward, and backward training respectively showed trends similar to their results. Experiment III of the Johnson and Senter study differed from our investigation in several ways. First they ran their Ss in a group rather than individually. The Ss had been matched prior to the treatment condition by means of a learning task. All Ss studied the list of 15 consonants using a method of covert anticipation rather than pronouncing the materials aloud. Each stimulus item was presented for a duration of 1 second with a 0.5 second inter-stimulus interval. The instructions to the Ss varied according to the particular learning condition being presented. Although some Ss mastered the

list after the 8 trials (120 stimulus presentations), the experimental data were error scores in recall of the consonants under four different test conditions. To obtain the error score they broke the 15-item list into 15 ordered pairs. The first pair was a starting point and the first consonant. The second pair was the first and second consonant, etc. The error score was determined by the number of ordered pairs omitted from the S's recall list.

The results in Experiment III showed performance highest for forward training with the greatest error score for the backward training group. The discrepancy between the Johnson and Senter data and the present investigation may reflect differences in procedures as outlined above. On the other hand, the differences in effect may be so slight that a matched groups design is required to show the effects. Further research is needed to settle the issues raised by these experiments. It might be instructive if the experiment were repeated with small children. Their limited experiences at rote learning might make the learning task more analogous to the chaining training normally seen in the animal laboratory.

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