Verbalizing and writing as auxiliary responses during discrimination learning¹

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Ss verbalized or wrote predetermined stimulus names during visual discrimination learning. Those verbalizing or writing only the names of correct stimuli made significantly fewer errors in learning the discriminations than did those required to verbalize or write a mixed pattern of correct and incorrect names. Although Ss writing a mixed pattern tended to make slightly fewer errors than those verbalizing the same pattern, a difference which appears to be statistically significant given large samples, the overall conclusion was that as auxiliary responses, verbalizing and writing have essentially equivalent effects.

Carmean & Weir (1967) have reported that visual discrimination learning can be either facilitated or hindered by having S verbalize the stimuli in prearranged patterns after the discriminatory responses. They explained their results by suggesting that discrimination learning is an indirect measure of recall—when S learns to respond correctly he is indicating that he remembers which stimulus was correct (or incorrect) on a previous trial. They then hypothesized that S tends to remember what he says, even when there is no direct reinforcement of his verbalizations, and hence, as an auxiliary response, verbalization influences discrimination learning through its effect on memory. Studies by Rosenbaum (1962) and by Carmean & McLachlan (1967) suggest that while it may be necessary that the auxiliary response be auditory, it is not necessary that S make it himself—it is not necessary that feedback from the vocalization apparatus be involved.

The present experiment was designed to determine the effect of a nonverbal auxiliary response, writing the names of the stimuli. It was assumed that if S remembers stimuli which he writes as well as he does those that he says, writing should have the same effects as verbalizing. If auditory input is a crucial factor, however, writing as an auxiliary response should not affect discrimination learning and the pattern of stimuli S writes should be immaterial. A third outcome was also anticipated. If writing has similar but weaker effects, it is possible that S might be able to utilize it in the facilitating condition but to ignore it in the interfering condition. This would result in an interaction effect of pattern and type of auxiliary response.

Method

In all essential respects the method was the same as that of Carmean and McLachlan. The same apparatus and stimuli were used, the instructions contained

the same information, and Ss were drawn from the same population.

Four groups of 25 Ss each (college undergraduates) were used. Two groups were instructed to say the name of the indicated stimulus after each response and two to write it. The stimulus was indicated by a blue signal lamp which came on over one of the two stimuli of each pair after the discriminatory response had been made. For one group using each type of auxiliary response, the correct stimulus was always indicated. For another group with each type, the pattern was mixed with sometimes a correct and sometimes an incorrect stimulus indicated in a prearranged, modified random order (see Carmean & McLachlan, 1967). In neither case was S told what the pattern would be. Data for two additional Ss were discarded because of E's errors in programming the apparatus. As a result of selective pressure on the subject pool from other experiments, 90 females and only 10 males were used with four males in the write-positive group and two in each of the others.

Ten pairs of animal pictures, randomly presented within blocks of 10, were used as stimuli. An additional pair was used for two pretraining trials.

The discriminatory response was button pushing, one button for each animal of the pair. Choosing the correct animal sounded a single-tone door chime (noncorrective procedure). The instructions emphasized that it was the door chime and not the signal lamps which indicated a correct response.

The experiment was terminated after two successive errorless blocks or, if S did not reach this criterion, after 120 trials. S was then given 3 min in which to verbally recall the names of the stimuli. No indication was previously given that this would be required.

Results and Discussion

Both the verbalize-positive and write-positive groups had means of 2.1 blocks of 10 trials before the first errorless block. Since guessing was necessary for the first block, this suggests that the task was quite easy for Ss in these groups. The corresponding means for the verbalize-mixed and write-mixed groups were 6.4 and 6.7. The difference between the patterns, positive or mixed, was significant beyond the .001 level ($F = 80.54$, $df = 1/96$); neither the effect attributable to type of auxiliary response, verbal or written ($F < 1$, $df = 1/96$), nor the interaction effect ($F < 1$, $df = 1/96$) approached significance.

The verbalize-positive group had a mean of 110.8 correct responses, the write-positive 111.0, the ver-

Fig. 1. Mean correct responses as a function of trials.

balize-mixed 90.8, and the write-mixed 94.6. Number of correct responses as a function of blocks of trials is shown in Fig. 1.

Pattern of auxiliary response was significant ($F=135.58$, $df=1/96$, $p<.001$). Type ($F=1.19$, $df=1/96$) and the interaction of Pattern by Type ($F<1$, $df=1/96$) were not. The same pattern appeared in the analysis across trials. Trials ($F=135.64$, $df=11/1056$, $p<.001$) and the Trials by Pattern interaction ($F=14.02$, $df=11/1056$, $p<.001$) were significant, reflecting learning by all groups and faster learning by groups with a positive auxiliary response pattern. Neither the Trials by Type ($F<1$, $df=11/1056$) nor the Trials by Pattern by Type ($F=1.65$, $df=11/1056$) interactions were significant at the .05 level. Inspection of Fig. 1 suggests that there could be a small difference between verbalizing and writing in the early blocks of trials, for while there is no difference between the verbalize-positive and write-positive, the verbalize-mixed group did slightly poorer than the write-mixed group through Block 7. Separate analyses of Blocks 2-7 does not show this difference to be statistically significant ($t=1.97$, $df=48$). However, the same difference between verbalize-mixed and write-mixed for the same trial blocks has occurred in a subsequent study (McLachlan & Carmean, unpublished), and when data from these two studies are combined, the effect is significant at the .05 level ($t=2.26$, $df=80$). The lack of difference

between the positive pattern groups cannot be taken as definitive since both learned so rapidly that there could be a small difference obscured by a ceiling effect.

As in the previous experiments with this task, the recall data indicated that Ss tended to remember the names which had constituted the auxiliary responses. The mean number of positive stimuli recalled were 8.0, 8.1, 7.1, and 7.6 for the verbalize-positive, write-positive, verbalize-mixed, and write-mixed groups, respectively. The corresponding means for negative stimuli were 4.8, 5.0, 7.7, and 6.8. The differences were significant for Total Recall ($F=12.72$, $df=1/96$, $p<.001$), Stimulus Valence ($F=56.11$, $df=1/96$, $p<.001$), and Stimulus Valence by Pattern ($F=49.35$, $df=1/96$, $p<.001$). Stimulus Valence refers to correct vs incorrect stimuli. Both the Total Recall and the Stimulus Valence by Pattern effects were largely due to superior recall of incorrect stimuli by mixed pattern groups—the only groups which were verbalizing or writing incorrect stimuli. Neither the main effect of type of auxiliary response nor any of the interactions into which it entered approached significance at the .10 level.

In summary, these data are congruent with the hypothesis that auxiliary responses which involve S generating stimulus names affect discrimination learning by affecting retention, and that verbalizing and writing as auxiliary responses are essentially equivalent. This eliminates the possibilities that the effect is dependent upon feedback from the vocal apparatus or that S simply remembers better what he hears, and suggests that it is the act of generating the name, irrespective of the modality in which it is expressed, which is crucial.

References

- CARMEAN, S. L., & McLACHLAN, J. C. Visual discrimination learning: Interactions of auditory input pattern, verbalization, and instructions. *Psychon. Sci.*, 1967, 8, 311-312.
- CARMEAN, S. L., & WEIR, M. W. Effects of verbalizations on discrimination learning and retention. *J. verbal Learn. verbal Behav.*, in press.
- McLACHLAN, J. C., & CARMEAN, S. L. Visual discrimination learning as a function of instructed information and pattern of auxiliary response. Unpublished.
- ROSENBAUM, M. E. Effect of direct and vicarious verbalization on retention. *Child Developm.*, 1962, 33, 103-110.

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