LEARNING PRINCIPLES IN PAIRED-ASSOCIATE LISTS

JOSEPH M. SCANDURA
University of Pennsylvania

Summary.—Learning rate and transfer to new stimuli requiring new responses, were found to vary directly with the number of instances (1, 2, 3, 6) of principles in a 12-pair list of paired associates. Also, a positive relationship was found between learning rate and transfer within the 6-instance condition.

Paired-associate learning (PA) has been studied as a function of many variables (e.g., meaningfulness, association value, pronounceability) but little attention has been given to relationships among different S-R pairs. The purpose of this exploratory effort was to determine relationships between the number of S-R pairs related by a common principle, learning rate, and transfer.

Method.—The materials to be learned consisted of 12-pair lists. Each stimulus had a property relating to shape, border, shading, outline, and color. Four colors and eight values of each of the other four attributes were used. The responses were descriptive labels attached to the non-color stimulus attributes (e.g., circle, two, shaded, dashed). Of the 12 pairs in each list, 6 were instances of one principle (P6), 3 were instances of another (P3), 2 were instances of a third (P2), and 1 was an instance of a fourth (P1). The principles were constructed so that the same principle applied to all stimuli having a given color. The response determining cue was either a shape, a border, a shading or an outline. The four colors and the determining attribute dimensions (e.g., shape) were randomly paired to form four principles (e.g., If black, then shape), which appeared equally often under each condition. The PA list was learned by the anticipation method to a criterion of three consecutive errorless trials.

To determine whether the principles were acquired sometime during the list learning, each S was shown two transfer lists of four new stimuli each, eight in all. Each transfer list included one stimulus associated with each of the four learning principles. Responding according to one of the principles was presumed to indicate that that principle had been learned.

Prior to learning the original list, each of the 20 college Ss was pre-trained so that he was familiar with the stimulus dimensions and could name each stimulus property. These responses were typed on a card and were always available to S. In addition, S was told that a pattern was involved which might facilitate his learning and guide his responses to the transfer stimuli.

The dependent variables were the mean number of errors made by S per instance (S-R pair) for each principle and the number of appropriate responses to the transfer stimuli.

Results.—Except for a very small reversal between treatments P3 and P2, learning rate (i.e., the mean number of errors per instance) decreased with the number of instances per principle: P1, 5.0; P2, 3.4; P3, 3.5; P6, 2.7 (F = 8.76, df = 3/76, p < .001). The difference between P1 and P2 was significant (F = 11.50, df = 1/76, p < .01) but none of the other adjacent means differed significantly. The addition of a second S-R instance apparently increased the rate of learning almost to asymptote under the experimental conditions.

The number of appropriate responses to the transfer stimuli was also affected by the number of instances per principle. There were 27, 8, 15, and 9 appropriate responses
given to the P6, P3, P2, and P1 transfer stimuli, respectively. Although the trend was not entirely regular, a sign test indicated that the degree of principle learning was higher in treatment P6 than in the average of treatments P3, P2, and P1 (z = 2.6, p < .005).

Another analysis demonstrated that P6 transfer was related to learning rate. Of those 9 Ss who responded appropriately to both P6 transfer stimuli, 7 had below median (2.61) error scores, indicating more rapid learning; of those 11 Ss who responded appropriately to at most one test stimulus, 8 had above median error scores, indicating slower learning. An exact probability test (Finney, 1948) on the resulting 2 x 2 contingency table indicated a significant relationship between P6 transfer and learning rate (p < .035). The small number of Ss who gave two appropriate responses with respect to the other conditions precluded the possibility of obtaining significant relationships. Only 3, 5, and 2 Ss gave both desired responses to the P3, P2, and P1 test stimuli, respectively.

The list learning and transfer results were not entirely consistent. The inclusion of more than two instances did not affect learning rate, but it may have affected transfer. These results could reflect real differences or be simply artifacts of the situation. In either case, the over-all pattern of results was sufficiently clear to make any interpretation in terms of stimulus or response generalization extremely difficult, if not impossible. Some resort to S-R generalization (Hull, 1943; Berlyne, 1965) appears necessary. For a contrast between S-R and cognitive (set-function language) representations of "what is learned" in this situation, the reader is referred elsewhere (Scandura, in press a, in press b).

REFERENCES

Scandura, J. M. The basic unit in meaningful learning—association or principle? School Review, in press. (a)
Scandura, J. M. Precision in research on mathematics learning. Journal of Research in Science Teaching, in press. (b)

Accepted February 13, 1967.

1It might be argued that the difference in the number of appropriate responses was due to the occurrence of more responses per category in treatment P6. When in doubt, Ss may have tended to give a response from the most frequently experienced category. However, the mean number of P6 responses given to the P3, P2, and P1 transfer stimuli (16) was not significantly higher than the 10 P3, P2, and P1 responses given to the P6 stimuli (p > .10).