Prediction of mixed schema learning in a reproduction task[1]

ED M. EDMONDS AND MARVIN R. MUELLER
AUGUSTA COLLEGE

In a reproduction task which included instances of several schemata mixed together, Ss learned to distinguish among the schemata without knowledge of results. A best fitting equation describing performance as a function of number of reproduction trials accurately predicted learning with new Ss and patterns randomly sampled from a different population (schema). These findings are related to previous research involving generalization of results in a single schema reproduction task.

A number of studies (e.g., Edmonds & Mueller, 1967a, b; Edmonds, Evans, & Mueller, 1966; Edmonds, Mueller, & Evans, 1966) have utilized patterns generated by a computer program, VARGUS 7 (Evans, 1967), to study schema learning in several perceptual tasks. The schema in these patterns is composed of particular column height sequences favored by the transitional probabilities of a seven element Markov process. Constraint redundancy is determined by the magnitude of the probabilities associated with the schematic sequences and so can be manipulated independently of the schema. The schema itself can be independently manipulated by varying the favored or most probable column height sequence. In fact, a population of schemata (column height sequences) can be defined and sampled. Manipulation of schema and redundancy do not affect certain other potentially relevant variables such as area.

Edmonds & Evans (1966a) found that in a reproduction task Ss benefitted more from training with patterns having a single schema than with random patterns, even though Ss received no external reinforcement. This result is in accord with other recent studies (Edmonds & Evans, 1966b; Edmonds, Evans, & Mueller, 1966) which indicate that in memory tasks humans encode the redundant (schematic) aspects of stimuli to reduce information processing requirements.

In the natural environment, however, patterns representing many schemata are mixed together. Learning several schemata should thus be more difficult than successively learning different single schemata (see Edmonds, Evans, & Mueller, 1966) since Ss must differentiate among the schemata at the same time he is learning the characteristics which constitute the basis for differentiation. The evidence from single schema learning cannot be interpreted to show that a mixed schema task which imposes memory requirements will produce learning.

The present study was designed to determine if Ss could learn to distinguish among different schemata when the reproduction task included three different schemata.

Subjects

The Ss were 45 undergraduates enrolled in psychology courses at Augusta College. They were randomly assigned to three training groups of 15 Ss each.

Patterns

Each of three different most probable column height sequences, designated pattern set PS1, PS2, and PS3, was used in a seven element Markov process to produce 12 column 67% redundant patterns (yielding a channel capacity of 10.07 bits per stimulus). The probability of each step of the most probable column height sequences was .839. The first column in each pattern was chosen at random with each column equiprobable.

Task and Procedure

A randomized block procedure was used in preparing the presentation order of the patterns so that examples of the three schemata were evenly distributed in the sequence. After each of four series of nine pattern reproductions in the mixed schema task, three patterns from a single schema (one of the three PSs) were presented. A different PS was used for each of three training groups in order to obtain data concerning the rate of learning for each of the three schemata. Each S thus reproduced a total of 48 patterns. A projector exposed each pattern onto a screen for 15 sec. The Ss were run in groups of four or less. After each exposure, Ss turned to the appropriate sheet in a mimeographed answer booklet where the pattern was printed with three columns randomly omitted. The Ss were allowed 30 sec to draw the three omitted columns in each pattern. The intertrial interval was 15 sec. No knowledge of results was given.

Results and Discussion

An analysis of variance based on the last three reproductions of each training group (PS1, PS2, and PS3) was used to evaluate performance differences among the three schemata. This comparison was nonsignificant, indicating that the schemata did not differ significantly in difficulty.

Figure 1 shows the PS1 means for the blocks of three trials that were interspersed in the mixed schema task. This performance curve indicates that the mixed schema task produces learning even when Ss are not provided with external reinforcement. In fact, the results are quite similar to previous findings (Edmonds & Evans, 1966a) in a reproduction task involving a single schema.

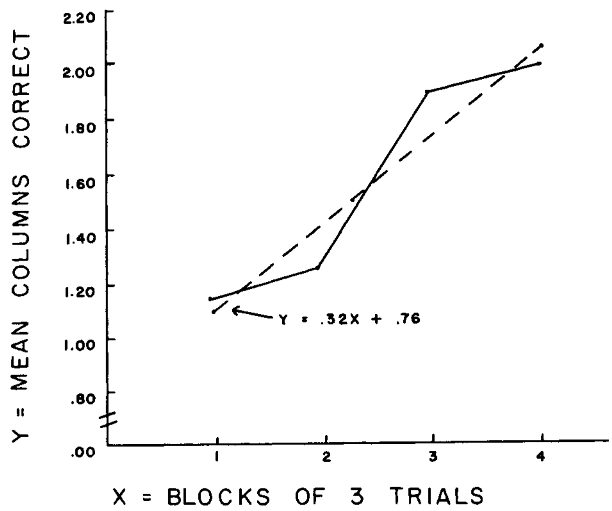

Fig. 1. Block means and regression line for PS1 training group.

A trend analysis for repeated measures was performed, using the four trial blocks for PS1, to determine the relationship describing reproduction accuracy (Y) as a function of trials (X). The results showed significant differences between the block means ($F = 14.8$, $df = 1/42$, $p < .001$). The linear trend was significant and had the form $Y = .32X + .76$ (see Fig. 1). This regression equation was obtained in order to determine how accurately the result of the PS1 training group could be used to predict performance as a function of trials with new Ss and different patterns. The PS3 training group was used for this purpose. The ratio of the square of the standard error of estimate to the total variance was .15, indicating that 85% of the variance of the PS3 block means was accounted for by this predictive equation.

In an experiment involving patterns representing a single schema family, Edmonds & Evans (1966b) found that a best fitting equation describing reproduction performance as a function of trials predicted 96% of the variance with new Ss and a new schema. Although this predictive equation was based on a different number of trials than the predictive equation obtained in the present study, the rate of schema learning over trials common to both tasks is quite similar. The mixing of three schemata together appears not to have made schema learning much more difficult. This result was also obtained in a previous study (Edmonds, Mueller, & Evans, 1966) with a mixed schema discrimination task.

The results of the present study indicate that in a reproduction task mixed schema learning not only occurs in a rather spontaneous manner, but also can be predicted quite accurately with new Ss and with patterns randomly selected from a different population (schema). The extreme effectiveness of schema learning is evidenced by the ability of Ss to assign instances to their appropriate schema family or equivalence class (Mueller, 1967) without any external source of information. This formation of equivalence classes reduces the amount of information that must be processed since all members of one class can be encoded with the same schema. These schema categories could be quite useful if they should happen to correspond with such taxonomic classifications as orders or species.

This research extends the findings reported by Edmonds & Evans (1966b) in that appropriate pattern generation procedures also allow generalization of results in a mixed schema reproduction task. These studies, however, investigated schema learning with only 67% redundant stimuli. Further research should seek to determine the relationship between rate of schema learning (reflected by slope of curve) and amount of redundancy in both the single schema and the mixed schema reproduction task.

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Note

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