Schema learning with low redundancy patterns

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Ss tend to perform poorly on schema learning tasks with patterns below 50% redundancy. The present experiment attempted to determine if this was due to either (1) inability to abstract the schema with low-redundancy patterns or (2) a limited usefulness of the schema as an aid in the efficient encoding of low-redundancy patterns. Ss who were pretrained on the schema prototype performed better when transferred to 40% redundant patterns than Ss who received only 40% redundant patterns. This indicates that poor performance with 40% redundant patterns is largely due to a failure to abstract the schema. The use of schematic learning sets, with a gradual decrease in redundancy, was suggested as a possible means for improving S's ability to abstract schemata from low-redundancy patterns.

On tasks that require Ss to abstract a schema from samples of stimuli, performance is significantly influenced by the level of constraint redundancy (Rc) employed in generating the stimulus samples (Mueller, Edmonds, & Evans, 1966). In several pilot studies, the present E has found that in the absence of knowledge of results, Ss who reproduced 40% Rc patterns did not perform significantly better ($p > .40$) than Ss who reproduced nonschematic (0% Rc) patterns.

Poor performance on low Rc patterns could be attributed to either or both (1) an inability to abstract the schema contained in the patterns or (2) to a limited usefulness of the schema as an aid in the efficient encoding of low Rc patterns. With low Rc, the central tendencies of the patterns may not occur with sufficient frequency to be detected by the Ss. Also, with low Rc, the schema may not be sufficiently descriptive of the individual patterns to be of help in encoding the individual patterns. Thus, the present experiment represents an attempt to determine the extent to which poor performance with low Rc patterns is due to (1) or (2), above.

METHOD

The Ss were 60 experimentally naive students enrolled in an introductory psychology course. They were assigned randomly to three groups of 20 Ss.

All Ss were trained in a reproduction task with 40 histoform patterns assembled into booklets. These patterns were constructed according to the rules of the VARGUS 9 program (Evans & Mueller, 1966). The schema consisted of the following average column heights (4, 9, 7, 5, 8, 3, 9, 5, 2).

Each pattern consisted of nine columns of reclining capital Os, produced by an IBM Model 11 electric typewriter. The base of each column was a reclining parenthesis sign ((). The patterns were reproduced by

a mimeograph machine onto 8½ x 11 in. paper and assembled into a booklet. The paper used in the booklet was sufficiently thick to preclude S's seeing through any page, and a blank sheet was used as a cover for the booklet. The patterns were reproduced on the odd-numbered pages of the booklet. The even-numbered pages contained the same patterns, except that three columns were omitted from each pattern. The columns to be omitted were determined randomly for each pattern.

The booklets received by the 100-100 group contained 40 copies of the schema prototype. The booklets received by the 100-40 group contained 20 copies of the schema prototype, followed by 20 variants of the prototype, with an Rc level of 40%. The 40-40 group received booklets containing 40 patterns that were 40% redundant. The last 20 patterns in the booklets received by the 40-40 group were identical to the last 20 patterns received by the 100-40 group.

The following instructions were read to all Ss: "Do not turn the cover page of the booklet until I tell you to do so. When I say 'turn the page,' you are to immediately turn it and look at the first page. On the first page you will see a pattern composed of zeros. You will have 15 sec in which to memorize the pattern. After 15 sec I will again say 'turn the page.' When you do so, you will see another pattern. This pattern is exactly like the one on the first page, except that there will be three columns which have been omitted. You are to draw in the three missing columns so that they are the same height as they were in the original pattern. Draw in the missing columns by drawing a short horizontal line at the height you remember the missing column to have been. You will have only 15 sec in which to do this, so work as rapidly as possible. If you do not remember the exact height of a missing column, go ahead and guess. Do not leave any column blank. After 15 sec I will again

say 'turn the page' and you will find a new pattern. The booklet contains a total of forty complete patterns and forty patterns with missing columns. Throughout the booklet we will repeat the same steps as I have just described. Once we begin, never turn any page until you are told to do so. Never turn back to any of the preceding pages. Are there any questions?"

RESULTS AND DISCUSSION

As indicated by Fig. 1, Ss in the 40-40 group demonstrated no significant improvement over the 40 patterns in their booklets. The performance of the 100-100 group rapidly improved and remained nearly perfect throughout the booklet. The performance of the 100-40 group paralleled that of the 100-100 group over the first 20 patterns but deteriorated when the Ss reproduced the last 20 (40% Rc) patterns. The difference in performance on the last 20 trials was significant (Scheffé's test, $F = 18.61$, $df = 1/57$, $p < .01$).

The 100-40 group's performance on the final 20 patterns was significantly superior to that of the 40-40 group (Scheffé's test, $F = 15.74$, $df = 1/57$, $p < .01$).

Although a number of alternative interpretations are possible, it could be assumed that the difference between the 100-40 and the 40-40 groups was due to the fact that the 100-40 group had knowledge of the schema. Thus, the poor performance of the 40-40 group is not entirely attributable to the limited usefulness of the schema in efficiently encoding individual patterns. The data suggest that the 40-40 group probably was

Fig. 1. Average number of columns correctly reproduced by Ss receiving 40 patterns, all 40% redundant (40-40 group), all 100% redundant (100-100 group), or 20 patterns at 100% redundancy followed by 20 patterns at 40% redundancy (100-40 group).

unable to abstract the schema from patterns with such low Rc.

Conversely, the difference between the 100-100 and 100-40 groups on the last 20 patterns could be largely attributed to the limited usefulness of the schema in encoding individual patterns at 40% Rc.

These results raise an interesting question for further research. Is the inability to abstract schemata from low Rc patterns the result of an ultimate limit imposed by the physiological mechanisms involved in schema learning, or is this a limitation that can be overcome by special training?

An answer could be obtained by giving Ss schematic learning-set training (as in

Edmonds, Evans, & Mueller, 1966) with high Rc schema families, then transferring them to a new schema family composed of low Rc patterns. Having "learned how to learn" schemata may enable Ss to abstract schemata even from patterns with 40% Rc.

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The effect of two types of associative linkage and position of association linkage on the recall of sentences

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The present study examined the influence of two types of association data on the recall of sentences. The results showed that "syntactic restricted" associations facilitated the recall of sentences while typical free associative connections may have some influence. However, the predominant underlying variable may be a syntactic association. The position of syntactic associative connection in the sentence had no differential effect on recall.

The present study consists of two experiments. One experiment examined the influence of free-association strength (FAS) collected in the typical manner (Palermo & Jenkins, 1964) on the recall of sentences. The second experiment was a replication of Experiment 1, except that syntactic associations (SA) were employed as an index of association strength. The syntactic associations were collected by presenting an independent group of Ss with stimuli and asking them to write down a word that follows the stimulus in written or spoken language. The sentences in Experiment 2 had 0% typical FAS value. In both studies the location of the associative linkage was manipulated. Certain sentences had associative linkage between the adjective-noun (A-N), the noun-verb (N-V), or the verb-adverbial (V-Adb) positions.

Experiment 1 was designed to extend an earlier investigation (Rosenberg, 1966). Rosenberg reported that sentences with a mean FAS = 23.25% (taken from Palermo & Jenkins, 1966) were recalled more readily than those with "moderate"

associative connections (no value given) and those with a mean FAS < .01%. Rosenberg (1966) simultaneously employed associative values in each of the three possible positions it could occur, i.e., between the adjective-noun, noun-verb, and verb-adverbial for both the high- and low-value sentences. For the "moderate" value sentences, an association existed only between the last two words (verb-adverbial). Thus, to some extent, associative linkage and position of association in a sentence is confounded.

EXPERIMENT 1

Lists

Three lists of nine sentences each were constructed. Each sentence consisted of the following: adjective-noun-verb-adverbial. In each list three sentences had three highly associated (20%) word pairs, three sentences had three weakly associated word pairs (4%), and three sentences had no associated pairs. List 1, List 2, and List 3 had the association between the adjective-noun, noun-verb, and verb-adverbial, respectively. The

association values between pairs were taken from the Palermo-Jenkins (1964) norms.

Subjects

Thirty Ss were employed. All were students in introductory psychology and completed the experiment for extra credit.

Apparatus and Procedure

Each S was told that he would be presented with a number of sentences one at a time for a short period of time. He was instructed that after seeing the sentences he would be requested to write down as many words, parts of sentences, or full sentences that he could recall. The S was instructed that this procedure would continue until they correctly recalled all of the sentences.

Each sentence was presented by means of a Lafayette Memory Drum with the anticipation shutter mechanism disconnected so that the S saw each sentence for 1 sec. Following each presentation of the six sentences, the Ss were given a slip of lined paper and instructed to write down any words, parts of sentences, or full sentences they could remember. Maximum recall time was 60 sec per trial; however, since this was usually more than enough time, when the S stopped writing for approximately 5 sec, the E asked him if he had written all he could remember. If the S replied "yes," the data sheet was removed and the next trial was given. This procedure was employed so that if the S finished recalling before 60 sec and could see the recall sheet, the S could not rehearse those words and sentences on the recall sheet. All Ss were run until a criterion of two consecutive errorless trials.

Results and Discussion

An analysis of variance was applied to the trials-to-criterion data. The analysis consisted of one between-S factor (location of FAS in the sentence) and one within-S factor (level of FAS). Neither the main effects nor the interaction was significant. This was totally unexpected and would appear to be in disagreement with the results of Rosenberg (1966). However, several major factors should first be noted. An examination of the sentences used by Rosenberg (1966) indicated that all of the high FAS sentences employed were meaningful (i.e., semantically consistent), while for the medium and low FAS sentences, three of four in each group were anomalous. Other investigators have indicated (Miller & Izard, 1963; Marks & Miller, 1964) that grammatical, meaningful sentences are dealt with more readily than syntactically correct, but anomalous, sentences. It was anticipated that the differences in the Rosenberg (1966) study may have been, at least in part, due to the lack of semantic consistency, and not FAS. The present study, in employing syntactic