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ABSTRACT

Two experiments evaluated the effects of mnemonic training upon 5- and 10-year-old children's learning and retention of patterns at varying intervals. Subjects were 172 middle class children evenly distributed across the two age groups. Experiment I investigated the effects of individual strategies (perceptual exploration, organization of distinctive features, or verbal cues) and reinforcement on retention by children of both age levels after a 3-minute interval. Experiment II investigated the effects of a constant sequence of all three strategies (perceptual exploration, organization of distinctive features, and verbal cues, in that order) and reinforcement on retention after 3-minute, 1-week, and 1-month intervals. Item recognition and reaction times were recorded for all recognition tests. The results indicated that training in both individual strategies and a sequence of strategies facilitated 5- and 10-year-old children's retention of patterns at all intervals. Reinforcement at the time of training was found to be effective in the retention of patterns. Item recognition diminished with lengthening intervals, but decreases were smaller for trained groups. The 10-year-old children had shorter reaction times than did 5-year-old children. Implications for classroom learning are noted briefly. (Author/MS)

THE EFFECTS OF MNEMONIC TRAINING ON FIVE-AND TEN-YEAR-OLD CHILDREN

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While research and theory in cognitive psychology is being refined, modified, expanded, and elaborated, there is even now a sound and respectable base that provides instructional designers with direction of greater value than sources available to them from other fields. Analyzing the learner's activities in terms of stages of information-processing affords those responsible for the design of instructional programs the opportunity to generate hypotheses about learning problems from a perspective very different from that addressed in the past.

Careful study of the work of Dick (1971), Chase and Simon (1973), and Gardner (1973) provides new definitions of perceptual processing; the work of Crowder and Morton (1969), Shiffrin and Geisler (1973), and Pellegrino, Siegel, and Dhawan (1975) help the educator to see the role of short-term memory processes in organizing and assimilating new material; and Rohwer (1970), Paivio (1971), and Bower (1972) present a structure from which to examine the place of images and language in thinking.

The current study was particularly concerned with the tasks of learning and remembering patterns. Using Gibson's (1969) perceptual learning, Rohwer's (1968) mnemonic elaboration, and Ellis's (1968, 1972) properties of verbal labels as a basis,

it was decided that a sound training program could be designed by implementing selected principles from these theorists. A combination of the strategies of perceptual exploration, organization of distinctive features, and verbal cues were expected to facilitate children's retention of information at varying time intervals.

The effects of training were examined in two experiments. In Experiment I, the effects of training with one of three strategies (perceptual exploration, organization of distinctive features, or verbal cues) upon five-and ten-year-old children's retention of ten patterns after a three minute interval were investigated. In addition, reinforcement was varied across treatment groups at the time of presentation to investigate reinforcement effects upon the attention focused upon the tasks. In Experiment II, the effects of a training program utilizing a constant sequence of all three strategies (perceptual exploration, organization of distinctive features, and verbal cues, in that order) upon the retention of a subset of the five-and ten-year-old children were evaluated after three minute, one week, and one month intervals. The reinforcement condition was again varied across treatment groups.

Subjects

Eighty-eight five-year-old and eighty-eight ten-year-old middle-class children with equal representation of boys and girls were randomly assigned to treatment groups.

Materials

Two sets of ten patterns were constructed on the basis of

symmetry, color, ratio of curves to angles, number of surfaces, and orientation. Set 1 patterns were used for the training and recognition testing of Experiment I. Set 2 patterns were used for the training and the recognition testing of Experiment II.

Two sets of decoys were also developed to complement the pattern construction criteria. Set 1 decoys were used in the recognition tests of Experiment I. In Experiment II, Set 1 and Set 2 decoys were varied at the three intervals in order to limit any implicit associations between pattern and decoy presentations. Specifically, Set 2 decoys were used after the three minute interval, Set 1 decoys were used after the one week interval, and five Set 1 and five Set 2 decoys were used after the one month interval. Pattern and decoy presentations were randomized except where noncolor patterns were paired with noncolor decoys.

Procedures

In Experiment 1, subjects in the experimental groups received training in one of the following strategies for ten patterns. The training program consisted of:

1. Perceptual exploration. The subjects were directed to visualize and tactually explore the pattern.
2. Organization of distinctive features. The subjects were directed to examine given distinctive features of the pattern and were directed to overtly rehearse those distinctive features.

3. Verbal cues. The subjects were given a label for the pattern and were asked to overtly rehearse the label. In Experiment II, subjects in the experimental groups received training in all of the above strategies.

The distinctive features and labels used in the training program had been previously elicited from the population from which the sample was selected, as was the reinforcement or desired reward preferences.

Results and Discussions

Because the frequencies of correct item recognition were binomially distributed, they were transformed into mean proportions by the arcsin formula. It was not necessary to transform reaction times.

Experiment I. Transformed item recognition proportions and reaction times were subjected to a 4 (treatment groups) by 2 (reinforcement conditions) by 2 (age levels) factorial design analysis of variance.

The analysis of item recognition indicated significant differences among the treatment groups (F-12.66, p.01). A Newman-Keuls comparison of treatment order effects indicated that the experimental groups correctly recognized higher proportions than did the control group, this difference significant at the .01 level. No significant differences were found among the experimental groups. A significant difference was also indicated for the effect of age (F-7.34, p.01); the ten-year-old group correctly reoognized a significantly higher proportion of items than did the five-year-old group. The interaction between reinforcement and age was found to be significant (F-10.16, p.01). The

Newman-Keuls analysis of reinforcement and age effects indicated that the five-year-old nonreinforced group recognized a significantly lower proportion of items correctly than did the five-year-old reinforced group and the ten-year-old reinforced and nonreinforced groups.

The results were interpreted as demonstrating that, although ten-year-old children were more successful than five-year-old children in retention of patterns after a three minute interval, children in both age groups were helped by training in any one of the three approaches. The reinforcement condition was shown to facilitate the five-year-old children's learning, retention, and retrieval while the ten-year-old children were relatively unaffected by the presence of materials rewards.

The analysis of reaction times pointed to age as the only factor producing significant differences (F-12.60, p.01) with the ten-year-old group achieving significantly shorter reaction times than did the five-year-old group.

The reaction time data may be interpreted as reflecting the ten-year-old children's efficient use of retrieval cues in locating information in a better organized associative network and, quite possibly better motor dexterity.

Experiment II. Transformed proportion of items correctly recognized and reaction times were subjected to a 2 (treatment groups) by 2 (reinforcement conditions) by 2 (age levels) by 3 (retention intervals) repeated measures analysis of variance.

The analysis of item recognition proportions yielded significant treatment effects (F-75.37, p.01), the experimental

group achieving a significantly higher proportion of items recognized correctly than the control group. Reinforcement as a main effect was also found to be significant (F-7.00, P.01), with the reinforced group achieving a significantly higher proportion of items recognized correctly than the nonreinforced group. No significant differences between the five-and ten-year-old groups were indicated. Significant differences were found between the retention intervals (F-16.81, p.01); a Newman-Keuls analysis of retention interval order effects indicated that the proportion of items recognized correctly did not decline between the three minute and one week interval, but did decline between one week and one month. A treatment by retention interval interaction proved to be significant (F-4.68, P.05); the Newman-Keuls analysis of treatment and retention interval effects indicated that there were significant differences in the proportions of items recognized over time for both experimental and control groups. An examination of grouped means indicated that the decreases in the proportion of items recognized correctly for the control group were greater than the decreases for the experimental group.

The results were interpreted as demonstrating that training in the three strategies facilitated the five-and ten-year-old children's retention over three intervals of time of increasing length. Though item recognition diminished as a function of time, the decreases in item recognition were lower for the group that did not receive training. The finding of reinforcement effects for the older children in Experiment II conditions and not in Experiment I conditions suggests the role of reinforcement may

be more important over longer periods of time. The finding of no differences between five-and ten-year-old children's item recognition in Experiment II conditions and age differences in Experiment I suggests five-year-old children's retention capacities are as effective as ten-year-old children's capacities over longer periods of time.

The analysis of reaction times indicated that age was the only factor reaching significance (F-31.72, p.01), with the ten-year-old group achieving shorter reaction times than the five-year-old group.

Because the same subjects were used for Experiment I and II, a supplemental analysis was undertaken to determine whether the performance on the item recognition scores of the experimental subjects was a function of the particular strategy used in Experiment I. t-tests were performed on the item recognition scores of the experimental subjects of Experiment I and II. The analysis indicated that there were no significant differences in the performances of the subset of subjects on Experiment I and II in all conditions except in the verbal cues reinforced condition. In the latter, there was a significantly lower item recognition score on Experiment II than on Experiment I.

These results suggest that the experimental subjects did not transfer skills gained from training in any one of the individual strategies to the three strategy sequence.

Conclusions and Educational Implications

Training in the use of individual strategies and in the sequence of the three strategies was shown to facilitate five- and ten-year-old children's learning and retention of patterns.

for lengthening intervals of time. Because both approaches aided retention, both should be expected to facilitate classroom learning where patterns must be learned and retained.

While it is expected that the systematic implementation of cognitive strategies such as those used here will be more successful with five-year-old children who have not developed such skills, general training in the skills should be provided for older children permitting them to integrate these with their own strategies.

The apparent long term effects of reinforcement may be interpreted as suggesting that the focusing of attention afforded by reinforcement at the point of learning provides the learner with the opportunity to select aspects of the task that will be useful as cues for future retrieval.

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