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ABSTRACT

Compared were performances of 39 educable mentally retarded (EMR) Ss, mean chronological age (CA) 11 1/2 years, mean mental age (MA) 7 3/4 years; 25 fifth graders matched on CA; and 27 second graders matched on MA to determine whether children of different ages and IQ spontaneously demonstrate learning strategies after repeated practice with paired associated tasks or apply mediational strategy as a result of training. In phase I the Ss named 18 picture pairs appearing on a screen, then named missing pictures during four trials (scoring was on the basis of correct responses per trial). In phase II, two groups were developed by comparing the Ss' performances on the last pretest trial, ranking the Ss within each group, and assigning the Ss randomly to the training or practice condition. During four trials training condition Ss used a memory "trick" (such as remembering "hook" and "glove" with a sentence "the glove got caught on the hook"). The practice condition Ss simulated the pretest phase pattern during the four trials. In phase III, a posttest two weeks later, all Ss were tested with the pretest pattern for four trials. Results showed that the performance of the EMR Ss was poorest, performance of MA controls was intermediary, and performance of CA controls was best; that for the practice condition all groups improved across trials though the relative position of the groups remained constant; and that for the training condition the three groups maintained the relative positions though all groups improved during training and declined on the posttest. Subsequent reminder of the "trick" during a posttraining phase produced marked improvement across groups. (MC)

STUDIES IN LEARNING POTENTIAL

THE EFFECTS OF AGE, IQ, AND SENTENCE MEDIATION STRATEGY TRAINING ON PAIRED - ASSOCIATES LEARNING

By

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THE EFFECTS OF AGE, IQ, AND SENTENCE MEDIATION STRATEGY TRAINING ON PAIRED - ASSOCIATES LEARNING [1, 2]

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Rationale

It has been repeatedly demonstrated that providing sentences as mediators enhances paired-associates learning in children and adults regardless of ability level. Jensen and Rohwer (1965), with normal and retarded children, found that subjects given instructions to mediate the items to be learned by use of sentences linking stimulus and response performed better than those not given specific instructions. Spontaneous usage of verbal mediation increased with age and sentence mediation instructions facilitated paired-associates learning, particularly in the age range from seven to thirteen years.

While a developmental trend in mediated paired-associates learning has been documented, little research has been done comparing spontaneous and induced changes in paired-associates learning within a developmental framework. The research reported below directly compares the performance of subjects allowed repeated practice with a paired-associates task with that of subjects receiving strategy training on the task at three age and IQ levels.

Method

Subjects

The subjects were 91 children from elementary schools in the Boston, Massachusetts area. There were three subject groups: a) 39 EMR children with a mean CA of 11 years, 6 months, mean MA of 7 years, 9 months, and a mean IQ of 68.6; b) 25 fifth graders of average intelligence selected as a CA match; c) 27 second graders also of average IQ, selected as an MA match.

Materials

The materials used were three 18-item sequences of picture paired-associates. Each pair consisted of pictures of two common and easily named but unrelated objects mounted on a slide. Comparable slides illustrated the stimulus member of each pair. A carousel projector was used to present the slides. Photographs of common objects mounted on cardboard were used in the pretraining phase of the study.

Procedure

Each subject was seen individually by an experimenter three times a week at two-week intervals. Each of the three phases of the study took about 25 minutes per subject. In each phase subjects were given four study-test trials.

Phase I. Phase I consisted of a brief familiarization task and a pretest. The procedure was identical for all subjects. In the familiarization task, each subject was shown three picture pairs (mounted on cardboard) not used in the experiment. He was asked to label the pictures and told to remember which pictures went together. When he saw only one of the pictures from a pair, he would have to name the picture it had been paired with. Any subject who failed to get this sequence of three picture pairs correct (orange-glove, cup-shoe, airplane-fork) was dropped from the sample. Only one EMR subject was unable to complete this task.

Following this task, each subject was presented with 18 consecutive picture pairs projected on a screen at eight-second intervals. He was asked to say the name of each picture in the pairs as they appeared and to try to remember which pictures went together as in the familiarization task. The experimenter provided the correct label if the subject was unable to name a picture and used the subject's label if it differed from the official name (for example, the subject might call the hatchet an axe). Following the first exposure to the 18 pairs, 18 slides showing just the stimulus member of each pair in a different random order were presented at eight-second intervals. After naming the picture shown, the subject was told to say the name of the missing response picture. The presentation of the 18 picture pairs and then the 18 stimulus pictures consituted a study-test trial. Four such trials using different random orders of pictures were conducted. Each subject received a score for each trial equal to the number of correct responses for that trial.

Phase II - Training Condition. Two groups, comparable in their performance on the last pretest trial, were developed by ranking all children within each group and randomly assigning them successively to training or practice condition.

Eighteen new picture-pairs were used in Phase II. Subjects in the training condition were told that this time they were going to try a "trick" to help them remember the picture pairs. After the subject labeled the first pair ("hook" and "glove" in this case) he was told the sentence, "the glove got caught on the hook," and asked to repeat it.

The experimenter explained that the sentence would help him to remember the missing picture when he saw just one picture from the pair. This procedure was followed for the 17 remaining picture-pairs. Subjects were then shown the stimulus items and asked to give the response member for each item as in the pretest. Four study-test trials were conducted in this manner.

Practice Condition. For the practice condition a procedure identical to that of the pretest was used. The slides were the same as those viewed by the training subjects, but the practice groups did not receive the sentence mediation instructions.

As in Phase I, the experimenter kept a complete record of responses as well as spontaneous associations and other comments made by the subjects. A brief paragraph relating a global impression of the subject was also included for each session.

Phase III. Phase III, a posttest, two weeks later, was the same for all subjects. A third list of 18 different picture-pairs was used. The instructions and procedure were those used in the pretest. Subjects in the training condition were not reminded of the sentence strategy and any spontaneous use of sentences was received neutrally by the experimenter. Subjects continued through four study-test trials or until all pairs were learned as in the first two phases of the study.

Method of Analysis. The experiment was designed to allow for a repeated measures analysis of variance with four factors: subject group (EMR, CA control, and MA control); treatment condition (training or practice); phase (pretest, training, and posttest); and trial (four). Number of correct responses on each trial was the dependent variable.

In addition, analyses with three factors (group, phase, and trial) were performed for the two treatment conditions (training and practice) separately. This allowed for a direct comparison of the performance of subjects given repeated practice and specific strategy training on the same task. More specifically, the analyses were designed to answer two experimental questions: 1) within a repeated practice condition, which groups spontaneously developed native strategies resulting in more efficient paired-associates learning? 2) Within a strategy training condition, for which groups did the experimenter-offered strategy facilitate learning during the training and post-training sessions?

Results

1. All Subjects

The results of the four-way analysis including all subjects revealed significant main effects for all four factors. The EMRs' performance was the poorest, the MA controls were intermediary, and the CA controls performed best ($F = 5.188$, $p < .008$).

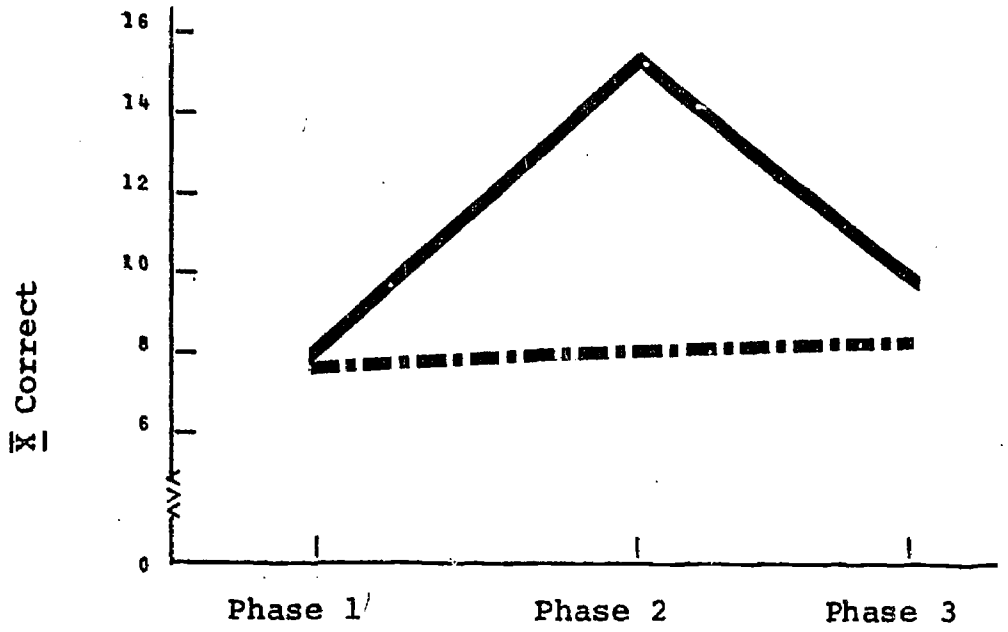
Patterns of performance for the practice subjects differed from those of the trained subjects ($F = 29.650$, $p < .001$). The significant interaction between groups and phase ($F = 4.092$, $p < .004$) revealed that while all three groups improved from the pretest to the treatment phase (mainly a contribution of the trained subjects within each group), the EMRs returned to their pretest level on the posttest, the MA controls lost some but performed at a level higher than the pretest while the CA controls maintained the level evident during training.

The significant condition by phase finding ($F = 75.913$, $p < .001$) is explained by the observation that practice subjects increase their scores minimally between Phase I and Phase II as well as between Phase II and Phase III, while trained subjects showed a large increase between the first two phases and a substantial drop on Phase III (see Figure 1A).

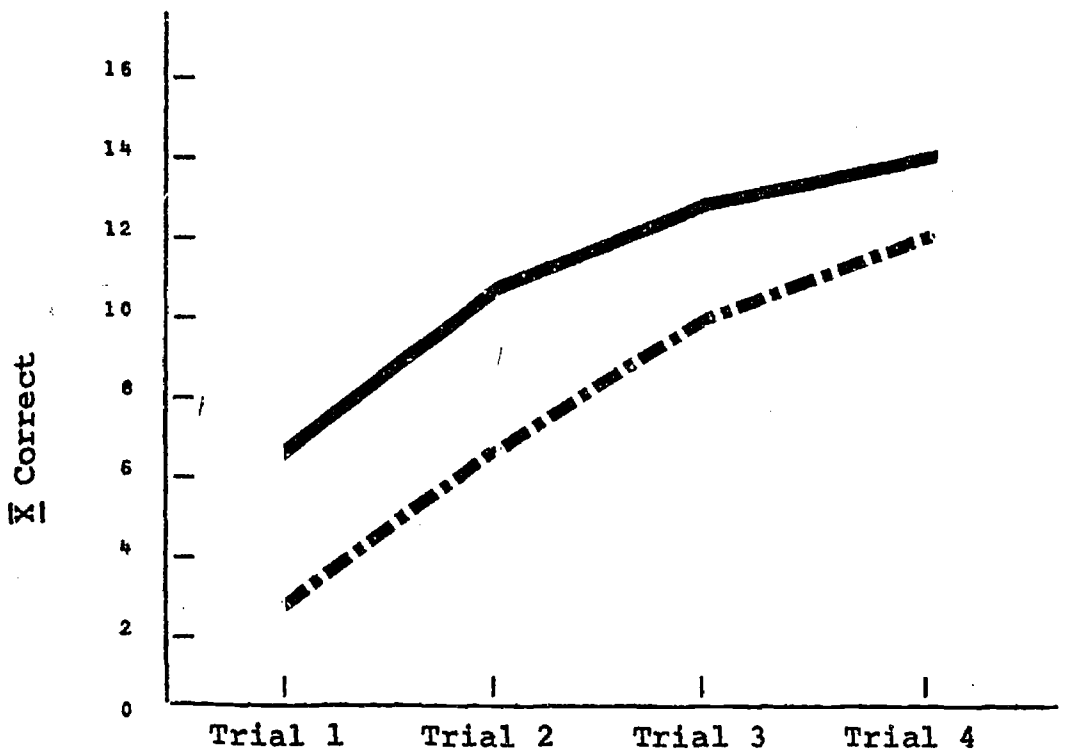
The significant trial effect ($F = 850.88$, $p < .001$) can be explained by the observation that while all subject groups increased in mean correct responses from trial 1 to trial 4 within each of the three phases, the EMRs' scores were consistently lowest, MA controls intermediary, and CA controls highest at each trial level. The significant interaction between condition and trial ($F = 5.277$, $p < .001$) can be explained in the same way: trained and practice subjects both increased in a linear fashion across trials with trained subjects consistently performing at a higher level. The lack of a significant interaction between group and condition is notable. All three groups were affected by training or practice in similar ways when the two are compared (see Figure 1B).

2. Practice Subjects

Since the goal of this study was to examine the relationship between spontaneous and induced changes in memory strategies for subject groups differing in chronological age and ability level (IQ), separate analyses for the practice and training conditions were also conducted. Among practice subjects, the only significant main effect is for trials ($F = 309.558$, $p < .001$). For all



A. Condition X Phase



B. Condition X Trials

FIGURE 1

practice
training

subjects, on all phases, there is a linear trend across trials with first trial performance lower than trial 4 performance.

The significant interaction between group and trials ($F = 3.790$, $p < ,002$) indicates that the groups improved at different rates and reached different final levels on trial 4, although they started at domparable levels. The EMRs made the most improvement between trials 1 and 2, and then increased at a steady rate from trial 2 to 3 and trial 3 to 4, ending up with a mean of 10.5 correct on trial 4. MA controls made the most progress between trials 2 and 3 and between trials 3 and 4, ending up at a 12.56 level. CA controls reached a final level of 14.17 and made more steady gains across all trials (see Figure 2).

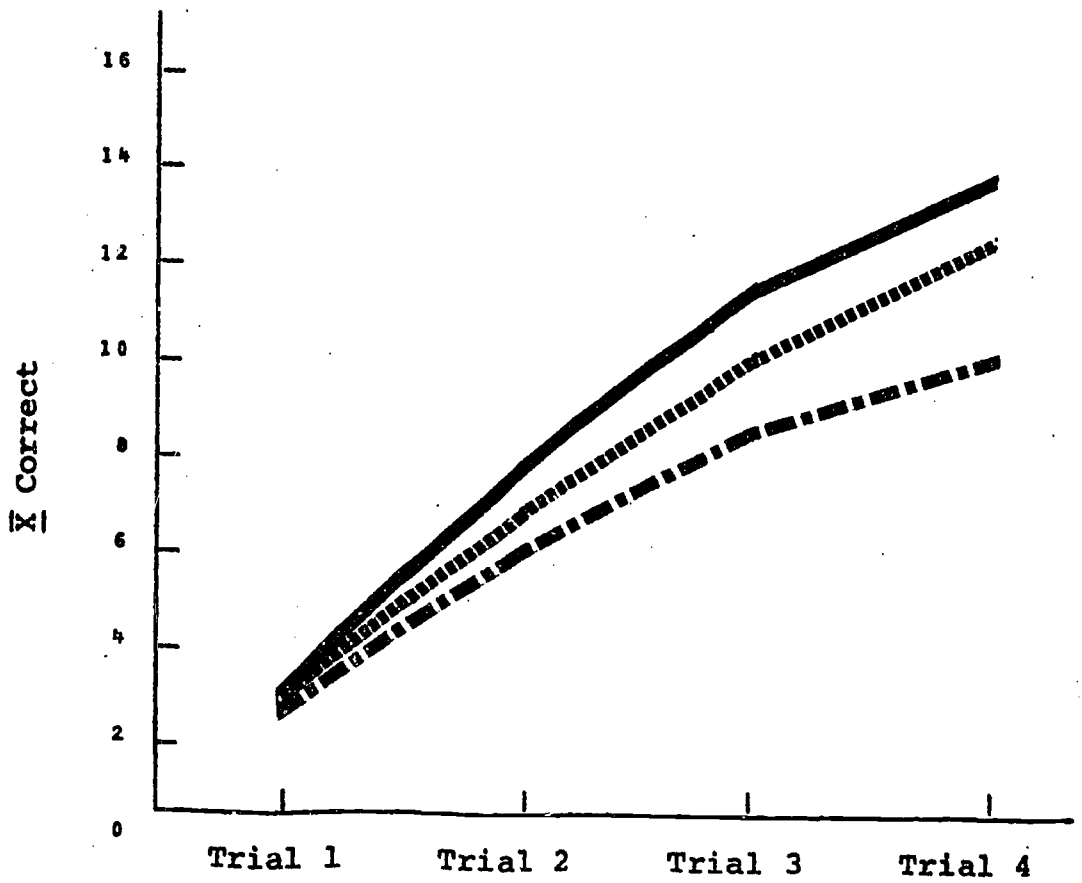
A significant interaction was found between group and phase ($F = 3.206$, $p = .018$). While the three groups started at comparable levels on the last pretest trial (EMRs at 7.02, MA controls at 7.85, and CA controls at 8.17), during Phase II, the EMRs did not improve, while MA controls and CA controls showed small mean increments. In the final session EMRs' performance declined below their pretest level, MA controls retained their higher levels, while CA controls continued to improve on the task. (Post-training trial 4 means for these groups were: EMR 6.75, MA control 8.23, and CA control 10.77) (see Figure 3).

To summarize: the relative position of the three groups remains constant with the EMRs making the least progress, the MA controls improving somewhat, and the CA controls achieving the most correct responses. All groups showed linear increments across trials.

3. Trained Subjects

All three main effects associated with training proved to be significant: group ($F = 3.903$, $p = .0281$), phase ($F = 134.513$, $p < .001$), trial ($F = 691.494$, $p < .001$). The three groups maintained the relative positions they did in the practice condition: EMRs have the lowest scores, CA controls are highest, and MA controls' performance is intermediary. Likewise, scores for all subject groups improve across trials. The significant main effect for phase is explained by the consistent quadratic trend in response. Performance tends to be lowest on the pretest, to improve to asymptotic levels during training and to decline somewhat two weeks later on the posttest.

While group differences were significant as a main effect, the interactions between group and phase and group and trial were not significant. In other words, although there were absolute differences among the three groups in their levels of performance, the patterns of performance



Group X Trials (Practice Condition)

FIGURE 2

EMR
MA
CA

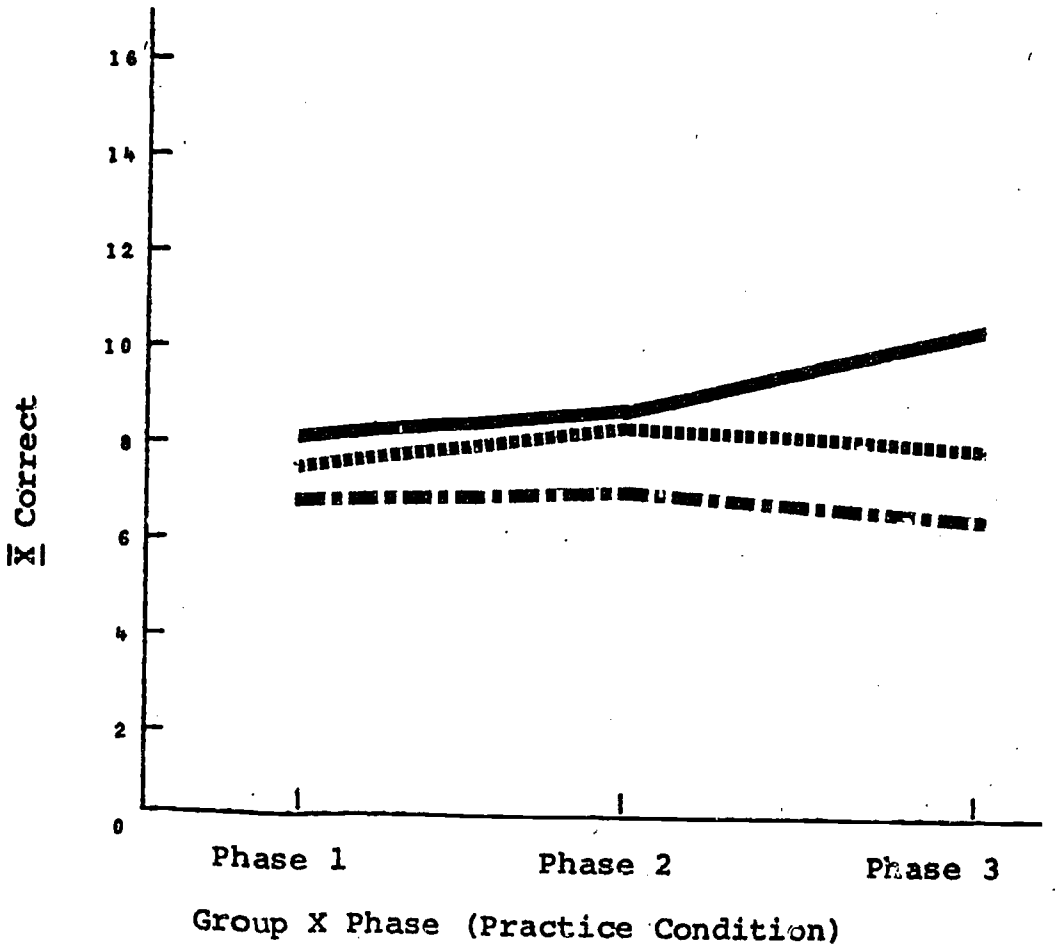


FIGURE 3

EMR
MA
CA

Footnotes

[1]Presented at a meeting of the Society for Research in Child Development, Philadelphia, Pennsylvania, March, 1973.

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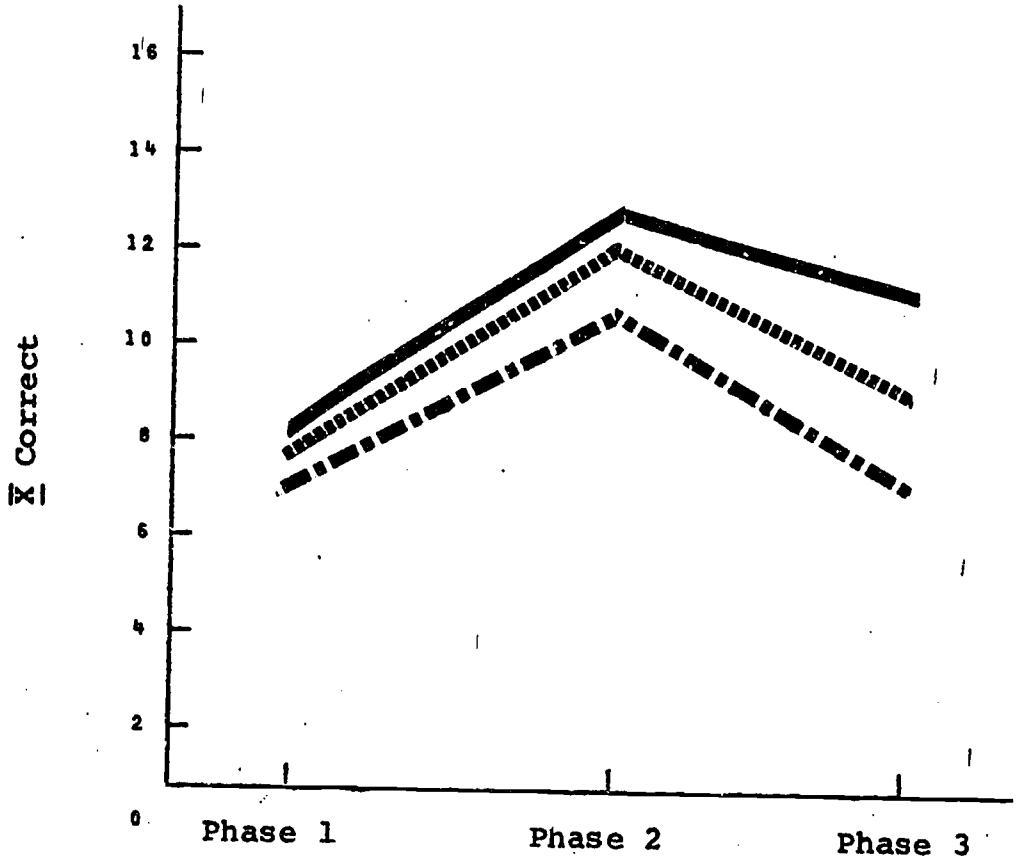
were parallel. The CA controls most clearly indicated retention of their strategies following training, attaining an asymptotic level for the task. EMRs' mean improvement following training was negligible (.6 items correct). MA controls made moderate improvement (2.3 items correct). Similarly, the mean performance per trial for the three groups was not significantly different although they maintained the same relative position. (EMRs lowest followed by MA controls with CA controls highest) (see Figures 4 & 5).

The three-way interaction between group, phase, and trials was significant ($F = 2.594$, $p < .003$). At trial 1 of the pretest, the three groups were equivalent. They progress at a roughly comparable rate with the EMRs dropping behind the MA controls and CA controls by trial 4. The same differences in position persist between the groups at trial 1 of the training phase (EMR low, MA control intermediary, and CA control high), but over the four trials, the subject groups come closer together. The EMRs make the most gain during training followed by the MA controls and CA controls (a possible ceiling effect must be noted here since CA controls reach a perfect score of 18 and MA controls go up to 17). Following training, the CA controls start off higher than the EMRs and MA controls and attain an asymptotic level. MA controls end up at a point lower than the CA controls but considerably higher than their trial 4 level on the pretest. The EMRs also improve across the four trials but only reach the level of 12 correct compared to 11 correct on the last trial of the pretest.

Discussion

We have asked two questions in this study: 1) With repeated practice on a paired-associates task, will children of different ages and IQ change their performance and spontaneously demonstrate learning strategies? 2) When offered a facilitating mediational strategy, to what extent will children differing in age and IQ utilize this new strategy and apply it to new instances of the task?

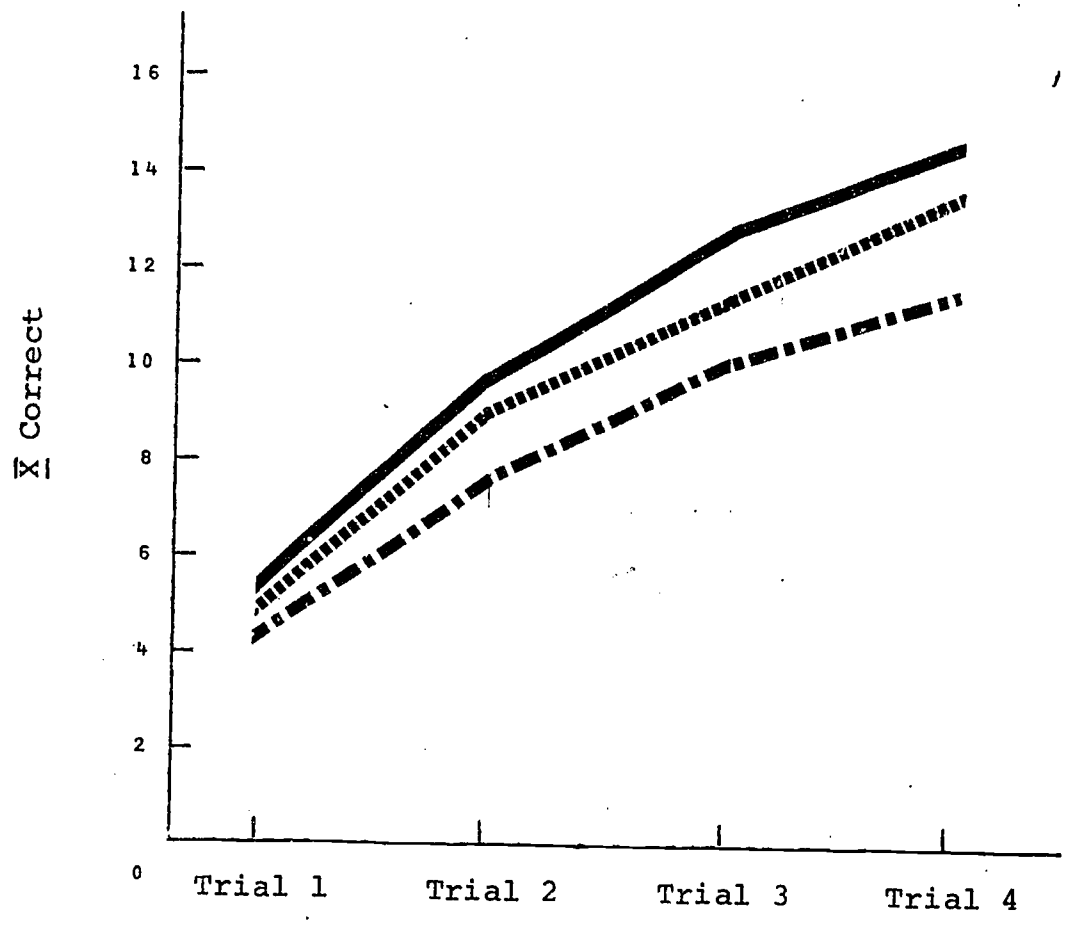
The results of the practice subjects indicate that fifth grade normal children improved steadily, starting each phase at successively higher trial 1 levels and attaining more correct responses at the end of each successive session. Younger normal and retarded children did not improve their performance markedly with practice across sessions, with the EMR subjects functioning consistently at a lower level than the MA matched normals. While it might be argued that the subjects who did not alter their performance just needed more time, this is unlikely since they returned to the same trial 1 level at each session, and repeated the same learning curve on each successive trial. It is important to note



Group X Phase (Trainin; Condition)

FIGURE 4

EMR
MA
CA



Group X Trial (Training Condition)

FIGURE 5

EMR
MA
CA

that even for the older subjects who improved, the change was gradual and steady, indicating that no abrupt change in learning strategy was spontaneously taking place. These subjects appear to have made quantitative but not qualitative changes in their performance.

The most striking finding among the strategy-trained subjects was the effectiveness of the training for all three groups of children. Within the training phase, the introduction of the mediational strategy tended to dissolve the differences between subject groups by trial 4. When offered a strategy to improve performance, the EMRs' scores improved most markedly and all three groups showed a ceiling effect by the 4th trial. However, two weeks later only the trained fifth graders attained nearly perfect performance. In contrast, the EMRs' performance approximated their pretest level and the 2nd grade normal attained a moderately improved score.

When we compare the posttest performance of the practice and training subjects we find minimal differences. In other words, it seems to be the case that for all trained groups, posttest performance could have been predicted from the posttest performance of the practice subjects (including the 5th graders who appeared to profit from training.) These results suggest that the changes in the performance of the older children can be explained in terms of spontaneous changes resulting from practice in the task.

Though all three groups clearly profited from training, when compared to their earlier performances, and those of their practiced matches, no group showed any evidence of using the sentence strategy two weeks after training. Our disappointment with this failure to spontaneously apply the mediational strategy during the posttraining phase led us to very briefly remind the trained subjects of the sentence strategy they had used in the training session after the experiment was over. With this minimal reminder, subjects from all three groups improved markedly despite the fact that the pairs on the posttest were different from those used in the training session and thus required the subjects to generate their own sentences (which they had never done before.) A subsequent study systematically built in the reminder factor and the results supported the findings from this informal procedure (Stein, Gampel, and Budoff, 1973).

The greatly improved scores during the training phase, even among the retarded children, indicate that all subjects in our experiment possessed the ability to construct and understand sentences and can be induced to apply this ability to the mediation of a learning task. This occurs despite the fact that these subjects do not spontaneously do so, and they failed to do so when presented with the same task after a brief interval. Flavell (1972) has called this

lag between competence and performance a production deficiency. It is not the case that they cannot mediate, but rather that they do not produce at the right time. Even 11 year old children of normal IQ do not produce the appropriate mediators spontaneously.

The effectiveness of the reminder highlights the notion of a production deficiency. The trained subjects, when given a minimal cue to use sentence mediation, changed their performance dramatically. Rather than forgetting the strategy or losing the ability to construct sentences, these subjects seemed not to see the relationship between the training and posttraining tasks, and therefore did not spontaneously apply the learned strategy. The strategy had not become a formal rule and procedure applicable in many settings.

Our findings of differences between groups were a function of differences in the spontaneous application of strategies. Invoking a learned strategy following training, even for pairs of pictures not seen before, erased the group differences between second and fifth graders and retarded subjects.

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