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ABSTRACT

Mandler (1969) found that one-third of adult subjects were seriators and two-thirds were categorizers in a task where either strategy could be employed. Study 1 was a replication of his procedure with children from Grades 1, 3, 5, 7, and 9. While there was weak evidence that some older subjects chose the categorial strategy, there was little evidence for use of the seriation strategy at any age level. In Study 2 we investigated the effects of strategy training with first and sixth graders. Subjects were given either serial, categorical, or no training. Categorical training was highly effective for older subjects, although it had but minor benefits for younger subjects. In contrast, serial training was not differentially effective for older and younger subjects. The data suggested that seriation as a retrieval strategy develops later than categorization, contrary to current theoretical notions. The implications of these developmental trends for adult individual differences in strategy performance were discussed. (Author)

Developmental Trends in Categorization and Seriation in Recall

Patricia E. Worden and George Mandler

The experiments I'm presenting today concern the development of organizational preferences for serial and categorical recall strategies. Mandler (1969) found that adults could be divided unambiguously into seriators and categorizers, respectively, on the basis of the output strategy they chose in a recall task where either strategy could be employed. Roughly one-third of the adults in that study used serial recall and two-thirds employed categorical clustering. This finding was consistent over at least two successive tasks. It has been replicated by Underwood with a sample of approximately 100 subjects. This finding of individual organizational preferences is related to a distinction made by Broadbent between people who use one of two styles of cognitive processing, holists and serialists.

Past research with children on the development of seriation and categorization as retrieval strategies, has shown that use of both strategies increases with age. However, the serial strategy, when compared to categorical clustering, has been considered theoretically to represent a less advanced cognitive skill. Neimark (1976) assigned serializing a lower position than categorical classification on her developmental hierarchy of recall strategies. Similarly, Rossi and Wittrock (1967) referred to seriation as a "less abstract" strategy. Scribner and Cole (1976) compared seriation with rote learning in contrast with the higher-order analytic thinking required for categorization. Thus, despite the view of Inhelder and Piaget (1969) that seriation and categorization show a roughly parallel course of development, many have considered seriation to be the more ele-

mentary strategy.

The development of the preferred adult strategies which we found previously could be ascribed to a variety of sources. Three possible sources are the following. First, younger children would prefer to seriate simply because it represents a less advanced retrieval strategy than use of adult taxonomic categories. Such biasing in favor of seriation could, for some individuals, persist into adulthood. Second, these strategy preferences might be related to fundamental individual differences in abilities to treat the world in either a holistic or a sequential manner. Third, mastery of the two ultimate strategies might be achieved relatively late in childhood. While individuals may be equally capable of using one or the other, a preference might develop for one of the strategies as a result of environmental and obntextual factors.

In the first study we examined the question of developmental preferences for categorical and serial structures. We wanted to see at what age discernable preferences between the two strategies could be found. The method was the 1 + 1 presentation method introduced by Mandler and Dean (1969). On each trial the subject was presented with one item and the task was to recall all of the previously presented items. Stimulus items were simple pictures, with the word name printed underneath. The list contained sixteen items from four categories. The order of presentation was random such that each block of four successive pictures contained one instance from each of the four categories. The subjects thus had the opportunity to organize their output by categories, or they could follow the serial order of presentation, which was not categorical. Subjects were told that they could recall in any order they wished.

The major dependent variables of interest in the 1 + 1 paradigm are

measures of category clustering and of serial concordance. The former measure assessed the degree of clustering to the designated categories, corrected for the maximum possible clustering given a particular output size. The serial concordance measure compares the subject's output order to the input order of the stimulus items. Both measures range from zero to one, with a score of one indicating perfect performance.

The subjects in Study I were ten children each from grades 1, 3, 5, 7 and 9. As would be expected, recall performance improved significantly across trials and with increasing age. Concerning the results on strategy preferences, we failed to find the unequivocally bi-modal distribution that we did with adults. That is, we were unable to identify distinct classes of seriators and categorizers on the basis of the serial concordance and categorical clustering measures. However, the fact that the variance of the categorical clustering increased with age indicated a trend for older subjects to group themselves into those who tended to categorize on the one hand, and those who did not categorize on the other. The results for the serial concordance measure showed no such developmental trend. Subjects at all grade levels showed dramatically lower levels of seriation than Mandler's adults.

To summarize, these results did not exhibit the clear developmental trends in strategy preference we were hoping to find in this first study. There was certainly no evidence for the hypothesis that, since seriation represents the more elementary classification structure, seriation should be the preferred strategy of younger children. Thus, while there was evidence that some seventh and ninth graders were approaching adult levels of categorization, it appears that seriation is subject to a developmental trend which may in fact not appear in full strength until after the ninth

grade.

In conclusion, the data from our first study cast doubt on two of the three possible sources of differential adult organizational strategies I mentioned earlier. Neither a preference for early seriating, nor a pervasive individual difference variable seems to account for the data. If in fact the choice between the two strategies is strongly influenced by environmental and contextual variables, then we ought to be able to manipulate the use of one or the other strategies in children by appropriate training procedures. We addressed that issue in our second study.

Study II involved teaching subjects how to use either the serial or the categorical strategy. This study was designed to determine at what age such instruction would be most effective. Since the first study showed that some seventh and ninth graders were approaching adult performance on the measure of categorization, we were particularly interested in the effect of training at an earlier age. Therefore we chose first and sixth graders as our Study II subject population. Subjects at each grade level were randomly assigned to either the categorical training group, the serial training group, or a no-training control group.

A nine-item list was prepared consisting of three categories. For the categorical training group the subjects were told that each picture belonged in a category and that all members from a given category should be recalled together. As each succeeding item was presented it was placed face down in a stack consisting of items from its category. The subject then recalled as many of the previously presented pictures as possible. As the subject recalled, the experimenter pointed to each category stack in turn. In this way the subject was trained to recall all the members of a given category before he or she gave the members of each successive

category.

The serial training subjects were instructed to remember the pictures in the order in which they had been presented. As each picture was presented it was placed face down in a row next to the preceeding picture. The experimenter pointed to each card in turn and the subject was thus trained to recall the pictures in order of presentation.

Finally, the training procedure for the no-training control group was identical to the procedure used in the first study. As each picture was presented the subject identified it and it was placed face down on top of the stack of previously presented pictures. Subjects were instructed that they could recall in any order they wished.

All subjects were then given the test task. A new stimulus list of sixteen items from four categories was employed. The procedure was the same as that used in the first study. The categorical subjects were instructed to recall by categories, the serial subjects were told to recall the items in order of presentation, and the no-training subjects were told to recall in any order they wished.

Recall performance in Study II was similar to that found in Study I. Recall increased over trials, and with increasing age. In addition, there was a significant effect of the training conditions. Serial training subjects recalled the most, no-training subjects were intermediate, and categorical subjects recalled the least, but these differences were not significant by an individual comparisons test.

The results for the strategy measures are shown in your handout. First grade subjects are on the left-hand side, and sixth graders are on the right of Figure 1. This graph presents subjects' performance on the categorical clustering measure over blocks of four trials. Not surprisingly,

the effect of the three training conditions, marked C, N, and S, was significant. The important finding was that the training was differentially effective for the two age groups. As indicated by the arrow on the handout, categorization training had a dramatic effect on sixth graders' categorical clustering, but a neglible effect on that of first graders. Note further that there was no significant overall effect of grades.

In comparison, Figure 2 shows performance on the serial concordance measure. As with the categorical measure, the effect of grades was nonsignificant. Furthermore, as expected, there was a significant effect of the training conditions on the serial concordance measure. Most important, the effects of the training conditions on the seriation of older and younger children did not differ statistically. In fact, the amount of seriation achieved by subjects in both grades was unimpressive, especially when compared with adult performance. Adult seriators consistently scored between 85 and 100% across trials on this measure.

Finally, we performed a subsequent analysis of subjective organization on the output protocols of subjects who received serial training. We found that these subjects tended to repeat their previous output orders, rather than seriating to the input order, as they had been trained.

In conclusion, the developmental trends we encountered in Study I were replicated in the training study. Categorical training was highly effective for the older subjects but had little benefit for younger subjects. On the other hand, serial training had a negligible effect on subjects in both grades. Despite training instructions to seriate in concordance with the input order, subjects at both grade levels preferred to repeat their own output orders from trial to trial.

In light of these results, we offer the following speculations regard-

ing individual differences in adult strategy preference for this task. It appears, contrary to previous suggestions, that seriation as a retrieval strategy develops later than categorization. While sixth graders showed dramatic effects of training in categorical clustering, the seriation training was ineffective for all subjects. Furthermore, there was no evidence for adult levels of seriation even in our ninth grade Study I subjects. This apparent developmental sequence in acquisition of the two strategies may account for the finding that only one-third of adults seriated spontaneously. Since the seriation strategy is learned later it may have less salience than the developmentally prior categorical strategy.

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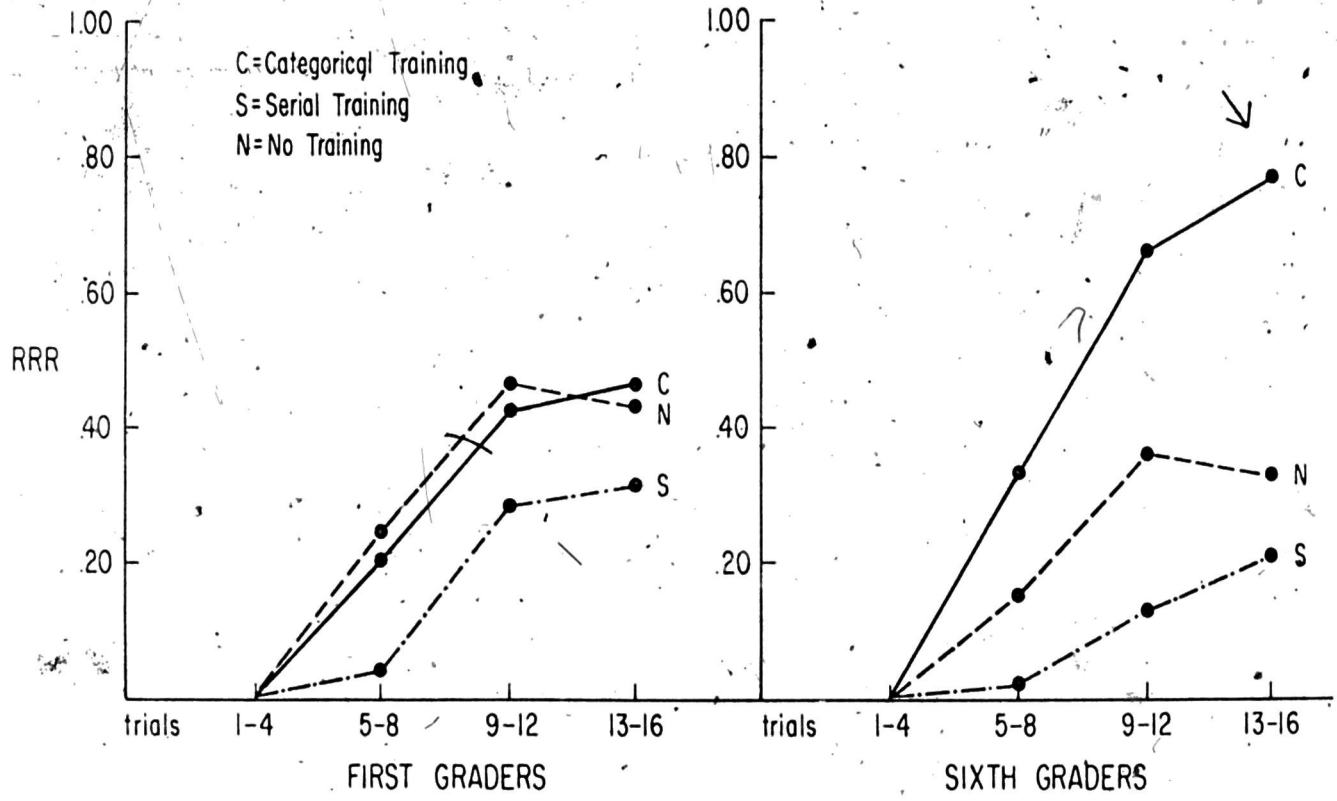

Figure 1: Categorical clustering for subjects in Study II.

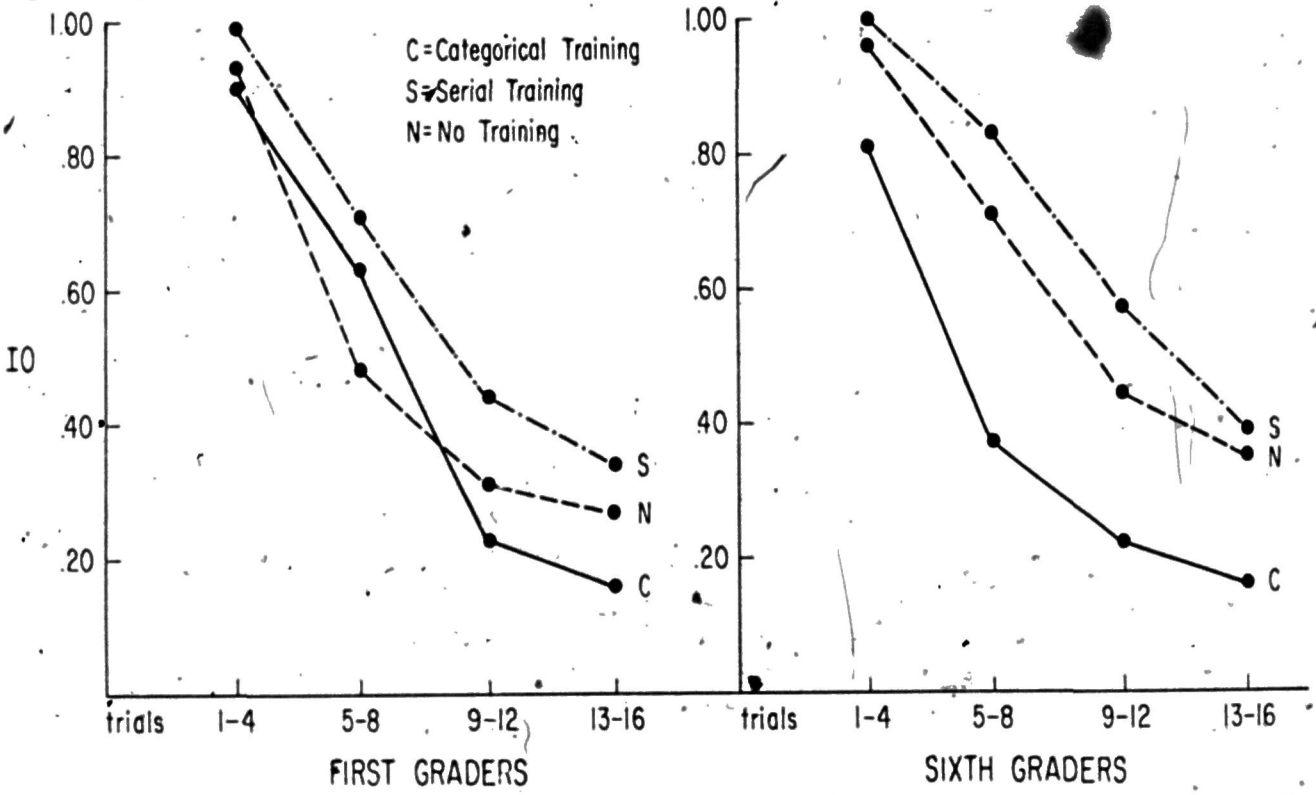

Figure 2: Serial concordance for subjects in Study II.