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Development of Strategies for Recall and Recognition

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Kindergartners, third graders, and fifth graders viewed 30 pictures of familiar objects, and then their free recall of the object names and their recognition of the original pictures were tested. The recognition test included pairing each picture with another similar picture of the same object. Half the subjects in each age-group were prepared for recall with a strategy known to improve it in adults, and half were prepared for recognition with a strategy known to improve recognition in adults. Children encoded the stimuli differentially in accordance with the expected memory task and retrieved different stored information for each task. Both free recall and picture recognition memory improved with age. The recall strategy improved free recall performance at all ages, but the recognition strategy improved recognition performance only at the oldest age tested.

Investigators of both children's and adults' memory have found different strategies beneficial for different memory tasks (e.g., Flavell, 1970; Paivio, 1971). Strategies are ways of encoding or representing material to facilitate later retrieval. For instance, Paivio and Csapo (1969) found that whereas verbal codes are particularly effective in sequential memory tasks, imaginal or pictorial codes are effective in free recall and paired-associate learning. Moreover, expectations about the type of memory task to be encountered alter the strategies subjects adopt. Frost (1972), for example, has shown that subjects encode visual information in a highly accessible form when anticipating recognition, but they encode verbal information in a highly accessible form when anticipating recall. Even preschool children encode simple pictures or their names verbally when expecting verbal comparison and pictorially when expecting pictorial comparison (Tversky, 1973a). Finally, there is evidence that the cognitive skills underlying various strategies develop at different ages. Rohwer (1970) has argued that children are unable to utilize imaginal codes effectively until they are efficient at verbal encoding; presumably the verbal code allows effective access or retrieval of the image.

Strategies that are effective for adults in improving free recall are those that organize the stimuli on the basis of categories, associations, or subjective relations among the items (Anderson, 1972; Tulving, 1968; Tversky, 1973b). These are skills that develop during the school years, and indeed free recall performance improves during these years (for recent reviews see Hagen, Jongeward, & Kail, 1975; and Jablonski, 1974). There has been less study of strategies in recognition, especially picture recognition, partly because performance is often so high in such tasks that failure is attributable to such trivial factors as momentary inattention at presentation. Also, strategies are typically conceived of in relation to retrieval, and because the items themselves are presented in a recognition test, many researchers have assumed that they need not be retrieved (e.g., Kintsch, 1970). Indeed, the evidence about picture

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recognition memory in children is notable for the absence of apparent age trends (e.g., Brown, 1973; Nelson, 1971).

In a procedure used recently (Tversky, 1973b, 1974), adults viewed pictures of familiar objects and were tested on their free recall of the objects' names as well as their ability to recognize each object when paired with another picture of the same object. Typically, recognition is regarded as simply an easier test than free recall, but in this task each test draws on different information that can be encoded from the stimuli. When subjects were prepared for free recall with a strategy appropriate for that task, they encoded the stimulus items differently from when they were prepared for recognition with a strategy appropriate to that task. Recall-set subjects performed considerably better on the recall task than recognition-set subjects, who, in turn, performed far better on the recognition test. Moreover, different information was retrieved to perform each task. The present experiment is a replication on elementary school children of this procedure. The purpose is to assess the ability of children to adapt their encoding strategy to fit the anticipated memory task and to assess the development of performance on these tasks, with and without preparatory strategies.

Method

Subjects

Subjects were 122 middle-class children from a day camp. There were three age-groups: graduates of kindergarten, third grade, and fifth grade. The 20 boys and 20 girls in kindergarten had a mean chronological age (CA) of 5 years 5 months, ranging from 5 years 1 month to 6 years 2 months. The 16 girls and 26 boys in third grade had a mean CA of 8 years 3 months, ranging from 6 years 7 months to 8 years 6 months. The 20 girls and 20 boys in fifth grade had a mean CA of 12 years 4 months, ranging from 11 years 1 month to 12 years 6 months.

Stimuli

The stimuli were 30 slides of line drawings of familiar objects in the following order of presentation: desk, lamp, scissors, camera, binoculars, picture, rug, television, refrigerator, cake, teapot, iron, umbrella, purse, luggage, airplane, submarine, ship, tent, house, fish, cow, butterfly, bird, tree, flowers, tractor, train, truck, car. Pictures were selected so that they could be easily recognized and given one-word labels by children. The order of presentation was selected to maximize the associations, clusters, and interrelations among items. For the recognition test, each stimulus was presented side by side with another line drawing of the same object which differed from the original in orientation or detail or both. Test order was the same as presentation order, and the original stimulus was presented on the right on half the trials at random.

Procedure

Subjects were tested in groups of three, each attended by one of the three young female experimenters.

After the instructions and training, the 30 stimuli were projected for 4 sec each. This was followed by a free-recall test; each subject whispered his answers to the experimenter assigned to him; the experimenter recorded the answers. The experiment was conducted in a large room, and the subject–experimenter pairs were scattered throughout the room so that the children could not hear each other. When the child stopped naming, the experimenter asked if there were any more items the child could remember. After all the children had completed free recall, a forced-choice recognition test was administered. Pairs of pictures with the same name were projected side by side, and each child indicated which of the pairs he believed he had viewed previously by pointing to one of two rectangles, oriented side by side like the pictures. Each experimenter recorded the responses, and when all the children had responded, the next test pair was presented. Previously it had been shown with adults and similar stimuli that a prior free-recall test did not affect recognition performance (Tversky, 1973b). When the child had completed both tasks, he was told he had done well and was given candy.

Instructions and Training

The children in the recall-set groups, approximately half the subjects of each age and sex, were individually instructed and trained to use a strategy of identifying similarities, relations, and associations among items, and to use these similarities to interrelate items in order to produce higher recall. For instance, they were told,

> Imagine that you saw pictures of the following objects: fork, knife, bread, supermarket. Now you can relate the fork to the knife, because they are both used for eating; then you can relate the knife to the bread because the knife cuts the bread, and finally, you can relate the bread to the supermarket because we buy bread at a supermarket.

Then, they were presented with another example and asked to state the connections among the items. The recall task was carefully explained to these subjects before they viewed the test stimuli. The procedure for the recognition test was explained to them after their free recall was assessed and just prior to the recognition test itself.

Children in the recognition-set groups were individually instructed and trained to use a strategy of paying careful attention to the details of objects in order to be able subsequently to discriminate them from similar objects. For instance, they were told,

> Imagine that you saw first a picture of an apple with a leaf. In the second part of the game, you see two pictures of an apple, one with a leaf and one without. Then, you must remember that the picture you saw earlier was of an apple with a leaf.

Then, they were presented with a picture of a cup, taken from the same larger set of pictures from which the 30 stimuli had been selected. Then, the picture of the previous cup was shown next to a picture of a similar cup, and the child was asked to point to the cup viewed previously and to state the differences between the pictures. These children were carefully prepared for the recognition test before viewing the test stimuli, and they were informed about and were administered the recall test after viewing the stimuli and prior to the recognition test.

Results

The average percent recall under recall and recognition instructions as a function of age is illustrated in Figure 1, and the average percent recognition scores are illustrated in Figure 2.

Separate analyses of variance (Winer, 1962) were performed on recall and recognition scores, each with age, instructions and sex as variables. For recall, age, $F(2, 110) = 49.3$, $p < .001$, instructions, $F(1, 110) = 52.74$, $p < .001$, and their interaction, $F(2, 110) = 5.12$, $p < .01$, were significant. No other effects or interactions reached significance. Post hoc comparisions by the Duncan technique showed that the effect of instructions was significant ($p < .01$) at all ages and the effect of age was significant ($p < .01$) under both instruction sets. In order to evaluate the Age × Instructions interaction, t tests were performed on the increment in recall attributable to appropriate instructions. This increment was significantly greater for fifth graders than for third graders, $t(38) = 4.5$, $p < .01$, and significantly greater for third graders than kindergartners, $t(38) = 6.4$, $p < .01$. Thus, recall instructions are increasingly effective with age.

The analysis of variance for recognition scores showed a significant improvement in performance with age, $F(2, 110) = 13.9$, $p < .01$, but no other significant effects or interactions. Moreover, the post hoc comparisions (Duncan technique) showed that although third graders did not significantly outperform kindergartners, the recognition scores of fifth graders were superior to those of third graders ($p < .01$) under each instructional set. Finally, the effect of instructions

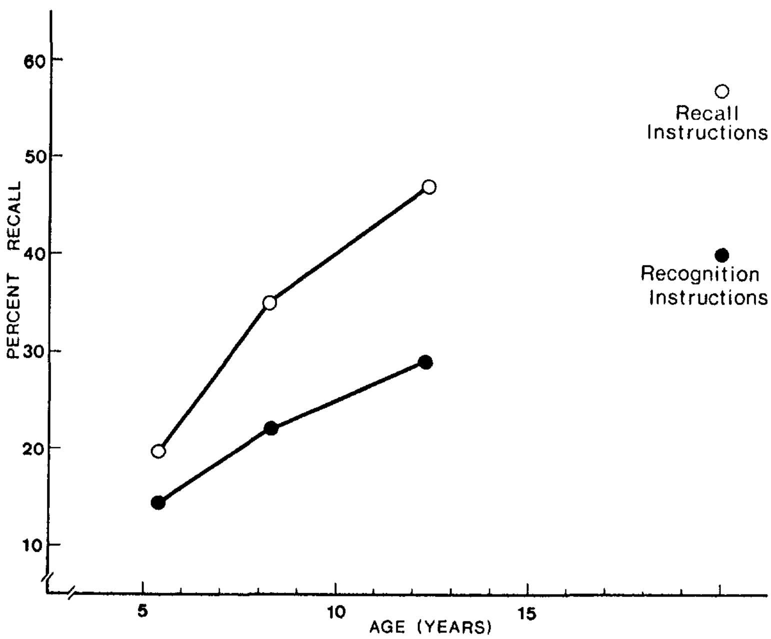

Figure 1. Percent correct recall as a function of age and instructions.

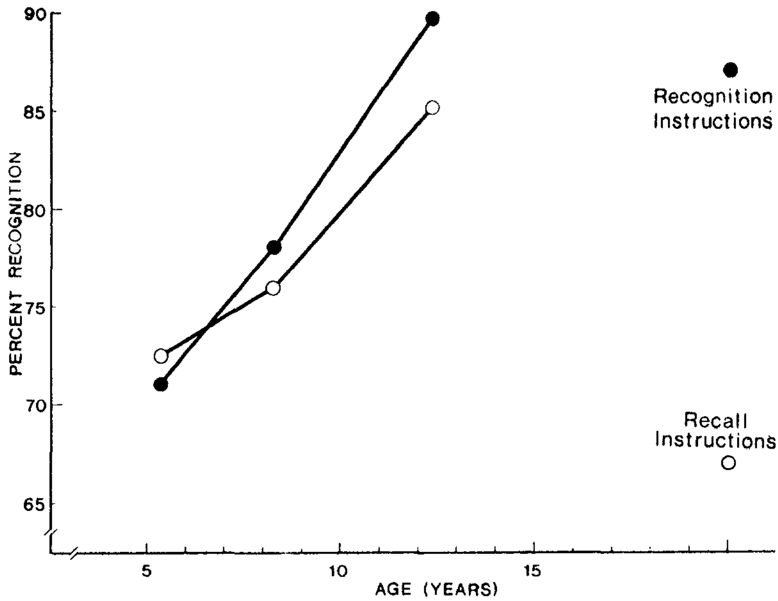

Figure 2. Percent correct recognition as a function of age and instructions.

was tested at each age-group, in spite of the failure to find an overall effect of instructions. Because college students' recognition scores are significantly improved by the recognition strategy, it was expected that only the oldest children could utilize the recognition instructions effectively. This expectation was confirmed, as the only significant comparison was at the oldest age-group, $t(40) = 2.08, p < .05$, where recognition-set subjects outperformed recall-set subjects on the recognition test.

Correlations were computed between recall and recognition scores of each subject. High positive correlations would indicate that information stored for recall of an item helped to recognize it and vice versa, that is, that the same stored information was used in performing both tasks. High negative correlations would indicate that storing information for one task was at the expense of storing information for the other. The average correlations both within and across age and instruction groups hovered very close to zero and in no case were significantly different from zero (range = $-.17$ to $+.15$). The average overall correlation was $+.027$, $t(122) = .29$. Thus, information used for recognition was different from information used for recall.

Discussion

Considerable improvements with age in both free recall and picture recognition were observed. Furthermore, children were able to alter their encoding of the same pictorial stimuli in accord with the memory task for which they were prepared. The free-recall strategy was effective at a much earlier age than was the picture recognition strategy. Even the youngest children retrieved different stored information to perform each memory task, attested by the absence of significant relations between recall and recognition of the same items within subjects.

There was steady improvement in recall from kindergarten throughout the elementary school years. Preparation in the strategy of organizing items according to interrelations and associations improved free-recall performance at all ages tested and led to significantly greater improvement as the children grow older. Older children performed better spontaneously in a free-recall task and were better able to use the effective strategy for free recall.

Picture recognition performance improved with age, but that improvement started at a later age—between 8 and 12 years—than did recall improvement.

Moreover, the strategy of paying attention to visual detail was successfully used only by the oldest group of subjects tested, 12-year-olds. Comparison with adults (Tversky, 1973b) indicates that the recognition strategy is even better utilized at ages beyond those tested here. The age trend for recognition is in contrast to the many failures to observe effects of age on picture recognition and suggests that the earlier observations were based on recognition tasks that were too easy or that could be passed by simple verbal labels or codes. This, together with the superior picture recognition of older children supplied with a strategy, should dispel the notions that picture recognition does not develop or is not sensitive to strategies.

It is possible that children in both conditions produced their own encoding strategies appropriate to the expected memory tasks and that these strategies differed from those suggested to them. Regardless of the exact strategies employed, children were able to encode the same stimuli in anticipation of recall differently from when they encoded in anticipation of recognition, and recall encoding was effective at an earlier age than recognition encoding. The finding that a strategy based on verbal encoding or symbolic representation is effective at an earlier age than a strategy based on pictorial encoding or iconic representation casts doubt on theories proposing that children pass through a stage of iconic representation prior to a stage of symbolic representation. Different skills underlie effective performance on different memory tasks and develop at different ages.

REFERENCES

Anderson, J. R. FRAN: A simulation model of free recall. In G. H. Bower (Ed.), *The psychology of learning and motivation* (Vol. 5). New York: Academic Press, 1972.

Brown, A. Judgments of recency for long sequences of pictures: The absence of a developmental trend. *Journal of Experimental Child Psychology*, 1973, *15*, 473–480.

Flavell, J. H. Developmental studies of mediated memory. In H. W. Reese and L. P. Lipsitt (Eds.), *Advances in child development and behavior* (Vol. 5). New York: Academic Press, 1970.

Frost, N. Encoding and retrieval in visual memory tasks. *Journal of Experimental Psychology*, 1972, *95*, 317–326.

Hagen, J. W., Jongeward, R. H., & Kail, R. V., Jr. Cognitive perspectives on the development of memory. In H. Reese (Ed.), *Advances in child development and behavior* (Vol. 10). New York: Academic Press, 1975.

Jablonski, E. Free recall in children. *Psychological Bulletin*, 1974, *81*, 522–539.

Kintsch, W. Models for free recall and recognition. In D. A. Norman (Ed.), *Models of human memory*. New York: Academic Press, 1970.

Nelson, K. E. Memory development in children: Evidence from nonverbal tasks. *Psychonomic Science*, 1971, *25*, 346–348.

Paivio, A. *Imagery and verbal processes*. New York: Holt, Rinehart & Winston, 1971.

Paivio, A., & Csapo, K. Concrete-image and verbal memory codes. *Journal of Experimental Psychology*, 1969, *80*, 279–285.

Rohwer, W. D., Jr. Images and pictures in children's learning: Research results and instructional implications. *Psychological Bulletin*, 1970, *73*, 393–403.

Tulving, E. Theoretical issues in free recall. In T. R. Dixon & D. L. Horton (Eds.), *Verbal behavior and general behavior theory*. Englewood Cliffs, N.J.: Prentice-Hall, 1968.

Tversky, B. Pictorial and verbal encoding in preschool children. *Developmental Psychology*, 1973, *8*, 149–153. (a)

Tversky, B. Encoding processes in recognition and recall. *Cognitive Psychology*, 1973, *5*, 275–287. (b)

Tversky, B. Eye fixations in prediction of recognition and recall. *Memory & Cognition*, 1974, *2*, 275–278.

Winer, B. J. *Statistical principles in experimental design*. New York: McGraw-Hill, 1962.

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