Memory-Strategy Learning and Maintenance in Preschool Children

Garrett Lange and Sarah H. Pierce
Human Development and Family Studies
University of North Carolina at Greensboro

This study examined preschool children's abilities to maintain the use of a newly learned organizational study-recall strategy in tasks administered immediately after training and 3 and 7 days after training. Thirty-six 4- and 5-year-olds were assigned to training and control conditions after performing study-recall tasks in a baseline session. Training included demonstration and practice in using the strategy, encouragement to apply the strategy in new tasks, a rationale for strategy use, feedback about strategy effectiveness, and incentive for effortful performance. Subjects in training groups showed marked increases in study-sorting, group-naming, and category self-cuing activities in posttraining tasks. The majority of the training subjects were able to remember and sequentially perform at least 3 of the 4 instructed strategy activities in the immediate and 3-day posttraining sessions. Training also served to improve recall, but recall improvements were modest relative to posttraining gains in study-strategy activities.

Previous findings that children failed to apply mature rehearsal and organization strategies after using them successfully in an instructed or cued-recall condition (e.g., Bjorklund, Ornstein, & Haig, 1977; Keeney, Cannizzo, & Flavell, 1967; Lange, 1973) suggested that younger age groups of children may be unable to transfer their learning of mature mnemonic strategies and unable to benefit from strategy instruction (for reviews and discussion, see Belmont, Butterfield, & Ferrelli, 1982; Borkowski, 1983; Brown, Bransford, Ferrara, & Campione, 1983). These findings were consistent with more general theoretical views that young children are preoperational and nonstrategic and lack the logical/causal reasoning skills that enable flexible applications of knowledge and skills across tasks and stimulus domains (cf. Brown et al., 1983).

Recently, it has been argued that children's strategy-transfer failures do not reflect an inherent inability to transfer cognitive skills, but rather are due to the use of deficient instructional procedures that lack the metacognitive and motivational elements necessary to promote strategy use in younger samples, that is, what Borkowski, Carr, and Pressley (1987) have termed an instruction deficiency. This view is supported by findings that children benefit from cognitive-strategy training (e.g., Bjorklund & Harnishfeger, 1987; Rabinowitz, 1984) and that under some instructional conditions, normally achieving elementary-age school children maintain the use of mature memory strategies and metacognitive skills after training (e.g., Carr, Kurtz, Schneider, Turner, & Borkowski, 1989; Hall & Madsen, 1978; Leal, Crays, & Moely, 1985; O'Sullivan & Pressley, 1984; Reid & Borkowski, 1985).

There is increasing evidence that even very young school-age children maintain the use of mature mnemonic strategies in new tasks when given metacognitive instruction. Investigations by Black and Rollins (1982), Paris, Newman, and McVey (1982), Rao and Moely (1989), and Ringel and Springer (1980) have shown that children as young as 7 years will use a newly learned clustering strategy with new stimulus categories when instruction provides or induces a meaningful rationale for the use of the strategy and includes feedback about the strategy's effectiveness. Moreover, Carr and Schneider (1991) have recently reported impressive training effects among kindergarten-age children who maintained the use of a newly learned study-recall clustering strategy for as long as 8 weeks after metacognitive training. In this study, the children were administered seven training sessions in which they were repeatedly shown how to sort items semantically, given a rationale for the use of the strategy, and given feedback concerning the strategy's effectiveness.

The present research was designed to extend the study of instructional effects on mnemonic-strategy learning and maintenance to preschool children, who rarely show evidence of deliberate strategy use in verbal/conceptual tasks. Using some of the stimuli and procedures of Paris et al. (1982), we instructed subjects in the present training conditions to learn and apply a mature organizational study-recall strategy in pictorial free-recall tasks. Training included verbal instruction, modeling, and practice in the use of taxonomic grouping at study group naming at study, naming items of study groups, and category self-cuing at retrieval.

Although it is reasonable to assume that younger children require a more embellished training procedure than the procedures that have been used with school-age samples in the previously cited research, there are no available data bearing on optimal training procedures for this age group. The few previous investigations of strategy training with preschool children (Hall...
& Madsen, 1978; Whittaker, 1988) failed to find maintenance effects. In Hall and Madsen's (1978) experiment, maintenance failures occurred after subjects received 26 sessions of instruction and practice in searching for conceptual relationships and using category labels as retrieval cues.

Schneider and Pressley (1989) summarized a large literature about potentially effective instructional strategies to use with children. Some recommendations focus on general characteristics of good instruction—namely, that it be direct, detailed, and explicit and that it allow for sufficient practice and a gradual shifting of responsibility and control from instructor to learner. Other recommendations focus on substantive components, suggesting that training include (a) instruction, demonstration, and practice in applying the strategy in new tasks (e.g., Borkowski et al., 1987; Brown et al., 1983; Moely & Jeffrey, 1974; O'Sullivan & Pressley, 1984; Waters & Andreassen, 1983); (b) encouragement to try to apply strategy learning to new settings (e.g., Campione, 1987); (c) a meaningful rationale for why and how the strategy serves to improve recall (e.g., Black & Rollins, 1982; Melot & Corroyer, 1987; Paris et al., 1982; Rao & Moely, 1989); and (d) explanation and demonstration that performance gains are due to strategy use and that effort is the cause of success (Borkowski et al., 1987; Paris et al., 1982; Reid & Borkowski, 1985; Ringel & Springer, 1980).

The present training procedure included each of these components. In contrast to the multiple training sessions used by Carr and Schneider (1991) and Paris et al. (1982), a single training session was used in the present study. Training was administered to two groups of 4- and 5-year-old children 3 days after performing study–recall tasks in a baseline session. At the time of test, one training group received a general reminder to think back to their earlier training experiences just prior to the start of each test task. The other training group performed the test tasks without reminders. The test tasks, requiring subjects to study and recall new sets of stimuli and categories, were administered immediately after training and 3 and 7 days after training. A no-training control group performed the same number of study–recall tasks without strategy instruction. Our purpose was threefold: (a) to determine whether children of preschool age could benefit from these conditions of instruction in learning to apply mature memory strategies to new tasks, (b) to determine which and how many of the newly learned strategy components the children could coordinate when applying the strategy, and (c) to examine the relative contributions of study-strategy activity and retrieval-organization activity to recall proficiency.

Method

Subjects

The subjects were 36 four- and five-year-old children (21 boys, 15 girls) ranging in chronological age from 50 to 69 months (mean age = 58.69 months). The children were drawn from an all-day child-care program located on a university campus in a moderate-sized southeastern city. All of the children were native speakers of English and were judged by teachers to be of average to above-average intellectual maturity. The children's families were predominantly middle income, and most of the children were White.

Tasks and Design

Equal numbers of subjects were assigned at random to a control condition, a training-only condition, and a training-and-remind condition. Training subjects received strategy instruction between the baseline and the test tasks. Subjects in the training-and-remind condition were, in addition, asked to think about their earlier strategy training experiences before performing each test task. Control subjects performed the same number of study–recall tasks with the experimenter but received no strategy instruction.

All subjects performed 10 study–recall tasks in four sessions over a 10-day period. Session 1 consisted of 2 study–recall tasks administered with standard instructions to establish baseline performance levels for all subjects. Session 2 was administered 3 days later and consisted of 4 study–recall tasks. For subjects in the training conditions, the first 2 tasks were used for training; the last 2 tasks were used to assess strategy maintenance performance immediately after training. Control subjects were administered 4 standard study–recall tasks with different stimuli during Session 2. In each of Sessions 3 and 4, administered 3 and 7 days after training, respectively, all subjects performed 2 standard study–recall tasks. Therefore, the basic design of the study was a two-factor analysis of variance design with training condition (3) as a between-subjects variable and session (4) as a within-subjects variable.

Stimuli

Nine 12-item sets of pictured objects and animals (108 different items) were arranged from the stimuli used by Paris et al. (1982). Each set contained four exemplars of each of three categories. Although some picture sets included categories similar to those of other sets (e.g., breakfast foods, dinner foods; farm animals, wild animals), none of the picture sets contained more than one variation of a category, and there was no overlap in the items appearing in the different sets. All same-category items were judged to be moderately or highly typical of categories, but most were not strongly associated with one another. The sets were arranged in 12 random orders with the constraint that training-task stimuli were the same for all subjects. One child in each instructional condition received each order.

Procedure

Subjects were tested individually while sitting next to a female experimenter at a table in a quiet testing room at an on-campus research center. Following some conversation with the child about the experimenter's interest in how young children go about remembering things, the experimenter administered the first two study–recall tasks. The children were told that they would be working on a remembering task and that after having an opportunity to look at some pictures with the intent to remember them, the pictures would be taken away and they would be asked to name as many of the items as possible. The children were further told that they could move the pictures around on the table or do anything they wished with the pictures to help themselves remember them, and that if they tried hard to remember the pictures they would receive a sticker at the end of the session. Picture sets were presented in a randomly arranged circular array, with no two items from the same category adjacent to one another. Prior to the study period, subjects named each item to ensure that they knew the picture names. The study period lasted 90 s, during which the experimenter recorded selected study behaviors occurring within 15-s intervals. Following the study period the stimuli were removed from the table. The child was administered a brief color-naming task and then asked to recall from memory as many of the picture names as possible. The recall period lasted a maximum of 60 s. After a 15-s period of continuous silence, the experimenter asked if the child could remember any
more objects. The experimenter recorded the order of recalled items. Following recall, the child was thanked for working hard on the tasks and given a sticker for effort. This procedure was used for the administration of all subsequent study-recall tasks.

The training tasks of Session 2 were administered as follows. The children were told that they would be working on more remembering tasks but that this time they would learn a "group-and-name trick" to help them remember more items. Training began with stimuli that the child had seen several days earlier in the second baseline task of Session 1. The experimenter placed the stimuli on the table and demonstrated to the child how to (a) make groups of similar items, (b) give names to the groups, (c) name items within each group, and (d) name the groups at the time of recall before attempting to recall the items from the group. The experimenter then provided a rationale for the use of the group-and-name trick. She explained that it is easier to remember a small number of pictures that go together in a group than many things that do not go together and are not in a group.

The experimenter then displayed a new set of training pictures and asked the child to try to perform the strategy with the new pictures. The experimenter provided coaching and assistance as subjects attempted to sequence the strategy activities and again explained the rationale for the use of the strategy. At this time, the experimenter informed the subject that the trick could be used with different kinds of pictures and that the child should look for new opportunities to use the trick. Training with this second set of training stimuli included a recall trial, after which the experimenter pointed out to the child that the strategy served to improve recall over that achieved in the baseline tasks. After emphasizing the effectiveness of the strategy and praising the child for effective use of the strategy, a new set of stimuli was presented for use in the first of two immediate test tasks.

For children in the control and training-only conditions, the procedures and instructions were identical for the study-recall tasks in the immediate and delayed test sessions were identical to those used for the baseline tasks. In these sessions, the experimenter made no mention of the child's previous experiences in the training session and responded neutrally to children's questions about the use of the strategy by restating the standard study-recall task instructions. The children in the training-and-remind condition also received standard study-recall instructions in these sessions; however, before each test session, these children were prompted to remember the strategy they learned at training.

Results

The results of the present study are summarized in five parts. In the first three sections, we describe the children's responsiveness to training and the effects of training on strategy use and recall performance in the test tasks. For these sections, the results of least-squares analyses of variance and covariance with repeated measures are reported to assess differences between subjects' pre- and posttraining performance. Preliminary one-way analyses of variance established that there were no reliable differences between the baseline performance of the training and control groups on any of the study-period and recall-period measures examined in these sections. Because repeated measures of the variables examined here are sometimes subject to violations of homogeneity of variance, the reported F ratios and dfS are based on calculations using Greenhouse and Geisser's (1959) conservative corrections of the lower bounds of variance estimates. In the last two sections, we present data bearing on the children's coordinated use of strategy components in the posttraining tasks and on relationships between study-strategy use, retrieval organization, and recall performance.

Children's Responsiveness to Training

Training was administered at the start of Session 2 and lasted approximately 30 min. Although coaching and assistance were offered in the training tasks, all children acquired the ability to self-perform most or all of the prescribed components of the study strategy. Therefore, no analyses were performed on study-strategy use during the training tasks. One indication of the children's responsiveness to training is found in their recall scores for training-task stimuli. A Training Condition (3) x Sex (2) x Session (2) analysis of variance of the combined numbers of items recalled by children at baseline and in the second training task (for control subjects, the second sort-recall task administered in Session 2) yielded significant effects for training condition, F(2, 30) = 25.01, p < .001, session, F(1, 30) = 214.99, p < .001, and the Training Condition x Session interaction, F(2, 30) = 64.36, p < .001. Least significant difference tests performed to examine mean differences contributing to the interaction effect showed significant baseline-to-training-task gains in recall (p < .001) for both training groups but no gain (p > .05) for the control group. Between-group comparisons of difference scores from baseline to the training task indicated greater recall change for the training groups: control versus training only, t(22) = 8.81, p < .001; control versus training-and-remind, t(22) = 9.15, p < .001. The change rates of the training-only and training-and-remind groups did not differ, t(22) = 1.25, p > .05.

Training Effects on the Maintenance of Study Behaviors

On each baseline and test task, subjects studied the pictures for 90 s. During this time, the experimenter recorded the occurrence of each of five measures of study behavior. The behaviors recorded were (a) physical sorting (arranging two or more pictures into discrete spatial groups), (b) group naming at study (verbalizing a name for one or more groups), (c) item naming at study (naming one or more pictured objects at least once), (d) looking-only behavior (visually attending to one or more pictures without engaging in other recorded study behaviors), and (e) off-task behavior (inattention to the task). Coding of study activities proceeded at 15-s intervals for the entire 90-s study period, resulting in maximum and minimum interval-frequency scores of 6 and 0 for each study activity. When physical sorting, group naming, or item naming occurred within an interval, each measure was recorded. Previous attempts to code these study behaviors have been shown to be highly reliable, exceeding 90% interrater agreement (cf. Lange, MacKinnon, & Nida, 1989; Wellman, Ritter, & Flavell, 1975). At the end of the study period, the experimenter recorded the numbers of pictures that were sorted into taxonomic groups. At the time of recall, the experimenter noted whether the subject had verbalized group names to self-cue recall.

Figure 1 shows means for the interval-frequency measure and the number-of-items-grouped measure of physical sorting activity. Figure 2 shows the interval-frequency measures of group naming and item naming at study. The mean for each measure represents an average for the two tasks administered in each session. The means shown for Session 1 represent subjects' combined baseline task performance before training. The means
Figure 1. Means for the frequency and number-of-items-sorted measures of study-sorting activity in pre- and posttraining sessions.

shown for Sessions 2, 3, and 4 represent subjects' combined performance averages on the two test tasks administered immediately after training (Test-0), 3 days after training (Test-3), and 7 days after training (Test-7). Preliminary analyses indicated that there were no main or interactive effects associated with sex of subject for any of the measures reported here. Training Condition (3) × Session (3) repeated measures analyses of covariance (ANCOVAs) were performed for all recorded
Figure 2. Mean frequencies of group naming and item naming at study in pre- and posttraining sessions.

study behaviors using the combined measure of baseline performance as the covariate. As can be seen from Figure 1, the training procedure produced marked improvements in the children's study-grouping activity. Subjects in the training conditions devoted more posttraining study intervals to sorting activity, $F(2, 32) = 69.22, p < .001, \eta^2 = .81$, and study-grouped more items into appropriate taxonomic groupings in these sessions, $F(2, 32) = 69.64, p < .001, \eta^2 = .81$, than did control subjects. There was no effect for session and no significant interaction ($p > .05$) in these analyses. $T$-test comparisons of difference scores performed on both measures of study-sorting activity showed that training subjects exhibited greater change
from baseline to each of the Test-0, Test-3, and Test-7 sessions than did control subjects and that the degree of change was comparable in the two training groups.

Figure 2 shows that training was also effective in increasing group-naming but not item-naming behaviors. The Training Condition (3) × Session (3) repeated measures ANCOVA performed on study intervals in which group-naming activities occurred showed that training subjects engaged in more group-naming activities during posttraining sessions than did control subjects, $F(2, 32) = 9.06, p < .001, \eta^2 = .36$. There was no effect for session or for the Training Condition × Session interaction ($p > .05$). T-test comparisons of difference scores for the group-naming measure further showed that both training groups exhibited greater change from baseline to each of the three test sessions than did control subjects. The same ANCOVA performed on the study-interval measure of item naming failed to yield effects for training condition or for the Training Condition × Session interaction ($p > .05$). A significant main effect for session, $F(2, 66) = 10.87, p < .001, \eta^2 = .29$, in this analysis reflects the subjects' declining tendencies to name items over posttraining sessions.

Training Condition (3) × Session (3) repeated measures ANCOVAs also showed that training subjects engaged in fewer looking-only behaviors, $F(2, 32) = 29.38, p < .001, \eta^2 = .65$, and fewer off-task behaviors, $F(2, 32) = 4.94, p < .05, \eta^2 = .24$, than did control subjects in all posttraining sessions. There were no effects for session or for the Training Condition × Session interaction in these analyses.

Training Effects on Performance During the Recall Periods

Throughout training we emphasized that remembering could be improved by recalling same-category items together and that saying the names of categories during the recall period would help the child recall more items. Category self-cuing was recorded by the experimenter if the subject named one or more categories before attempting to recall items. Only 1 training subject self-cued recall in the baseline session, whereas 14, 13, and 10 training subjects self-cued recall in one or both tasks in the Test-0, Test-3, and Test-7 sessions, respectively. Chi-square analyses performed on these frequencies showed that training-group subjects were more likely than control subjects to self-cue recall at Test-0, $\chi^2(1, N = 36) = 9.13, p < .01$, and at Test-3, $\chi^2(1, N = 36) = 13.71, p < .001$, but not at Test-7.

The children's mean recall scores (numbers of items recalled) and mean recall organization scores (adjusted ratio of clustering [ARC]) are shown in Figure 3. A Training Condition (3) × Session (3) repeated measures ANCOVA performed on the recall scores showed better recall for subjects in the training groups than for control subjects, $F(2, 32) = 11.38, p < .001, \eta^2 = .42$. There was no effect for session and no interaction in this analysis. Difference-score comparisons of pre- and posttraining performance showed that training-and-remind subjects achieved greater recall improvements than control subjects in all test sessions and that training-only subjects had greater improvements in the Test-3 and Test-7 sessions, but not at Test-0.

The repeated measures ANCOVA performed on subjects' ARC clustering scores also yielded a significant effect for training condition, $F(2, 32) = 4.97, p < .05, \eta^2 = .24$, and no effect for session or for the interaction. However, because of unexpected improvements in ARC clustering scores over sessions by the control subjects, the difference-score comparisons failed to show greater pre- to posttraining improvements among training subjects than among control subjects. A closer inspection of these data revealed differences in the characteristics of clustering improvements among the training and control children. Whereas the control children showed a preponderance of two-item clusters relative to three-item and four-item clusters, both at baseline (84%) and after training (71%), training children showed marked declines in the percentage of two-item clusters over sessions (78% at baseline; 41% on posttraining tasks) and marked increases in three- and four-item clusters. Given that picture sets were systematically counterbalanced across sessions, it is unlikely that the improvements of control subjects were due to the qualities of the materials. Rather, it appears that the control children developed greater propensities to pair related items at retrieval as a result of their repeated exposures to the categorized items in these tasks.

Coordinated Use of Strategy Components in Posttraining Tasks

In order to evaluate the children's abilities to coordinate the use of different strategy components (item naming, group naming, study grouping, self-cuing at retrieval) in the posttraining tasks, we examined patterns of strategy-component usage among individual children. The predominant study activity used by control subjects, and by training subjects in each of the baseline tasks, was item naming. After training, approximately half of the training subjects used three or four components per task in the Test-0 and Test-3 sessions, and one third of the children used three or four components in each of the Test-7 tasks. An inspection of these data further showed that two thirds or more of training subjects combined the use of study sorting with at least one other instructed activity in each posttraining task, and although fewer subjects continued to name groups at study and self-cue retrieval 7 days after training, more than 80% of training subjects continued to study their materials taxonomically in each of the final two tasks of the Test-7 session.

Relationships Among Strategy Activities and Recall Performance

To examine relationships among strategy activities used and recall performance for training subjects, we performed correlational analyses among the interval-frequency measures of study behavior and the recall-period measures of category self-cuing, ARC clustering, and item recall. All measures entered into these analyses were averaged results of the two tasks of each session. As shown in Table 1, significant relationships were more frequent after training, and off-task behaviors were unrelated or inversely related to all other measures in all sessions. Although naming items at study was unrelated and in some cases inversely related to the other measures, subjects who engaged in more frequent group-naming activity at study were also more likely to self-cue their recall in all posttraining ses-
sions and to have higher ARC recall clustering scores in all but the final session, where group naming was less frequent. The only instructed strategy activity that bore a positive relationship to the amount and organization of recall in all posttraining sessions was study sorting.

To examine the relative contributions of strategic study and retrieval activities to recall among the present subjects, we performed forward stepwise regression analyses separately for the training subjects' recall performance in each of the three posttraining sessions. Each equation included two forced-entry variables (averaged baseline recall scores were entered first to control for pretraining recall differences; averaged ARC clustering

Figure 3. Mean item recall scores and adjusted ratio of clustering (ARC) scores in pre- and posttraining sessions.
Table 1
Relationships Among Study-Strategy Activities and Recall Performance for Training Groups

<table>
<thead>
<tr>
<th>Measures</th>
<th>NI</th>
<th>NG</th>
<th>SO</th>
<th>RC</th>
<th>ARC</th>
<th>Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off-task behavior</td>
<td>-.24</td>
<td>.00</td>
<td>-.22</td>
<td>-.24</td>
<td>-.21</td>
<td>-.01</td>
</tr>
<tr>
<td>Name items (NI)</td>
<td></td>
<td>.00</td>
<td>-.04</td>
<td>-.20</td>
<td>.02</td>
<td>.32</td>
</tr>
<tr>
<td>Name groups (NG)</td>
<td></td>
<td></td>
<td>.00</td>
<td></td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>Sorting (SO)</td>
<td></td>
<td></td>
<td></td>
<td>.79**</td>
<td>-1.18</td>
<td>.07</td>
</tr>
<tr>
<td>Retrieval cuing (RC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-10</td>
<td>.19</td>
</tr>
<tr>
<td>ARC score (ARC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.06</td>
</tr>
<tr>
<td><strong>Test-0</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off-task behavior</td>
<td>.19</td>
<td>-.30</td>
<td>-.55**</td>
<td>-.28</td>
<td>-.54**</td>
<td>-59**</td>
</tr>
<tr>
<td>Name items</td>
<td></td>
<td>-.59**</td>
<td>-.60**</td>
<td>-.52**</td>
<td>-.46**</td>
<td>.09</td>
</tr>
<tr>
<td>Name groups</td>
<td></td>
<td></td>
<td>.54**</td>
<td>.65**</td>
<td>.34**</td>
<td>.24</td>
</tr>
<tr>
<td>Sorting</td>
<td></td>
<td></td>
<td></td>
<td>.38*</td>
<td>.48**</td>
<td>.50**</td>
</tr>
<tr>
<td>Retrieval cuing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.35*</td>
<td>.04</td>
</tr>
<tr>
<td>ARC score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.32</td>
</tr>
<tr>
<td><strong>Test-3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off-task behavior</td>
<td>-.25</td>
<td>-.33</td>
<td>-.46**</td>
<td>-.27</td>
<td>-.42*</td>
<td>-.46**</td>
</tr>
<tr>
<td>Name items</td>
<td></td>
<td>.26</td>
<td>.06</td>
<td>.11</td>
<td>.08</td>
<td>.33</td>
</tr>
<tr>
<td>Name groups</td>
<td></td>
<td></td>
<td>.27</td>
<td></td>
<td>.45*</td>
<td>.48**</td>
</tr>
<tr>
<td>Sorting</td>
<td></td>
<td></td>
<td></td>
<td>.37*</td>
<td>.65**</td>
<td>.39*</td>
</tr>
<tr>
<td>Retrieval cuing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.64**</td>
<td>.51**</td>
</tr>
<tr>
<td>ARC score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.61**</td>
</tr>
<tr>
<td><strong>Test-7</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off-task behavior</td>
<td>-.06</td>
<td>-.22</td>
<td>-.62**</td>
<td>-.05</td>
<td>-.26</td>
<td>-.32</td>
</tr>
<tr>
<td>Name items</td>
<td></td>
<td>.13</td>
<td>-.37*</td>
<td>-.14</td>
<td>-.41*</td>
<td>-.27</td>
</tr>
<tr>
<td>Name groups</td>
<td></td>
<td></td>
<td>.06</td>
<td></td>
<td>.43*</td>
<td>.06</td>
</tr>
<tr>
<td>Sorting</td>
<td></td>
<td></td>
<td></td>
<td>.26</td>
<td>.57**</td>
<td>.50**</td>
</tr>
<tr>
<td>Retrieval cuing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.14</td>
<td>.34</td>
</tr>
<tr>
<td>ARC score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.55**</td>
</tr>
</tbody>
</table>

Note. ARC = adjusted ratio of clustering. n = 24.

* Correlation based on a single subject who self-cued recall in the baseline session.
* * p < .05. ** p < .01.

Scores achieved in each posttraining session were entered second, and one free-entry carrier variable (the averaged interval measure of study sorting). The forced entries of baseline recall and ARC scores produced multiple R's of .18, .51, and .47, for the Test-0, Test-3, and Test-7 sessions, respectively. The study-sorting measure entered the equation for the Test-0 session (improving the multiple R² to .40) but failed to enter the Test-3 and Test-7 equations.

Discussion

The results of the present study demonstrate that children as young as preschool age will maintain the use of a newly learned organizational study—recall strategy in new stimulus tasks when sufficiently motivated to perform well and when given even a brief period of metacognitive instruction about why the strategy is effective and about how, when, and where to use it. Our training subjects, most of whom failed to sort stimuli into meaningful groups before training, showed marked increases in taxonomic study-sorting and group-naming activities in all posttraining sessions and increases in category self-cuing in the immediate and 3-day test sessions. Increases in strategic study and recall activities were paralleled by decreased frequencies of looking-only and off-task behaviors. Reminding the children of their earlier training experiences before each test task had little effect on study-strategy use. Although increases in group naming at study do not appear to be as pronounced as those found for the study-sorting measures, group naming took less time to complete and could only occur in the last one or two intervals of the study period when all sorts were complete. The absence of a training effect for item-naming activity reflects the fact that most subjects were observed to name items in one or two study intervals before training and either maintained or decreased the frequency of this activity when beginning to apply the sorting and group-naming activities.

The strategy taught here was a difficult one requiring children to perform a sequenced pattern of sorting, group-naming, item-naming, and self-cuing activities before attempting to recall items. Given the limited processing capabilities of young children, and the fact that the present subjects had limited opportunities for instruction and practice, we were interested in the numbers and types of instructed activities the children would produce in combination in the posttraining tasks. Although few of the 24 training-group children produced all four
of the instructed behaviors in a single task, some did produce all behaviors, and half of the training-group children were able to remember and perform, sequentially, at least three of the instructed activities in one or both tasks at the immediate and 3-day test sessions. Declines in group naming and self-cuing in the last test session may reflect the children’s failures to remember these activities over a 7-day period. However, the declines may also be due to the children’s loss of interest in repeatedly performing the strategies and tasks.

There are indications from previous training and maintenance studies that children may learn to perform and apply a newly learned organizational strategy correctly but fail to use it effectively to enhance recall. For example, the kindergarten subjects in the Carr and Schneider (1991) study and the first-grade subjects in the Black and Rollins (1982) and Paris et al. (1982) studies improved their strategy scores over posttraining tasks but showed some declines in recall in these tasks. Moreover, Bjorklund and Harnishfeger (1987, Exp. 2) found that third-grade subjects instructed in the use of an organizational strategy in the second of two study–recall tasks used the strategy to increase recall organization (clustering) but showed no improvement in the numbers of items recalled.

Anticipating possible strategy–recall discrepancies among the present subjects, we emphasized at several points during training the means–ends relationships between effort, strategy use, and recall improvement. These procedures appear to have been effective in improving posttraining recall among most subjects. However, the recall improvements found here were modest relative to the sharp posttraining increases in strategic study-sorting and naming activities.

Several explanations have been offered to account for findings of children’s strategy–recall discrepancies after training. Bjorklund and Harnishfeger (1987) attributed their findings to the mental effort requirements of strategy use, arguing that their younger subjects had insufficient capacity left for storage. Rabinowitz (1984), when showing that children had better recall for typical than for less typical categorized materials, emphasized the importance of age differences in the content and organization of the knowledge base. He suggested that new stimulus organizations may not be accessible at recall for children when category exemplars do not sufficiently represent their related superordinates. The present results do not bear directly on the source of children’s strategy–recall discrepancies. Nevertheless, they support previous claims that young children’s recall difficulties stem largely from deficient retrieval operations (e.g., Emmerick & Ackerman, 1978; Morrison & Lord, 1982) and that with limited instruction and practice young children may not be as able as older children and adults to take advantage of newly learned organizational memory skills to improve recall (e.g., Rabinowitz, 1984).

Black and Rollins (1982) and Paris et al. (1982) argued that relationships between children’s study-strategy activities and recall scores are mediated by recall organization. In these studies of 7-year-olds, strategic activities at study did not bear a direct relationship to amount recalled, but rather were related to higher recall organization scores, which independently predicted recall. Alternatively, Lange, Gutten tag, and Nida (1990) and Sodian, Schneider, and Perlmutter (1986) showed that for 4- and 5-year-old children, study organization bore direct relationships to recall independent of retrieval organization. The results of the present regression analyses suggest that the relative contributions of study sorting and retrieval clustering to recall may change as the child becomes more experienced in performing and coordinating strategic study and retrieval activities. In the immediate test session of the present study, ARC clustering scores added little to the amount of recall-score variance accounted for by pretraining levels of recall, but study-sorting activity added substantially to the prediction equation.

However, in each of the two delayed test sessions, administered 3 and 7 days after training, clustering scores added substantially to the variance attributable to pretraining recall scores, and the study-sorting measure failed to account for additional variance independently of recall clustering. These findings suggest the possibility that during very early stages of children’s deliberate attempts to coordinate strategic study and retrieval organization activities, retrieval organization may be ineffective for enhancing recall. Rather, the attentional and semantic-processing demands of study-sorting activity may serve to enhance item retrieval independent of retrieval organization.

The primary purpose of this investigation was to document young children’s abilities to learn and maintain the use of newly learned study–recall strategies in new tasks. The strategy maintenance effects shown here were produced with a highly embellished instructional procedure and were observed to occur in tasks similar to those performed at training. Additional study is needed to identify (a) those instructional components most and least essential for maintenance and strategy–recall relations, (b) task parameters that produce better and poorer maintenance effects, and (c) strategy components that enhance and inhibit recall proficiency.

References


Received October 9, 1990
Revision received October 9, 1991
Accepted October 15, 1991