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The efforts of 69 elementary school teachers to instruct children in cognitive processing activities were observed. Although the teaching of such activities was relatively infrequent, it varied by grade (occurring more often in grades 2-3 than in higher or lower grades) and by the content of instruction. Teachers of grade 4 and above more often provided rationales for the use of cognitive strategies than did teachers of younger children. In a second study, children of three achievement levels were selected from classrooms in which teachers varied in their use of suggestions regarding cognitive processes. Subsequent to training in the use of a memory strategy, children's performance on a maintenance trial was evaluated: Among average and low achievers, those whose teachers were relatively high in strategy suggestions showed better maintenance and more deliberate use of the trained strategy than did children whose teachers rarely made strategy suggestions. The role of school experience in the development of children's memory skills is discussed.

Over the elementary school years, children become increasingly adept at planning and executing appropriate memory strategies and also become more aware of their own memory processes. We know little about factors in the child's environment that contribute to these developmental changes, although there are suggestions from cross-cultural research that exposure to formal schooling plays an important role (Schneider & Pressley, 1989; Wagner, 1978). Investigation of how memory activity is encouraged in the classroom may allow us to explicate the role of the school, thereby increasing our understanding of the processes underlying developmental changes in memory knowledge and skill.

Of major interest in the present research were the questions of how and when teachers encourage children's cognitive activity and how such instruction is related to children's skill acquisition. There is an extensive literature demonstrating developmental change in the ways that children approach memory tasks (Brown, Bransford, Ferrara, & Campione, 1983; Kail & Hagen, 1977; Moely, 1977) and differential effects of training on strategy maintenance and generalization as a function of the child's developmental level (Brown, Campione, & Barclay, 1979; Hagen & Stanovich, 1977; Moely, Olson, Halwes, & Flavell, 1969). If effective teaching takes into account such differences, we would expect to see variation over grade level in the kinds of cognitive processing activities teachers encourage and perhaps also in the procedures used to encourage strategy maintenance and generalization. Further, we might expect that exposure to a teacher

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who provides instruction in information-processing activities would lead children to be more effective in their learning. The two studies presented below evaluate these expectations, first investigating the ways in which teachers encourage cognitive processing activities in classroom learning, and, second, investigating the relation between teachers' emphasis on cognitive processing and children's memory skills.

Experiment 1

Although some observational studies have been concerned with the teacher's influence on cognitive processes in children's learning (Dunkin & Biddle, 1974; Simon & Boyer, 1974), they have not focused on teachers' efforts to suggest or suppress strategy use in children or to provide children with rationales for strategy use. In the present research, a time-sampling scheme was developed for classroom observations and was used to identify procedures by which teachers encourage activities for cognitive processing and to determine how these efforts are related to other teaching behaviors. The observational scheme also included an event-sampling component by which information was recorded about strategy suggestions that teachers made. We used the observational procedure to investigate variations in the use of cognitive processing suggestions as a function of grade level and lesson content.

An initial problem in developing the observational scheme was to define "strategy suggestion" in a way that would be workable in the open, uncontrolled environment of the classroom. Most memory strategy work has been done in laboratory settings, where it is possible to observe strategies such as verbal rehearsal (Hagen & Stanovich, 1977), organization of items (Moely, 1977), elaborative processing (Pressley, 1982), or self-testing (Leal, Crays, & Moely, 1985). In order to identify a strategy suggestion, we considered two defining features of "strategy" that have been discussed in the literature (Flavell, 1970; Paris, 1988; Pressley, Heisel, McCormick, & Nakamura, 1982). First, the activity the teacher suggested had to be a voluntary one that children could employ in doing a task, not simply an automatic accompaniment of task involvement. Thus, circling the correct answer with a pencil was not a strategy, since that was a necessary component of task performance. On the other hand, keeping one's pencil on an item as a marker to indicate which item the class was discussing would be considered a strategy, since it is a voluntary, "extra" activity that the child could carry out to aid performance. The second aspect of the definition of a strategy was that the activity must be goal-directed, especially directed toward goals of learning, remembering information, understanding, or completing a task.

We also wanted to consider the ways in which teachers might encourage children's maintenance and generalization of strategies. We examined observational records for evidence of three teaching activities that would be expected to produce continued and generalized strategy use. The first activity involved the repetition of strategy suggestions. Repetition of training trials has been shown to be effective in producing both maintenance and transfer of a trained strategy (Borkowski, Cavanaugh, & Reichhart, 1978; Turnure & Thurlow, 1973). A second teaching activity that we considered was the provision of explicit metamemory information concerning the usefulness of the strategy (Kennedy & Miller, 1976; Rao & Moely, 1989; Ringel & Springer, 1980). Third, we examined teachers' efforts to explicitly inform the child that the strategy could be used in other learning situations or to suggest some change in or elaboration of the strategy itself. Training studies including such generalization suggestions have been successful in demonstrating strategy generalization (Belmont, Butterfield, & Borkowski, 1978; Kramer & Engle, 1981).

The aims of the first study, then, were to describe teachers' instruction of cognitive processing techniques, especially the nature of their suggestions for children's use of memory strategies; to observe ways in which teachers might promote maintenance and generalization of strategy use; and to determine whether these activities show systematic variation as a function of the grade level or the content of lessons being instructed.

Method

Subjects

Teachers from grades K through 6 were observed. For analysis, the 69 teachers were divided into three grade-level groups: early elementary (consisting of eight kindergarten and nine first-grade teachers), middle elementary (consisting of 11 second-grade and 13 third-grade teachers), and later elementary (consisting of 11 fourth-grade, 13 fifth-grade, and four sixth-grade teachers). All of the teachers were working in public schools

in the metropolitan area of a southern city. Sixty-five teachers who gave information on their backgrounds indicated that they had spent an average of 8.44 years teaching the grade at which they were observed, and they had spent an average of 14.89 years in the teaching profession. On average, 11.32 years had elapsed since these teachers last attended college classes. All teachers had college degrees, and 42% had pursued graduate training. All but three of the teachers were female; 22 (32%) were African-American, the rest white; 42% reported their age as less than 40 years (median age approximately 35 years). No differences as a function of grade level taught were identified for any of these indices.

Procedure

Observational instrument.—A classroom observation instrument was developed to provide information about how teachers structure classroom learning activities and how they monitor and direct children's study, including suggestions for memory and study strategies. The instrument contained 23 categories describing aspects of the teaching process. Observations were made using intervals of 30-sec duration: Observation was conducted during the first 20 sec of each interval, while the remaining 10-sec period was used for recording by checking off each behavioral category that had been observed in that interval. An observation session lasted for a period of 30 consecutive min. Each teacher was observed teaching language arts or math lessons on 5 different days, usually within a period of about 2 weeks, during the spring of the academic year. For each teacher, then, 300 intervals were scored (30 min × 2 observations per min × 5 days), except when scheduling difficulties limited observation time. The average number of intervals in which teachers were observed was 294 (SD = 9.0).

In preparation for data collection, pairs of observers scored videotapes of teachers and conducted pilot work in classrooms to establish a criterion of at least 75% reliability (assessed as percentage agreement for occurrences). Calculations of Cohen's kappa (Cohen, 1960) for each category indicated generally satisfactory reliabilities among pairs of observers immediately prior to data collection, with a median value of .93. Throughout the course of data collection, periodic checks on reliability were made, showing kappas ranging from .63 to 1.00, with a median value of .91.

In order to summarize the information derived from observations, a factor analysis was conducted on category scores obtained for each teacher through use of the time-sampling observational procedure. The score for any single category represented the proportion of total observation intervals in which the designated behavior was recorded. These scores were subjected to a log transformation before analysis in order to reduce skew of score distributions due to the low frequency of occurrence of some categories (Tabachnik & Fidell, 1989). Transformed data from all teachers were used in a factor analysis involving principal components extraction and varimax rotation. A four-factor description of the observational categories accounted for 49% of the variance in scores. In the descriptions below, a category was included as part of a factor if the rotated factor loading was .35 or higher.

The four factors can be characterized as follows: Factor 1 (Eigenvalue = 4.50): Teachers' Responses to Error. The behaviors loading on this factor involved the teachers quizzing children and then reacting to their responses. Categories included asking for information, providing feedback that the child had made a correct response or an error, telling the child the correct answer, giving a hint about the correct answer, or encouraging the child's further effort after an error was made.

Factor 2 (Eigenvalue = 2.82): Cognitive Processes and Strategies. This factor was of particular interest for our work, since it included the several observational categories dealing with teachers' suggestions to children about how to study. These categories and their factor loadings are shown in Appendix A. Teachers who suggested strategies for studying and remembering were also likely to offer rationales for strategy use, to provide information about appropriate cognitive processes for task performance, to warn children about the need for memory activity, and to tell children not to engage in certain study strategies. In addition, these teachers were likely to ask children to tell them about their questions or problems with learning tasks.

Factor 3 (Eigenvalue = 2.24): Positive Interactive Teaching. This factor included categories concerned with using questions and positive feedback during lessons. Questions ranged from requests for memorized information and factual material to requests for divergent thinking and for the child's

personal evaluation of some aspect of the lesson. Positive feedback involved providing information about the child's correct performance and praising the child's efforts.

The fourth factor (Eigenvalue = 1.78), Communicating Task-Related Information, involved communication of information from the teacher to the child in a rather traditional teaching fashion, whereby the teacher set the lesson in the context of previous work, stated goals or objectives, and described specific information involved in the lesson. Time spent simply monitoring children's individual work was negatively loaded on this factor, which generally seemed to reflect the extent to which the teacher provided content-specific information during lessons.

Recording strategy suggestions and rationales.—As they were using the time-sampling scheme to record behaviors included in the four factors above, observers also wrote accounts of the teachers' strategy suggestions and efforts to suppress strategy use. Observers were highly reliable in producing descriptions of strategy suggestions, showing essentially perfect agreement in recording instances of such suggestions.

These descriptions of teachers' strategy suggestions were categorized according to a scheme developed by Hart (1984), shown in Appendix B. Assignment of narratives to categories was made by four raters, who agreed on the initial classification of 86% of the items. For the remaining items, these raters reached consensus on item assignment through discussion. To assess the reliability of coding, two independent raters repeated the categorization of 307 strategy descriptions, showing 78% and 82% agreement with the original classification.

Observational records and narratives describing the strategy suggestions were examined in order to determine how often teachers engaged in various "facilitating" activities when they suggested a strategy. First, repetition of strategy suggestions was coded by counting the number of 10-sec observation intervals in which the teacher was scored as having given a particular strategy suggestion, either within or across observation periods. Scores for the number of presentations teachers made of each strategy suggestion showed a reliability correlation between raters of .95. Second, we determined whether the teacher gave a rationale for the use of each unique strategy, or offered feedback concerning the way in which the strategy might improve performance. Each teacher received a score indicating the proportion of his or her strategy suggestions that were accompanied by rationale/feedback statements. Agreement on whether or not the teacher had offered a rationale along with a given strategy suggestion was shown for 93% (% = agreements/(agreements + disagreements) × 100) of the strategy suggestions considered. Finally, narratives were examined for instances in which teachers specifically instructed children in the generalization of a strategy. Pairs of raters showed 71% agreement as to whether or not the teacher had attempted to provide instruction in the generalization of a given strategy.

Results

Teaching Behaviors Observed in the Classroom

Teachers most often engaged in rather traditional teaching activities, asking children for correct answers (seen on an average of 32.3% of the intervals in which teachers' behaviors were observed), acknowledging their correct responses (27.8%), describing procedures involved in doing a lesson (27.1%), and providing specific information concerning the lesson (26.1% of observation intervals). Teachers spent a moderate part of the time praising children (8.51%), asking children to remember previously learned information (7.2%), and monitoring study activity (8.0% of observation intervals).

In contrast, the behaviors involved in Factor 2, described (above) as efforts to teach children about the cognitive processes they could use in dealing with classroom lessons, were seen less often. On an average of 9.5% of observation intervals, teachers gave some description of the cognitive processes that children might use in completing the lesson. Means scores for particular kinds of suggestions were lower: teachers' suggestions for strategies that children might use occurred on only 2.28% of the observation intervals. Rationales for strategy use were given on less than 1% (.47%) of the intervals. Seven of the 69 teachers (10%) gave no strategy suggestions at all during the time that the observers were in their classrooms.

Grade Level and Subject Matter Differences in Instruction in Cognitive Processes

The first aim in data analysis was to determine if the frequency with which teachers suggested cognitive processing activities

(Factor 2 categories) was related to grade level taught or the content of lessons. Teachers were grouped into three grade levels and then, within these groups, were dichotomized according to the nature of instruction during the time of observations. For 29 teachers (5 at grades K–1, 10 at grades 2–3, and 14 at grades 4–6), all five observations were made during the teaching of language arts (reading, spelling, and other language-related activities). For the remaining 40 teachers, instruction during observations included mathematics or both math and language arts; these teachers were combined into a group described as having "mixed" classroom activities (12 at grades K–1, 14 at grades 2–3, and 14 at grades 4–6).

Log-transformed scores for each of the six categories involved in Factor 2 (Appendix A) were subjected to an analysis of variance involving grade (three levels) and subject matter (reading vs. mixed curriculum) as between-subjects variables and category (six levels) as a within-subjects variable. The analysis yielded a significant interaction of grade × category, $F(10,315) = 1.94$, $p = .0397$. Analyses of variance involving grade were then conducted on scores for each of the six categories. These analyses showed a significant effect of grade for the category involving teachers' use of strategy suggestions, $F(2,66) = 4.31$, $p = .0174$. Teachers of second- and third-grade classes were observed to suggest strategies more often than teachers of older children ($p = .0248$, according to a Newman-Keuls test of the means), and also tended to suggest strategies more often than teachers of younger children ($p = .0629$). The mean percentage of observation intervals in which strategies were suggested were 2.1% (SD = 2.3) for the combined kindergarten and first-grade group, 3.1% (SD = 3.4) for the second- and third-grade groups, and 1.6% (SD = 1.8) for the fourth- through sixth-grade teachers. No grade level differences were found for the other categories involved in Factor 2.

The overall analysis also showed a significant interaction of subject matter × category, $F(5,315) = 2.78$, $p = .0180$. Analyses of variance with subject matter as an independent variable were used to evaluate differences in mean scores for each category. Teachers instructing classes that included math as well as language arts made more suggestions for cognitive processes, $F(1,67) = 10.08$, $p = .0023$, and more suggestions for specific strategies that children should use, $F(1,67) = 4.03$, $p = .0487$, than did teachers who were teaching only language arts lessons during observation periods. The mean percentage of observation intervals in which cognitive processing activities were mentioned by language arts teachers was 7.31% (SD = 4.9), while teachers of mixed content classes described cognitive processing on an average of 11.10% (SD = 6.1) of observation intervals. For strategy suggestions, language arts teachers made suggestions on an average of 1.93% (SD = 3.1) of intervals, while teachers of mixed curriculum made strategy suggestions on 2.52% (SD = 2.3) of observation intervals.

The analysis of variance also yielded a main effect of subject matter, $F(1,63) = 4.36$, $p = .0408$, which is qualified by the interaction described above. An overall effect of category, $F(5,315) = 197.09$, $p < .0001$, shows that there was variation in the frequency with which behaviors involved in Factor 2 were scored. Most often observed was the teacher's mention of a procedure for cognitive processing (occurring on 9.51% [SD = 5.9] of the observation intervals, significantly [$p < .0001$] more often than any of the other categories included in Factor 2, according to Newman-Keuls tests of the means). Teachers suggested strategies that children could use in studying on 28% (SD = 2.6) of the intervals. Strategy suggestions were observed significantly ($p < .0001$) more often than the other four categories (giving a rationale for strategy use, attempting to suppress strategy use, warning that memory activity is needed, and requesting the child's questions). Each of these four categories occurred infrequently, and, in fact, was scored on less than 1% of the observation intervals.

Strategy Suggestions Made by Teachers

Of the total set of 307 events recorded by observers as teacher references to strategies, 292 were instances of strategy suggestions made by teachers and 15 were instances in which the teacher attempted to suppress the use of a strategy by a child. The mean number of strategy suggestions made by teachers at each grade level is shown in Table 1. Teachers showed wide variation in the frequency with which they made strategy suggestions, with an average of 4.23 suggestions (range: 0–16) observed for each teacher.

The occurrence of these strategy suggestions varied over grade level, as might be expected on the basis of findings for the time-sampling data. More interesting is the

TABLE 1

MEAN NUMBER (with Standard Deviations) OF EACH TYPE OF STRATEGY SUGGESTION MADE BY TEACHERS INSTRUCTING LANGUAGE ARTS OR A MIXED CURRICULUM

	SUBJECT MATTER TAUGHT		
CATEGORY	Language Arts (N = 29)	Mixed (N = 40)	All Teachers (N = 69)
Rote learning	.45 (.9)	.42 (.7)	.43 (.8)
Elaboration	.38 (1.2)	.35 (1.0)	.36 (1.1)
Deduction	.79 (1.0)	.25 (.4)	.48 (.8)
Transformation	.03 (.2)	.48 (.7)	.28 (.6)
Specific aids	.14 (.4)	1.03 (1.5)	.65 (1.2)
General aids	.38 (.7)	.22 (.5)	.29 (.6)
Imagery	.21 (.8)	.12 (.5)	.16 (.7)
Exclusion	.21 (.6)	.07 (.3)	.13 (.4)
Attention	.34 (.7)	.63 (1.1)	.51 (.9)
Attentional aids	.38 (1.2)	.30 (.7)	.33 (.9)
Self-checking	.38 (.7)	.32 (.6)	.35 (.6)
Metamemory	.24 (.5)	.25 (.5)	.25 (.5)
Total strategy suggestions	3.93 (4.0)	4.45 (3.6)	4.23 (3.7)

finding that the nature of strategy suggestions varied with subject matter taught. Scores representing the frequency of occurrence in observations of each teacher of each type of strategy suggestion were adjusted by means of a log transformation to correct for skew and subjected to an analysis of variance, including grade level (3) and subject matter (2) as between-subjects variables and type of strategy (12) as a within-subjects variable. More strategy suggestions were given at grades 2–3 than at the lower or higher grade levels, $F(2,63) = 4.34$, $p = .0172$. Newman-Keuls tests of the transformed mean scores showed that teachers of grades 2–3 suggested strategies more often than did either teachers of grades 1–2 ($p = .0047$) or teachers of grades 4–6 ($p = .0005$), while the latter two groups did not differ from each other. The mean frequency of occurrence of all strategy suggestions combined was 5.83 (SD = 4.2) for teachers of grades 2–3, 4.00 (SD = 3.8) for teachers of grades K–1, and 3.00 (SD = 2.8) for teachers of grades 4–6. This grade level difference is consistent with that shown earlier.

Use of particular kinds of strategy suggestion varied as a function of whether the teacher was teaching language arts or a mixed curriculum including math, as shown by an interaction of subject matter by category, $F(11,693) = 3.94$, $p < .0001$. As indicated in Table 1, different patterns of strategy suggestions occurred for the two groups of teachers: Teachers instructing language arts suggested deduction strategies most often, significantly more often than they suggested exclusion ($p = .0369$), imagery ($p = .0151$), or specific aids for problem solving ($p = .0122$). On the other hand, teachers instructing mixed subject matter (including math) most often suggested the use of specific aids. Use of such aids was suggested

more often by these teachers than were other strategies, including rote learning activities ($p = .0280$), elaboration ($p = .0074$), attentional aids ($p = .0080$), deduction ($p = .0083$), exclusion ($p = .0008$), imagery ($p = .0008$), general aids ($p = .0042$), self-checking ($p = .0170$), or metacognitive suggestions ($p = .0068$). In comparisons of strategy suggestions made by the two groups, the teachers instructing language arts suggested the use of specific aids much less often than did teachers who instructed a mixed curriculum that included math ($p = .0008$). The analysis also showed a significant main effect of category, $F(11,693) = 2.55$, $p = .0036$.

Only a few efforts by teachers to suppress children's strategy use were observed. Such attempts most often (in 10 of the 15 cases observed) involved suggestions to stop using or to avoid the use of specific aids, especially the use of fingers as counters for math activities.

Teaching Activities Accompanying Strategy Suggestions

We examined several teaching activities that might be used to promote children's maintenance and generalization of strategy use. First, the teachers' repetition of strategy suggestions either within or across observation periods was examined. The number of times that suggestions were made ranged from 1 to 17. The highest score among teachers at the lower grade level was shown by a first-grade teacher who gave, over three observation sessions, 13 repetitions of a strategy suggestion that involved use of a "number ladder" to solve simple addition problems. At second grade, a teacher instructing techniques for learning spelling words recommended the simple rote strategy of spelling the word aloud during 12 observation intervals. At fifth grade, a teacher suggested ways to use Cuisenaire rods for solving problems involving proportional relations on 17 intervals during a single observation session. However, these examples are not typical, since, overall, teachers averaged only 1.81 presentations of each strategy suggestion. Another way of representing this information is to note that of the total set of unique strategy suggestions made by teachers, only 44% were observed to occur more than a single time within or across observation periods. No grade level or subject matter differences were seen in this teaching activity.

Another way to promote maintenance and generalization of a strategy is to accompany the strategy suggestion with a statement providing a rationale for strategy use. For each of the 62 teachers who suggested strategies, a score was derived representing the proportion of all instances of strategy suggestion accompanied by rationale/feedback statements. These proportion scores were subjected to a log transformation to reduce skew. An analysis of variance including grade level and subject matter as variables was performed on the transformed scores. There was an increase over grade level in the teachers' use of rationale/feedback statements, $F(2,56) = 3.74$, $p = .0298$. Follow-up tests of the means indicated that teachers of the highest grade level (fourth grade and above) where higher in the use of rationale/feedback statements than teachers of grades K–1 ($p = .0039$). Teachers of grades 2–3 did not differ from either of the other groups. At the kindergarten/first-grade level, about 21% of all strategy suggestions were accompanied by a rationale or feedback statement; this increased only to 30% at the second/third-grade level, while at grade 4 and above, nearly half (48%) of all strategy suggestions included some statement concerning the value or usefulness of the strategy for more effective learning, remembering, or problem solving. Use of rationales did not vary with subject matter.

It was disappointing to find that there were only 19 instances in the entire data set in which teachers were judged to be instructing pupils in the generalization of a strategy. In most cases, these involved pairs of strategy suggestions in which the teacher indicated two situations in which a strategy could be used (e.g., a rote memory procedure of writing spelling words or multiplication facts repeatedly as a way to learn them, using textbook illustrations in two different lessons in order to help understand math problems, etc.). There were also a few instances in which teachers suggested variations on a strategy, such as describing different ways of writing words as a way to remember them (writing "in the air" or on paper) or varying the procedures used in applying a self-checking strategy. Approximately 23% of the teachers made one or more generalization suggestions; these teachers were quite evenly distributed across grade levels.

Discussion

In this study, we attempted to learn how teachers encourage study and memory strategy use in the elementary school classroom.

A teacher can be active in the classroom without necessarily being concerned with providing information about how to process information effectively, as demonstrated by the factor analysis, in which items concerned with cognitive processes and strategies were independent of these for other teaching activities. We found through our observations that teachers spent relatively little instruction time dealing with cognitive processes. Less than 15% of the observation intervals were scored for combinations of the behaviors included in Factor 2, and less than 2.5% of the intervals specifically involved the teachers' discussion of some strategic activity the child might use to deal with learning situations. Nearly 10% of the teachers made no strategy suggestions at all during the times they were observed.

However, we also observed considerable variation among teachers in the use of cognitive processing suggestions. What variables influenced the teacher's tendency to offer suggestions about cognitive processes and strategic ways of dealing with classroom tasks? We found that the teacher's emphasis on cognitive processes varied with the grade level of his or her class and also with the particular subject matter of lessons. With regard to grade level differences, it was shown for both the time-sampling data and in the written records of strategy-suggestion events that teachers of grades 2–3 made more strategy suggestions than did teachers of either lower or higher levels. This accords well with findings in the literature regarding memory development and the training of memory strategies, in that children of grades 2–3 are unlikely to generate effective strategies in all but very simple learning situations and are relatively unsophisticated in their views of memory processes, but are also very amenable to training in memory strategy use (see Brown et al., 1983).

Examination of the nature of teaching activities occurring in conjunction with strategy suggestions revealed a second change over grade level that shows a congruence with the literature. Teachers of older children were more likely than teachers of younger children to accompany a strategy suggestion with an explicitly stated rationale for its use. The teacher might indicate that the strategy would aid memory or that it might help the child deal effectively with a difficult task. This grade difference seems to reflect sensitivity on the part of teachers to the developing metacognitive ability of students. Research on memory-metamemory connections often reveals a stronger relation between these two domains at the higher elementary levels (Borkowski, Peck, Reid, & Kurtz, 1983; Schneider, 1985; Schneider & Pressley, 1989).Therefore, research provides some justification for teachers' greater provision of metacognitive information for children at higher developmental levels, where its effectiveness is more apparent.

Another variable affecting teachers' suggestions for study was the subject matter of the lesson on which the teacher and child were working. More suggestions for cognitive processing and strategy use were made by teachers observed in lessons that involved mathematics activity as well as language arts than for those concerned only with language arts instruction. In teaching mathematics, teachers may suggest strategies as they help children think through the processes involved in conceptualizing a problem, and also as they help children carry out the step-by-step procedures involved in mathematical performance. Santulli, Moely, and Kogut (1991) reported high use of strategy suggestions by teachers engaged with their students in math problem-solving activities.

The nature of teachers' suggestions also varied with subject matter. Mathematics instruction often involved the use of specific aid strategies, a useful teachnique to help the child understand a mathematical procedure. Language arts teachers often suggested deduction strategies by which children could derive meaning from text by using cues from the material (either from illustrations, the content of the text, or from the word or grapheme environment in which the unknown unit was embedded) to make sense of the material being read. Similar strategies for reading comprehension have been described by Cunningham, Moore, Cunningham, and Moore (1983), who discuss the need for attending to important information in reading and using the content to infer information that is necessary for understanding.

With regard to instructional activities, we did find some repetition of strategy suggestions among teachers of all grade levels. However, of the three teaching procedures that were considered as ways of promoting strategy maintenance and generalization, repetition is the least certain to provide necessary tools to the child for subsequent strategy maintenance and generalization. Although several studies show beneficial ef-

fects of extended training, other studies (e.g., Gruenenfelder & Borkowski, 1975; Wanschura & Borkowski, 1975) do not. The infrequent provision of rationales for strategy use to the younger children is disappointing, in that such explicit metamemory information might be particularly helpful for their acquisition and use of strategies (Kennedy & Miller, 1976; Rao & Moely, 1989; Ringel & Springer, 1980). Finally, instructions that promote strategy generalization were rarely seen. Because teachers' strategy suggestions were usually quite task-specific, it is perhaps not surprising that so little instruction in generalization was found. However, in light of the research literature, it is disappointing that teachers do not make more frequent efforts to encourage children's use of strategies in new task situations.

In conclusion, teachers employed a range of suggestions for cognitive processes and strategy use or suppression in their work in elementary school classrooms, especially at the intermediate grade levels, and modified their suggestions to fit the characteristics of lesson content. Although suggestions for cognitive processing were generally limited, many of the teachers' suggestions appeared to be appropriate and potentially helpful aids to children's learning. The next question, then, was whether the learning skills of children who do experience these teaching activities to some extent differ from those of children who, rarely, if ever, are given instruction in cognitive processing activities. The second study was conducted with children whose teachers had been relatively high or very low in the use of strategy suggestions in Experiment 1.

Experiment 2

It has been shown that instruction in the use of cognitive strategies improves children's performance in memory tasks (Moely, 1977; Pressley et al., 1982), as well as in tasks involving reading (Palincsar & Brown, 1984; Paris & Oka, 1986) and mathematics problem solving (Swing, Stoiber, & Peterson, 1988). Such instruction also may increase children's metacognition, including their awareness of the value of strategic study and their ability to monitor and regulate study activity (Paris & Oka, 1986; Pressley, Borkowski, & O'Sullivan, 1984; Rao & Moely, 1989). In the present study, we were interested in how already-existing individual differences in teachers' instructional practices would be reflected in their students' cognitive performance.

We reasoned that exposure to teachers varying in their emphasis on cognitive processes should, over the course of a school year, affect the child's use of strategies and knowledge of the value of strategic study. Therefore, children of teachers who relatively often made strategy suggestions were expected to show relatively high strategy use and metamemory. Further, Borkowski and his colleagues have shown in several studies that children higher in metacognition are more responsive to teaching interventions, showing greater maintenance and generalization of the trained strategies than their peers who are lower in metacognition (Borkowski et al., 1983; Kurtz & Borkowski, 1987; Kurtz, Reid, Borkowski, & Cavanaugh, 1982). If teachers high in strategy use promote increased awareness of metacognitive processes in their children, the children should profit more by training in the use of a strategy than would children whose teachers do not stress cognitive processes. Thus use of strategies and metamemory was expected to be relatively greater in children taught by teachers who emphasize cognitive processes, both in a baseline assessment and following training in strategy use.

On the basis of the observations described in Experiment 1, it was possible to constitute two groups of competent and interested teachers, so that the groups were similar in many instructional behaviors shown in the classroom (including those included in Factors 1, 3, and 4 in Experiment 1), and also were similar in various demographic characteristics but could be classified as high or low in their efforts to provide information during instruction about strategies and other cognitive processes. Two groups of teachers were selected: The high strategy group made suggestions for cognitive processes to use in dealing with academic tasks, mentioned strategies that children could use in acquiring and retrieving information, and provided rationales for strategy use; the low strategy group rarely conveyed such information to students. Data concerning student performance were gathered in the last month of the school year, when children had experienced approximately 8 months with their teachers. After such extensive exposure to a particular teaching style, we felt that children might reflect their teachers' approach to memory tasks.

In order to assess possible attribute × treatment interactions (Snow & Lohman, 1984), children of high, moderate, and low achievement levels from the classrooms of these teachers were selected for participation. They were exposed to tasks assessing memory strategy use and knowledge about study strategies, before and after exposure to a simple memory strategy training procedure. The memory tasks used required free recall of category items, and training involved instruction in the use of an organization strategy (Moely, 1977).

The aims of the study were (1) to compare the performance of children varying in grade, achievement level, and teacher's instructional style on a free-recall task in which use of an organization strategy and memory knowledge could be measured, and (2) to evaluate the effects of a brief training procedure on subsequent recall task performance by these children.

Method

Subjects

A group of 64 children (33 boys and 31 girls) from first-, second-, and third-grade classrooms participated (mean age = 94.4 months, SD = 11.3). The sample was of mixed ethnic background, including 50% African-American, 37% white, 11% Oriental, and 2% Hispanic children. Within each classroom, children were selected on the basis of teacher recommendations and achievement test scores to represent groups showing high (N = 24), moderate (N = 21), and low (N = 19) academic achievement. High achievers showed mean percentile scores (based on national norms) on the Comprehensive Tests of Basic Skills (1975) of 84.3 for reading and 88.3 for math; moderate achievers' scores averaged 65.4 for reading and 75.9 for math, while those classed as low achievers had mean percentile scores of 47.6 for reading and 55.1 for math.

The children were attending classes taught by teachers who were either high (N = 8 teachers of 38 children, including 11 first-grade, 15 second-grade, and 12 third-grade children) or low (N = 5 teachers of 26 children, including 12 first-grade, eight second-grade, and six third-grade children) in their tendency to make suggestions about cognitive activities during learning. Ten of these teachers (five high and five low in strategy suggestions) had been observed in Experiment 1 while they taught a mixed curriculum including language arts and mathematics. The three other high strategy teachers had been observed teaching only language arts (two teachers) or only math (one teacher). The two groups of teachers did not differ in age, years since receiving the Bachelor's degree, years spent teaching, years teaching the grade presently taught, or the number of children in their classrooms at the time this work was done. Observational data from Experient 1 showed that the two groups of teachers did not differ in total teaching activity shown during five 30-min observations. They also were not different in observational categories representing factors of teachers' responses to error, positive interactive teaching, or communicating task-related information (as described in Experiment 1). Only on behaviors involving suggestions for cognitive processes, strategy use, and rationales for strategy use did the groups differ, as shown in Table 2. Analyses of variance were used to compare the two groups of teachers on each of the variables listed in Table 2; differences between the two groups were shown for teachers' use of descriptions of cognitive processes to use in studying, $F(1,11) = 31.24$, $p = .0002$, strategy suggestions, $F(1,11) = 13.50$, $p = .0037$, and provision of rationales for strategy use, $F(1,11) = 9.21$, $p = .0114$. The groups did not differ on the other variables loading on Factor 2, or on any of the other variables derived from the time-sampling data in Experiment 1.

Materials

Items were 40 line drawings representing easy-to-label objects from eight conceptual categories. Similar items have been used in a number of studies investigating recall in elementary school children (Black & Rollins, 1982; Moely et al., 1969); as in those studies, items were ones that children were able to group categorically. To roughly equate task difficulty across grades, the number of items on each list was varied systematically by grade level. On each trial, first graders saw 12 items (three items from each of four categories), second graders were presented 16 times (four items per category), and third graders received a 20-item list (five items per category).

Procedure

Children were seen by one of two female experimenters, in individual sessions that lasted approximately 30 min. All children first received two trials on a free-recall task. The initial trial (pretest) assessed their spontaneous use of organization and other study strategies, while the second (training)

TABLE 2

VARIABLES DIFFERENTIATING THE TWO GROUPS OF TEACHERS IN EXPERIMENT 2: MEANS (and Standard Deviations) FOR THE PERCENT OF OBSERVATION INTERVALS IN WHICH TEACHERS SUGGESTED COGNITIVE ACTIVITIES (see Experiment 1)

Observational Category	High Strategy Teacher (N = 8)	Low Strategy Teacher (N = 5)
Describes cognitive processes	17.25 (3.62)	6.80 (2.59)
Strategy suggested	7.38 (3.78)	1.00 (.71)
Gives rational feedback for strategy use	1.75 (.89)	.40 (.55)

trial was used to provide simple instruction in the use of category organization during study and recall. Standard free-recall instructions were given in introducing the first trial. Immediately following the child's recall, the experimenter carried out a brief instructional session in which the child was encouraged to group the items used on the pretest into conceptual categories. Procedures for study and retrieval according to category groupings were described and the child was told that category grouping would aid his or her recall. Each child was then asked to attempt a second recall of the items used on the pretest, using the procedure that had been explained. After intervening tasks involving spelling or math activities lasting 15 to 20 min, children received a final free-recall trial (posttest) in order to assess the extent to which the trained strategy would be applied to a new stimulus list, in the absence of a specific suggestion to do so. This task was introduced in the same manner as the pretest, and no reference was made to previous free-recall trials or instructions.

On each trial, the child was permitted to study the items until ready to recall them. At the end of the study period, items recalled were recorded and the experimenter rated the extent to which the child had sorted items by category during study. Following each trial, children were questioned about procedures used in study and recall. Classification of verbal responses showed interrater agreements of 83% to 100%.

RESULTS

Recall Performance

The proportion of items recalled varied over trials, as might be expected if a training effect occurs, but, more important, the nature of change over trials was not the same for all groups. As indicated in Table 3, children of low or moderate achievement levels, whose teachers rarely offered strategy suggestions, showed little change from pretest to posttest and recalled less information in the posttest than did groups similar in achievement level whose teachers made fre-

TABLE 3

MEANS (and Standard Deviations) FOR PROPORTION RECALLED BEFORE AND AFTER TRAINING BY CHILDREN VARYING IN ACHIEVEMENT LEVEL AND TEACHER CHARACTERISTICS: EXPERIMENT 2

	LOW STRATEGY TEACHER			HIGH STRATEGY TEACHER		
	Achievement Level			Achievement Level		
TEST	Low	Moderate	High	Low	Moderate	High
Pretest	.62 (.10)	.70 (.18)	.61 (.14)	.62 (.15)	.61 (.13)	.61 (.15)
Posttest	.74 (.15)	.64 (.10)	.91 (.13)	.78 (.19)	.85 (.14)	.86 (.14)

quent strategy suggestions. High achievers, on the other hand, profited by training and did well on the posttest, regardless of teacher characteristics.

These findings are supported by an analysis of variance performed on recall scores, an analysis that included grade (three levels), teacher (high or low in strategy suggestions), and achievement level (high, moderate, low) as between-subjects variables and trials (pretest, posttest) as a within-subjects variable. A significant interaction of teacher × achievement × trials, $F(2,46) = 6.98$, $p = .0023$, shown in Table 3, qualifies a significant effect of trials, $F(1,46) = 62.38$, $p < .0001$, as well as significant interactions of achievement level × trials, $F(2,46) = 5.58$, $p = .0068$, and teacher × trials, $F(1,46) = 5.14$, $p = .0261$. To explicate the three-way interaction, an analysis of variance was done on recall scores of children from the classrooms of high strategy teachers, using achievement level as a between-subjects variable and trials as a within-subjects variable. As indicated in the right-hand panel of Table 3, children whose teachers were high in strategy suggestions showed a significant increase in performance from pretest to posttest, $F(1,35) = 56.40$, $p < .0001$. No achievement level differences were shown. A similar analysis of data from children whose teachers rarely suggested cognitive processing activities showed an achievement level × trials interaction, $F(2,23) = 12.02$, $p = .0003$, which qualifies an effect of trials, $F(1,23) = 14.15$, $p = .001$. As indicated in the left-hand panel in Table 3, only the high achievers showed a significant increase in recall from the pretest to the posttest ($p < .0001$). For moderate and low achievers, posttest recall did not differ significantly from the amount recalled on the pretest. At the posttest, the high achievers recalled more than the moderate ($p = .0003$) or the low achievers ($p = .0053$), who did not differ significantly from each other.

There was also an overall difference in proportion of items recalled by children of different grade levels, $F(2,46) = 3.86$, $p = .0283$, which simply indicates that the effort to equate difficulty level by varying the number of items given to children of different grades was not entirely successful. First graders ($M = .77$, SD = .12) had a somewhat easier task than did second ($M = .69$, SD = .12) or third ($M = .69$, SD = .09) graders, although no apparent floor or ceiling effects were present at any grade.

Use of Category Organization during Recall

Use of category organization during recall was assessed by means of the ratio of repetition (RR) index of category clustering (Frender & Doubilet, 1974). As indicated in Table 4, low and moderate achievers from classrooms in which teachers were low in cognitive and strategy suggestions showed limited use of category clustering on the posttest. These results closely mirror those shown above for recall, suggesting that variations in recall performance are due at least in part to the lesser use of the trained strategy by these groups.

An analysis of variance of clustering scores including grade, teacher, and achievement level as between-subjects variables and trials (pretest, posttest) as a within-subjects variable supported these conclusions. The analysis yielded a significant interaction of teacher × achievement level × trials, $F(2,46) = 5.75$, $p = .0059$, which is shown in Table 4. Follow-up analyses were conducted, using analyses of variance with factors of achievement level (be-

TABLE 4

MEANS (and Standard Deviations) FOR CLUSTERING IN RECALL (RR) BEFORE AND AFTER TRAINING BY CHILDREN VARYING IN ACHIEVEMENT LEVEL AND TEACHER CHARACTERISTICS: EXPERIMENT 2

	LOW STRATEGY TEACHER			HIGH STRATEGY TEACHER		
	Achievement Level			Achievement Level		
TEST	Low	Moderate	High	Low	Moderate	High
Pretest	.28	.37	.22	.26	.21	.29
	(.20)	(.10)	(.18)	(.17)	(.13)	(.16)
Posttest	.53	.49	.74	.66	.73	.68
	(.27)	(.25)	(.06)	(.18)	(.10)	(.22)

tween subjects) and trials (within subjects) to examine data from children in each of the two teacher groups. As shown in the right-hand panel of Table 4, children whose teachers often made strategy suggestions showed an overall increase from the pretest to the posttest in the use of category clustering, $F(1,35) = 132.38$, $p < .0001$. No differences between achievement level groups were shown. The analysis of data from children whose teachers rarely made strategy suggestions showed an effect of trials, $F(1,23) = 38.93$, $p < .0001$, which is qualified by an interaction of achievement level × trials, $F(2,23) = 6.75$, $p = .0049$. Means involved in this interaction are shown in the left-hand panel of Table 4. Significant increases in clustering from pretest to posttest were shown by the low achievers ($p = .0264$) and by the high achievers ($p < .0001$), but not by moderate achievers. On the posttest, the high achievers clustered their recall to a greater extent than either the moderate ($p = .0143$) or low ($p = .0197$) achievers.

The overall analysis also yielded a significant main effect of trials, $F(1,46) = 149.75$, $p < .0001$, and a significant interaction of teacher × trials, $F(1,46) = 4.95$, $p = .0311$, which are qualified by the three-way interaction reported above. Clustering increased with grade level, $F(2,46) = 5.62$, $p = .0065$ (for first grade, $M = .411$, SD = .126; second grade = .463, SD = .120; third grade = .522, SD = .103). There was also an interaction of grade × teacher, $F(2,46) = 5.30$, $p = .0085$, which indicates that at the first-grade level, children whose teachers more often made strategy suggestions used category clustering more ($M = .477$, SD = .108) than did those whose teachers were low in strategy suggestions ($M = .351$, SD = .114) ($p = .051$, according to Newman-Keuls tests of the means). No such difference appeared in the second- or third-grade groups.

Category Organization during Study

The sort the child produced during study was rated for the use of category organization: 2 points were given for a perfect sort by category, 1 point for a partial sort, and a score of 0 for sorting that involved no grouping by category. Among the first-grade group, children of moderate and lower achievement levels from classrooms in which teachers rarely suggested strategies were relatively unlikely to sort items by category as they studied during the posttest, as shown in Table 5. Second- and third-grade children, once shown the possibility of grouping by category during training, were likely to maintain the strategy on the posttest.

An analysis of variance was carried out on scores representing the extent of category grouping shown during study, including grade, teacher, and achievement level as between-subjects variables and trials (pretest-posttest) as a within-subjects variable. This analysis showed main effects of teacher, $F(1,46) = 5.70$, $p = .0211$, and trials, $F(1,46) = 255.15$, $p < .0001$, as well as an interaction of grade × trials, $F(2,46) = 4.75$, $p = .0133$, all of which are qualified by an interaction of grade × achievement level × teacher × trials, $F(4,46) = 3.22$, $p = .0207$. To explicate this interaction, analyses of variance including achievement level, teacher, and trials were carried out for each of the three grade levels separately. Both second and third graders showed strong increases from pretest to posttest in the amount of category sorting carried out during study ($p < .0001$ for each group). No other effects were significant for second or

TABLE 5

MEANS (and Standard Deviations) FOR CATEGORY SORTING SCORES OBTAINED BEFORE AND AFTER TRAINING BY FIRST-GRADE CHILDREN OF VARYING ACHIEVEMENT LEVELS AND TEACHER CHARACTERISTICS: EXPERIMENT 2

	LOW STRATEGY TEACHER			HIGH STRATEGY TEACHER		
	Achievement Level			Achievement Level		
TEST	Low	Moderate	High	Low	Moderate	High
Pretest	0	0	.20	0	0	1.00
	(0)	(0)	(.45)	(0)	(0)	(1.50)
Posttest	.33	.75	2.00	1.75	2.00	1.50
	(.58)	(.96)	(0)	(.50)	(0)	(1.00)

third graders. The separate analysis of first-grade data showed an interaction of teacher × achievement level × trials, $F(2,17) = 4.99$, $p = .0197$, reflecting the differences shown in Table 5. An analysis of variance, including achievement level (between-subjects variable) and trials (within subjects), was carried out on sorting task data from first-grade children whose teachers were high in the use of strategy suggestions. As indicated in the right-hand panel of Table 5, children sorted by category to a greater extent on the posttest than they had on the pretest, $F(1,8) = 14.76$, $p = .0049$. No achievement level differences were found in this analysis. A similar analysis of variance was carried out on category sorting scores for children whose teachers were low in the use of strategy suggestions (means appear in the left-hand panel of Table 5). The analysis yielded an interaction of achievement level × trials, $F(2,9) = 5.02$, $p = .0344$, which qualifies a main effect of trials, $F(1,9) = 22.65$, $p = .001$. According to Newman-Keuls tests of the means, high achieving children showed an increase in category sorting from the pretest to the posttest ($p = .0028$), while the moderate and low achievers did not change over trials. At the posttest, high achievers sorted by category to a greater extent than either moderate ($p = .006$) or low ($p = .0026$) achievers.

Children's Metacognition about Study and Recall Strategies

Children were given several interview questions to assess their metacognition about category organization as a study and recall strategy. First, children's descriptions of how they had studied and attempted to recall items on pretest and posttest trials were examined to see how often children mentioned the use of category organization. Children received 1 point for mention of categorization during study and 1 additional point for mention of categorization as a retrieval cue. (Scores for metacognition about category organization, then, could range from 0 [no mention] to 2 [mention both in study and recall]). An analysis of variance was carried out on these scores, with grade, teacher, and achievement level as between-subjects variables and trials (pretest, posttest) as a within-subjects variable. Children's scores increased greatly from the pretest ($M = .12$, SD = .38) to the posttest ($M = 1.17$, SD = .75), $F(1,46) = 98.94$, $p < .0001$, indicating an increased awareness of the importance of categorization for the sample as a whole following training. Children of high ($M = .74$, SD = .34) strategy teachers were more likely to mention categorization than those of low ($M = .52$, SD = .46) strategy teachers, $F(1,46) = 4.74$, $p = .0346$. There was also an overall difference between achievement groups, with greater mention among high ($M = .75$, SD = .42) and moderate achievers ($M = .69$, SD = .40) than among low ($M = .47$, SD = .35) achievers, $F(2,46) = 3.90$, $p = .0272$.

To determine what children had learned during training about the use of category organization as a strategy for recall, they were asked at the end of the posttest to describe the training instruction. Nearly all (36 of 38) of the children whose teachers were high in strategy suggestions mentioned category organization as an aspect of training, while 65% (17 of 26) of the children of low strategy teachers did so, a significant difference according to a chi-square test of frequencies, $\chi^2(1, N = 64) = 9.34$, $p = .0022$. No significant grade level or achievement level differences were found in the proportions of children describing the strategy aspect of training.

Intercorrelations of Strategy and Recall Measures

Intercorrelations of pretest and posttest scores for proportion of items recalled, RR during recall, category sorting during study, and metacognition about the use of organization are shown in Table 6. Partial correlations, controlling for potential confounding due to grade or achievement level differences, are presented. As indicated in Table 6, notable differences between children taught by teachers high and low in strategy suggestions appeared on the pretest. Children whose teachers relatively often suggested strategies showed significant intercorrelations between recall, strategy, and metamemory measures. Children whose teachers were low in the use of cognitive processing suggestions, on the other hand, showed generally low intercorrelations between recall and the three measures reflecting the use of an organizational strategy. They did show a correspondence between measures of sorting during study and metamemory.

Differences between the two groups were reduced somewhat on the posttest. Here, children taught by teachers relatively high in strategy suggestions continued to show significant intercorrelations of measures reflecting strategy use in study and in recall and amount recalled, although the

TABLE 6

PARTIAL CORRELATIONS (Grade and Achievement Level Held Constant) OF STRATEGY AND RECALL MEASURES FOR CHILDREN TAUGHT BY TEACHERS DIFFERING IN THEIR USE OF COGNITIVE PROCESSING SUGGESTIONS (Experiment 2)

	STUDENTS OF TEACHERS HIGH IN STRATEGY SUGGESTIONS (N = 38)					
	Pretest			Posttest		
	RR	Sorting	Metamemory	RR	Sorting	Metamemory
Recall	.54**	.39*	.47**	.43*	.41*	.24
RR		.56**	.62**		.61**	.45**
Sorting			.87**			.58**
	STUDENTS OF TEACHERS LOW IN STRATEGY SUGGESTIONS (N = 26)					
	Pretest			Posttest		
	RR	Sorting	Metamemory	RR	Sorting	Metamemory
Recall	.39	−.21	−.03	.30	.34	.20
RR		00	.18		.86**	.39
Sorting			.67**			.49*

* $p < .05$.
** $p < .01$.

previously significant relation of metamemory and recall was not obtained. Children of teachers who rarely made strategy suggestions did not show significant relations of amount recalled to measures of strategy use or metamemory, but did continue to show a correspondence between sorting task behavior and metamemory, and also showed an increased congruence between strategy use during study and in recall.

Training Trial Performance Measures

Measures of performance on the training trial were examined in order to see if achievement level and teacher differences in posttest performance might be accounted for by differential responsivity to training. Analyses of variance involving achievement level and teacher as variables were carried out on scores for proportion recalled, clustering in recall, category sorting during study, and description of category use as a strategy. For recall, there was a difference due to achievement level, $F(2,58) = 3.83$, $p = .0275$, with proportion recalled varying among high achievers ($M = .90$, SD = 10), moderate achievers ($M = .83$, SD = 12), and low achievers ($M = .82$, SD = .15). No other achievement level differences were shown, and there were no significant differences between children selected from classrooms of teachers high and low in cognitive instruction. Recall clustering (RR) on the training trial averaged .71 (SD = .12). For category organization during sorting, the mean overall score was 1.95 (SD = .28).

DISCUSSION

Differences were shown in the memory task performance of children whose teachers varied in their use of cognitive strategy suggestions in teaching, but only for children of average or low achievement levels. High achievement groups, regardless of teacher characteristics, were positively affected by a brief training procedure and maintained strategy use on a posttest trial with new materials. Among average and low achievers, the degree to which the trained strategy was maintained was related to teacher characteristics. In particular, average and low achievers whose teachers were high in strategy suggestions in the classroom were more likely to use organization during recall, to recall more items, and to organize items to a greater extent during study (the last was especially obvious at first grade). In general, children whose teachers were high in strategy suggestions showed a greater ability to articulate verbally the features of the organizational strategy that they were taught. They also were better able to recollect the essential features of the category training procedure when queried at the end of the session than were children taught by teachers who rarely made strategy suggestions. Thus, a pattern of varying benefit of training appears

on several measures that index use of category grouping as a study/recall strategy, lending strength to a conclusion that teacher characteristics influence children's reaction to training. This finding is consistent with the conclusion of Shrager and Mayer (1989) and Snow and Lohman (1984) that instruction focusing on learning strategies is particularly valuable for less skilled learners.

Findings for the sorting task showed a stronger relation between teacher characteristics and child behavior for first graders than for older children. Instructions were effective in producing category sorting on the posttest for the two older groups. For the younger children, ability and teacher characteristics, in interaction, were related to strategy maintenance. It is possible that first graders are particularly susceptible to a teacher's emphasis on cognitive processing strategies. First graders may be more dependent upon the teacher as a source of information about how to study than older children are, since their own limited metamemory and self-regulatory skills make them less able to invent and accurately evaluate their own ways of learning.

Relations between measures of recall, metamemory, and strategy use during study and recall also suggest differences between children who have experienced teachers varying in cognitive strategy instruction. As indicated in Table 3, differences are particularly notable on the pretest, where the children of high strategy teachers show significant intercorrelations of these variables. Children of low strategy teachers did not show any consistency between strategy use during study and during recall or between strategic behavior and amount recalled, although they did show consistency between metamemory and sorting behavior. Several investigators have argued that high interrelations of recall, strategy use, and metamemory reflect the deliberate selection and application of a strategy for study and retrieval (Lange, Guttentag, & Nida, 1990; Schneider, 1986). Consistent with this view, it has been shown that older children are more likely than younger ones to show high interrelations among measures of strategy use during study, strategy use during recall, amount recalled, and specific strategy knowledge (Bjorklund & Jacobs, 1985; Frankel & Rollins, 1985; Lange et al., 1990; Sodian, Schneider, & Perlmutter, 1986). The children of high strategy teachers, then, appear to have been more mature than the children of teachers low in strategy suggestions, showing a more deliberately strategic approach to the memory task prior to training.

It has been demonstrated in previous studies that training produces more mature intercorrelational patterns (Black & Rollins, 1982; Lange et al., 1990). Although the children of teachers low in strategy suggestions showed an increased relation between strategic sorting and use of clustering in recall on the posttest, they did not show significant relationships between recall and the strategy measures. Thus, even with training, these children did not produce a pattern indicating deliberate strategy use, implying that for them there was only a limited impact of training.

From these findings, we can speculate about the teacher's role in affecting a child's learning activities. A high strategy teacher may be influential in setting the stage for learning about effective cognitive processing strategies. Such teachers may be influencing children's metacognitive learning capabilities, as well as their task performance, when they offer strategy suggestions in the classroom. Although the strategies suggested in the classroom are relatively specific to subject matter taught, as indicated in Experiment 1, students exposed to a high strategy teacher seem to be acquiring some more generalized tendency to be amenable to the teaching of cognitive processing activities.

Concluding Remarks

We began this work with the assumption that children's school experiences play a part in the developmental changes in strategy use and cognitive processing skill seen during the elementary school years. The evidence we have gathered in these two studies suggests reciprocal influences: in Experiment 1, we saw that teachers' suggestions varied with the grade level of the class. Teachers seem to be responding to children's developing abilities, as well as guiding this development, when they make frequent strategy suggestions to second and third graders, and give greater direct metamemory instruction to older children. The findings of Experiment 2 allow us to propose that teachers' instruction of cognitive processing activities has an impact on children's skill. Especially for low and moderate achievers, exposure to a high strategy teacher is related to better comprehension and use of cognitive processing instruction.

However, the infrequent use of strategy suggestions and the very limited effort made by most teachers to instruct children in metacognition suggest less than maximally effective cognitive instruction in these elementary school classes. Recent reports of the ways in which parents attempt to facilitate children's cognitive development (Carr, Kurtz, Schneider, Turner, & Borkowski, 1989; Frankel & Rollins, 1983) indicate that we need to look at a variety of sources for information about factors affecting the development of memory skills. Work on the relative contributions of family members and teachers to the child's study behaviors and metacognitive concepts is needed, as well as comparative work on the effects of schooling in various student populations and cultures.

Appendix A

Observational Categories Included in Factor 2: Instructing Cognitive Processes and Strategies

Describes or Suggests Cognitive Processes (factor loading = .72)

The teacher gives information concerning ways and means of dealing with the task at hand. It includes the teacher's explanation of cognitive processes to be gone through in solving a problem or producing the correct answer. Whereas "procedures" (below) focuses on the task and what has to be done according to the rules of the task, this category focuses on the *learner* and what activities the learner has to engage in while performing the task.

Strategy Suggested (factor loading = .78)

The teacher suggests or demonstrates a strategy for use in dealing with a learning situation. A strategy is defined as a voluntary, goal-directed activity that the teacher appears to assume will be useful to the child in dealing with the task at hand. In describing the strategy on the observation sheet, the observer indicates (1) the nature of the lesson in which the strategy was to be used, (2) what the strategy was supposed to accomplish, (3) what the teacher said or did to introduce the strategy: how (s)he described or demonstrated the strategy, (4) any rationale the teacher gave for using the strategy, and (5) any follow-up the teacher made later in the lesson to remind children to use the strategy.

Gives Rationale or Feedback for Strategy Use (factor loading = .82)

The teacher, while telling the child to use a strategy, makes clear that it will serve a memory/learning function for the child.

Strategy Suppressed (factor loading = .37)

The teacher urges children *not* to use some strategy. The observer describes the strategy on the observation sheet and writes a narrative description, including: (1) the nature of the lesson in which the potential use of the strategy occurred, (2) what the teacher said or did to discourage use of the strategy, (3) what the strategy was, (4) any rationale the teacher gave for not using the strategy, (5) any follow-up instructions the teacher made later in the lesson to remind children not to use the strategy, and (6) an evaluation as to whether the attempted suppression appeared to be appropriate or not.

Requests Child's Inquiry (factor loading = .61)

The teacher invites children to seek clarification of information that has already been presented. Such comments can occur within the context of presenting information on goals, procedures, task content, or cognitive processes.

Warns or States Memory Goal (factor loading = .55)

The teacher simply states his or her expectation that the child is to remember some material, implying that studying should be done but not specifying the nature of study or strategy use.

Appendix B

Classification of Teachers' Strategy Suggestions

Rote Learning

Rote learning strategies are instructed for simple repetitive learning. Children are told to rehearse stimuli verbally, or to write, look at, go over, study, or repeat them in some other way. The children may be instructed to rehearse items just once, a finite number of times, or an unlimited number of times. Rote learning strategies *do not include* any explicit activities that would add meaning to the stimulus or cause it to be processed to a deeper level or in terms of more extensive associative relations.

Elaboration

The elaboration strategy is instructed for use with stimulus materials that generally do not have much intrinsic meaning to children, such as the definition or pronunciation of words. Children are instructed to use elements of the stimulus material and assign meaning by, for instance, making up a phrase or sentence, making an analogy, or drawing a relation based on specific characteristics found in the stimulus material.

Deduction

In deduction, children are instructed to use their general knowledge, in combination with any clue from the material that seems helpful, to deduce and construct the correct answer. Teachers might direct children to use contextual information (e.g., pictures accompanying a text, or parts of the text) or to analyze the item into smaller units (e.g., looking for root words, analyzing words phonetically).

Transformation

Transformation is a strategy suggested by teachers for transforming unfamiliar or difficult problems into familiar or simpler ones that can then be solved more easily. Transformations are possible because of logical, rule-governed relations between stimulus elements. Teachers identify these relations and tell children either that a problem can be rewritten or that it can be reformulated if the method of solution is related to or derived from rules and procedures learned previously. Due to the emphasis on logical, rule-governed relations, this strategy is usually suggested in mathematics.

Specific Aids for Problem Solving and Memorizing

This strategy involves the use of specific aids in problem solving or memorizing. Even though these aids may have other uses, the teacher instructs one specific application of them. Teachers may give explicit instructions on how to use the aids in the task at hand. Thus, children are instructed to use objects, body parts, or assigned reading materials in learning and memory tasks. For example, teachers often told children to use blocks or other counters to represent addition or subtraction operations in a concrete way.

General Aids

In contrast to specific aids, teachers recommend the same general aid for a variety of different problems. These aids are designed and used to serve a general reference purpose. Children often have prior training in their use and, once familiar with them, are expected to utilize them without further explanation. Examples include the use of dictionaries or other reference works.

Imagery

This strategy usually consists of nonspecific instructions to remember items by taking a mental picture of them or to maintain or manipulate them in the mind. It also refers to visualizing procedures or characters.

Exclusion

This is a strategy to help children answer test or workbook questions even if they don't know the correct answer initially. Children are told to eliminate incorrect options systematically, either by doing the problems they know first and then trying to match questions and answers that are left over, or by trying out all possibilities and selecting the one that seems correct.

Attention

These strategies are suggested by teachers to direct or maintain children's attention to a task. For example, teachers may instruct children to "follow along" or "listen carefully" during lessons.

Specific Attentional Aids

This strategy is similar to the attention strategy, but children are instructed to use objects, language, or a part of their body in a specific way to maintain orientation to a task. Although these aids are employed in a specific way for the attentional task, they may have other uses ordinarily.

Self-Checking

Teachers instructing this strategy suggest that children check their work for errors before turning it in. It includes procedures children can use on their own to make sure they are doing a task correctly. Teachers may also suggest that children test themselves or have someone else test them. Or children might be encouraged to keep track of all steps involved in a task so that they can later identify where they made a mistake. The instructions for this strategy are often not specific but rather a general remark to "check" the work.

Metamemory

Teachers instructing this strategy tell children that certain procedures will be more helpful for studying and remembering than others, and sometimes teachers may also explain why this is so. The instruction frequently includes giving hints about the limits of memory, asking children about the task factors that will influence ease of remembering, or helping them understand the reasons for their own performance. Teachers may ask children how they can focus memory efforts effectively, or what they can do to remember. Teachers also tell children that they can devise procedures that will aid their memory or indicate the value of using a specific strategy.

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