Exceptional Children

Vol. 69, No. 4, pp. 497-505.

Strategy Acquisition and Maintenance of Gifted and Nongifted Young Children

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ABSTRACT: *Young children's strategy acquisition and maintenance were examined by comparing the recall, clustering, and study behaviors of children of different ages and intelligences. Three groups were included in the study: 5-year-old gifted children, 5-year-old nongifted children, and 7-year-old nongifted children. All were observed and measured on 5 consecutive days, with training on strategy use provided on the third day. Several differences among groups were found, generally favoring the gifted children in terms of performance and maintenance of strategies. In addition, the 5-year-old gifted children seemed to spontaneously use categorization strategies and clustered items in recall before training, while the 7-year-old children used categorization and clustering in recall after training. Implications for instruction for gifted students are discussed.*

Learning strategies are believed to make an important contribution to the enhancement of students' intellectual performance. A considerable body of research has addressed the issue of strategy use in classroom settings and has demonstrated that younger children use cognitive strategies less frequently for learning new information than older children. Developmental studies on strategy acquisition have shown that different strategies become available for children's use at different developmental stages (Weinstein & Mayer, 1986). For example, strategies such as labeling, sorting, verbalizing, and clustering seem to become available during the preschool years (Alexander & Schwanenflugel, 1994; Moley, Olsen, Hawles, & Flavell, 1969), while children in Grades 1 and 2 develop organization strategies, using them when prompted but failing to apply them immediately when a memory task is given (Alexander & Schwanenflugel).

The phenomenon of having strategies but failing to use them spontaneously has been labeled *production deficient* (Brown, 1977; Flavell, 1970; Flavell, Miller, & Miller, 1993; Weinstein & Mayer, 1986) or *utilization deficient* (DeMarie-Dreblow & Miller, 1988; Gaultney, 1998). Thus, children can use a strategy when asked or guided, but act as if they do not possess this knowledge when given a relevant task without guidance

Developmental studies on strategy acquisition have shown that different strategies become available for children's use at different developmental stages.

(Nisbet & Shucksmith, 1986). Because younger children do not have a sophisticated understanding of strategy use (Fabricius & Hagen, 1984), they may get no, little, or less benefit from strategies than older children do. It is possible that as children acquire and maintain more refined strategies through experience, strategies can become more automatic and demand less memory capacity. Therefore, younger children may be reluctant to try to produce an effortful strategy. They may be neither adequately planful, foresighted, nor goal-oriented, at least in a memory-task situation (Flavell et al.).

Alexander and Schwanenflugel (1994) asserted that intelligence scores (assessed by Peabody Picture Vocabulary Test-Revised and Matrix Analogies Test-Short Form) of Grade 1 and 2 students did not seem to be directly related to strategy regulation and recall. More specifically, they indicated that intelligence played a small role in predicting strategy use and the number of items recalled when other factors such as knowledge base level, grade, and causal attribution were taken into account. However, it appeared that the intelligence scores of the children who participated in their study were limited to a narrow range around average intelligence. Thus, it is more appropriate to conclude that children of average intelligence can execute the strategy on the surface but have a vague or missing understanding of the purposes behind the use of the strategy.

Wong (1982) chose three different groups (e.g., gifted children, children with average intelligence, and children with learning disabilities) to investigate organizational strategies and self-checking behavior in selecting retrieval cues. Wong found that children of high intelligence who are gifted appeared to spontaneously generate adaptive-efficient strategies when selecting retrieval cues. The gifted children's organizational strategy for selecting retrieval cues was to operate by a nonverbalized scheme. It was observed that the gifted children rapidly scanned the pausal-idea units of the retrieval cues and then examined the cards in the smaller pile, ensuring the content and the number of cards of retrieval cues.

Wong's (1982) study indicated that gifted children can select and use appropriate strategies already existing within their repertoire spontaneously and without instruction. Unlike nongifted children, gifted children have greater factual knowledge about how their mind works and have a greater tendency to use strategies on tasks quite different from the task on which the strategy instruction was given (Carr, Alexander, & Schwanenflugel, 1996). Moreover, gifted children use more leading rules and strategies more efficiently, or learn new strategies with greater ease than nongifted children (Hong, 1999).

However, there is substantially less evidence that gifted children can generate new strategies or use strategies that were not in their repertoire prior to special training aimed at solving given problems. Would the positive effect of training be maintained even after training? Although it seems that intelligence scores and strategy use are highly correlated, the findings on the relationship between children's higher intelligence and strategy use are inconsistent. Alexander and Schwanenflugel (1994) found that there is a significant pathway from intelligence to number of items recalled through reported strategy sophistication (p = .25, .28, respectively, $p < .05$). They argued that intelligence predicts children's reporting of the use of more sophisticated viable strategies, which was reflected in higher recall. Therefore, children of higher intelligence tend to use feasible and possibly multiple or more sophisticated strategies. They asserted that children having a thorough understanding of the usefulness of the strategy tend to have optimal recall.

On the contrary, Carr and her associates (1996) asserted that children of higher intelligence who appeared to be gifted do not tend to use strategies consistently on their own, maintain the strategy over a longer period of time, or use strategies that they were taught. Accordingly, it cannot be assumed that gifted children are better able to independently use strategies. Moreover, there is still a lack of studies ascertaining whether the gifted can generate effective strategies and use them spontaneously without instruction when faced with unfamiliar (nonentrenched tasks as defined by Sternberg, 1981) tasks.

Unlike nongifted children, gifted children have greater factual knowledge about how their mind works and have a greater tendency to use strategies on tasks quite different from the task on which the strategy instruction was given.

Furthermore, as noted in a series of studies (Baker & Anderson, 1982; Brown, 1978, 1980; Brown & Barclay, 1976; Paris & Myers, 1981), initial benefits of mnemonic strategy instruction did not seem to last over a longer period of time, even though mnemonic devices are supposed to elevate one's learning speed (Wang & Thomas, 1996). In addition, there have been virtually no studies that evaluate the effects of training on students' patterns of change. Thus, in this study we examined strategy acquisition and maintenance of gifted children, their nongifted mental peers, and their nongifted chronological peers through measuring their recall, clustering, and study behaviors during the 5 consecutive days of learning.

METHOD

Experimental Design

Cognitive behaviors of gifted and nongifted children were observed and measured for 5 consecutive days. Training on strategy use was provided on Day 3 to all groups. On each day, children were individually presented with one deck of 24 stimulus cards to remember. All of the groups were presented with the same experimental conditions on each day.

Subjects

The three groups of children included in the study were ten 5-year-old nongifted children (5 years 4 months; average IQ = 103.5, range = 95-105); eleven 5-year-old gifted children (5 years 5 months; average IQ = 142.1, range = 130-153); and eleven 7-year-old nongifted children (7 years 5 months; average IQ = 100.3, range = 90-110). Knowledge of objects depicted on stimulus cards was controlled by selecting for analysis only those who could give correct names for all of the objects; one child each from the 5-year-old gifted group and the 7-year-old nongifted group was dropped from data analyses. KEDI-WISC, the Korean version of WISC-R, was used to measure children's intelligence quotients, which were used to designate children as gifted or nongifted.

Materials

Five decks of 24 stimulus cards, one for each day of testing, were prepared by cutting out pictures of 120 common objects in magazines and drawing them on 10 x 15-cm index cards. The pictures were selected for their familiarity, simplicity, and representativeness of categories such as vegetables, wild animals, and furniture. There were four examples of six different categories per deck, with different categories used in each of the five decks. The decks were arranged in seven random orders with four or five children receiving each order.

Procedures

Each child was seen on the 5 consecutive days for approximately 30 min per day. On Days 1 and 2, the child was asked to perform two study-recall trials with a deck of 24 randomly presented pictures. The children were asked first to name each item to ensure that they knew the objects in the pictures. They were then allowed to study the cards for 3 min in any way they wanted. The cards were collected and then a verbal recall task was followed. The order of recalled items was recorded numerically on a score sheet. After a brief interval, this procedure was repeated once more with the same set of cards. The frequencies of five classes of overt strategic behaviors were recorded during each 15-s interval. Thus, Day 1 and 2 were tests of *strategy generation*.

Day 3 began with a training session prior to the study recall tasks. The training offered the children information about four learning strategies. Using the deck of cards for the third day's task, the experimenter demonstrated how to (a) put each picture into groups of similar items, (b) label each item and cumulatively rehearse the pictures by group, (c) cover or close the eyes and self-test, and (d) recall the pictures by group. The experimenter also provided a brief explanation of the reasons why each strategy would aid in remembering the pictures. All the subjects were encouraged to use the directed strategies on the first trial of Day 3. The second trial was presented without encouragement or directions to use the strategies. On Days 4 and 5, neither group received any training, and the tasks were presented in the same way as the first 2 days. Thus, Day 4 and 5 were tests of *strategy learning and maintenance*.

The number of items recalled was analyzed by calculating mean number of items each day. An Adjusted Ratio of Clustering (ARC) was calculated to identify the tendency to cluster while recalling the items. The ARC measure was used because it takes into account chance and number of available categories for sorting as well as the cohesiveness of the sorts within the categories (Murray & Puff, 1982; Roenker, Thomson & Brown, 1971).

Data Analysis

Descriptive analysis was conducted to identify differences among the three groups of children. Dependent variables were the number of items recalled, the ARC, and the kinds and frequency of strategies used. Analysis of variance was carried out to indicate significant difference in groups, days, and their interaction effects. Scheffé tests were used to compare performance means across the 5 days.

RESULTS

Numbers of Items Recalled

With respect to the number of items recalled across the 5 days, analysis of variance indicated that the main effect of Day $F(4,18) = 7.00$, $p < .001$ was significant, but the main effect of Group and the interaction effect were not significant. It appeared that the highest number of items correct occurred on Day 3, the day of strategy training (see Table 1). Scheffé tests on the mean differences among days for each group showed that both the 5-year-old gifted children, $F(1,9) = 5.67$, $p < .05$; and the 7-year-old nongifted children, $F(1,9) = 24.24$, $p < .01$, recalled the most on Day 3. The number of items recalled was maintained on Days 4 and 5 (see Table 2). No significant difference was found between the 5-year-old gifted children and the 7-year-old nongifted children in the number of items recalled, and no difference was found among all days for the 5-year-old nongifted children.

Clustering of Items in Recall

To determine whether there were differences among the three groups in the clustering of items, we calculated an ARC for the recalled items in each trial. ARC was calculated using the Roenker et al. (1971) method and the equation suggested by Murray and Puff (1982, p. 120). The maximum and minimum values of the ARC are 1 and 0 respectively (see Table 3).

Analysis of variance indicated that there was a main effect only for Day $F(4,18) = .252$, $p < .001$. The Scheffé test for the mean difference among days for each group showed that the apparent increase from Day 2 for the 5-year-old gifted children's ARC was not statistically significant. The ARC of the 7-year-old nongifted children showed a significant change from Day 2 to Day 3, $F(1,9) = 13.74$, $p < .01$, and the ARC was maintained during the rest of the experimental period. There were no significant changes in ARC observed from Day 1 to Day 5 for the 5-year-old nongifted children.

Comparisons of differences in ARC across the consecutive days are shown in Table 4 for the 5-year-old gifted children and the 7-year-old nongifted children. The 5-year-old gifted children started recall with clustering after just 1 day of practice and repeated experience with the memory task even without external instruction. In contrast, the 7-year-old nongifted children started recall with clustering only after they received the training. Therefore, the positive effect of the training was only apparent in the 7-year-old nongifted children.

Use of Learning Strategies

Observations of strategy use were examined to determine whether there were differences in the kinds of strategies used to remember pictures by the three groups before, during, and after the ategy instruction. The following study behaviors were observed: (a) labeling and rehearsal, (b) categorization, (c) self-testing, (d) flipping cards over,

TABLE 1

Mean Number of Items Recalled for Groups and Days

Groups	Day 1	Day 2	Day 3	Day 4	Day 5
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
5-year Nongifted (n = 10)	7.7 (3.3)	7.2 (3.1)	6.7 (5.5)	7.8 (3.7)	8.0 (3.4)
5-year Gifted (n = 10)	13.8 (3.1)	14.5 (2.4)	17.5 (5.3)	16.6 (3.9)	14.8 (3.2)
7-year Nongifted (n =10)	13.9 (1.7)	12.3 (3.2)	16.1 (3.6)	14.8 (4.2)	14.4 (4.1)

TABLE 2

Differences Between Consecutive Days in Recalled Items

Days Compared	5-Year-Old Gifted	7-Year-Old Nongifted
Day 1 vs. Day 2	$F(1,9) = .78$	$F(1,9) = 3.07$
	$p = .40$	$p = .11$
Day 2 vs. Day 3	$F(1,9) = 5.67$	$F(1,9) = 24.24$
	$p = .041$*	$p = .001$**
Day 3 vs. Day 4	$F(1,9) = .51$	$F(1,9) = 1.74$
	$p = .49$	$p = .22$
Day 4 vs. Day 5	$F(1,9) = 1.71$	$F(1,9) = .11$
	$p = .22$	$p = .75$

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

TABLE 3

Mean ARC for Groups and Days

Groups	Day 1	Day 2	Day 3	Day 4	Day 5
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
5-year Nongifted (*n* = 10)	.32(.16)	.57(.22)	.52(.23)	.35(.18)	.49(.18)
5-year Gifted (*n* = 10)	.38(.19)	.59(.18)	.61(.21)	.60(.32)	.63(.19)
7-year Nongifted (*n* =10)	.40(.12)	.37(.26)	.72(.16)	.64(.12)	.58(.20)

TABLE 4

Differences Between Consecutive Days in Adjusted Ratio of Clustering (ARC)

Days Compared	5-Year-Old Gifted	7-Year-Old Nongifted
Day 1 vs. Day 2	$F(1,9) = 3.78$	$F(1,9) = .12$
	$p = .08$	$p = .74$
Day 2 vs. Day 3	$F(1,9) = .07$	$F(1,9) = 13.74$
	$p = .80$	$p = .005$**
Day 3 vs. Day 4	$F(1,9) = .02$	$F(1,9) = 1.49$
	$p = .90$	$p = .25$
Day 4 vs. Day 5	$F(1,9) = .05$	$F(1,9) = .66$
	$p = .83$	$p = .44$

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

and (e) staring. Different kinds of study behaviors shown during each interval were counted separately and one behavior that continued during the interval was counted only once.

Analysis of variance revealed a main effect of Study Behavior, ($F(3,18)=307.92$, $p < .001$) and an interaction effect between Groups and Study Behavior ($F(3,354)=5.71$, $p < .01$). In general, labeling and rehearsal strategies seemed to be used more than any other strategies. In addition, the children in different groups used different strategies. For example, the 5-year-old gifted children used categorization more frequently than the 7-year-old nongifted children, and the 7-year-old

TABLE 5

Frequency of Labeling, Rehearsal, and Categorization Strategies for Groups by Days

Groups	*Day 1*	*Day 2*	*Day 3*	*Day 4*	*Day 5*
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Labeling and Rehearsal					
5-year Gifted (*n* = 10)	7.05(4.4)	7.90(3.5)	7.35(4.4)	5.80(4.0)	7.45(4.4)
7-year Nongifted (*n* =10)	10.05(1.1)	11.20(1.1)	6.85(3.2)	9.20(2.0)	7.70(2.7)
Categorization					
5-year Gifted (*n* = 10)	1.20(3.2)	1.40(3.1)	3.55(3.4)	4.30(3.1)	2.65(3.3)
7-year Nongifted (*n* =10)	.25(.6)	.20(.6)	4.10(3.1)	1.95(2.5)	2.55(2.5)

nongifted children used labeling and rehearsal more frequently than the 5-year-old gifted children. There were no significant main effects or interaction effects shown in the use of other strategies such as self-testing, flipping cards over, and staring. The use of labeling and rehearsal and the use of categorization by the 5-year-old gifted children and the 7-year-old nongifted children are shown in Table 5.

Analysis of variance revealed no significant main effects of Groups $F(1,8) = 1.30$, $p > .05$; or Days $F(4, 354) = .13$, $p > .05$. There were no significant interaction effects between Groups X Days $F(4, 354) = .15$, $p > .05$; and Groups X Days X Study Behaviors, $F(12, 354) = 1.34$, $p > .05$. Thus, the 5-year-old gifted and 7-year-old nongifted children were similar to each other in terms of using strategies in general.

For labeling and rehearsal and for categorization, two-way analyses of variance were conducted. A significant main effect was found for Days $F(4,72) = 3.35$, $p < .05$; and an interaction effect between Groups and Days $F(4,72) = 2.97$, $p < .05$ was observed. The 5-year-old gifted children and the 7-year-old non-gifted children frequently used labeling and rehearsal strategies more than categorization; the remaining strategies were used minimally. The 5-year-old gifted children used labeling and rehearsal much less than the 7-year-old nongifted children did during the 5-day period, and there was not much change with passage of days in terms of the strategies use (see Table 6). Also, the 7-year-old nongifted children used labeling and rehearsal strategies more frequently before the training and then drastically decreased the use of this strategy right after the training on Day 3, $F(1,9) = 20.05$, $p < .01$; maintaining the change on Days 4 and 5 (see Table 6).

For Categorization, there were a main effect of Days $F(4,72) = 38.95$, $p < .001$; and an interaction effect between Groups and Days $F(4,72) = 1.15$, $p < .05$. No other effect was shown. As can be seen in Table 6, the two groups of children showed slightly different patterns in the use of categorization for the memory task. More specifically, the 7-year-old nongifted children did not use categorization on Days 1 and 2; the frequency of categorization increased drastically on Day 3, $F(1,9) = 14.82$, $p < .01$; and was maintained on Days 4 and 5. The 5-year-old gifted children used categorization even before the strategy instruction, and it increased dramatically on Day 3. It also increased on Day 4 and was maintained on Day 5. The mean frequency of categorization during the 5-day period was similar for the two groups.

DISCUSSION

This study indicated that 5-year-old nongifted children recalled fewer items than other groups, and that 5-year-old gifted children recalled as much as 7-year-old nongifted children. Similarly, the 5-year-old gifted children were very similar to the 7-year-old nongifted children in the ratio of clustering items in recall. The clustering of the 5-year-old nongifted children could not be compared with the other two groups because they recalled too few items to calculate an ARC.

The 7-year-old nongifted children used labeling and rehearsal more before and after the training than on Day 3. While they rarely used the categorization strategy before and after the training, they did use it significantly more on Day 3 when they had explicit instruction. Unexpectedly, the 5-year-old gifted children did not show a

TABLE 6

Mean Adjusted Ratio of Clustering (ARC) for Groups and Days

Days Compared	*5-Year-Old Gifted*	*7-Year-Old Nongifted*
Labeling and Rehearsal		
Day 1 vs. Day 2	$F(1,9) = 1.56$ $p = .242$	$F(1,9) = 3.12$ $p = .11$
Day 2 vs. Day 3	$F(1,9) = .23$ $p = .641$	$F(1,9) = 20.05$ $p = .002^{**}$
Day 3 vs. Day 4	$F(1,9) = .14$ $p = .325$	$F(1,9) = 4.29$ $p = .07$
Day 4 vs. Day 5	$F(1,9) = 1.42$ $p = .26$	$F(1,9) = 2.08$ $p = .18$
Categorization		
Day 1 vs. Day 2	$F(1,9) = 2.25$ $p = .168$	$F(1,9) = 1.00$ $p = .34$
Day 2 vs. Day 3	$F(1,9) = 3.53$ $p = .093$	$F(1,9) = 14.82$ $p = .004^{**}$
Day 3 vs. Day 4	$F(1,9) = .24$ $p = .636$	$F(1,9) = 2.76$ $p = .13$
Day 4 vs. Day 5	$F(1,9) = 1.78$ $p = .21$	$F(1,9) = 1.03$ $p = .34$

$^{*}p < .05$. $^{**}p < .01$.

significant training effect. This was evidenced by insignificant changes before and after the training in the use of categorization and clustering in recall. The 5-year-old gifted children gradually increased their use of categorization from Day 1 to Day 4 without being influenced by the training.

Categorization is more efficient for memorization than labeling and rehearsal, especially in a task like that used in this study. It appears that the gifted children learned on their own that the categorization strategy was better and more efficient for memorizing than labeling and rehearsal.

There were different training effects for the two groups along the 5-day period reflected in the ARC and the frequency of study behavior. More specifically, while the training had a significant effect on the 7-year-old nongifted childen, it did not have a significant effect on the 5-year-old gifted children. The 5-year-old gifted children showed categorization behavior and clustering in recall even before the training and increased its frequency and maintained them after the training. Meanwhile, the 7-year-old nongifted children showed neither categorization behavior nor clustering in recall before the training, but the frequency of categorization behavior and clustering in recall increased significantly after the training. Whereas the 5-year-old gifted children started clustering in recall even before the training, most of the 7-year-old nongifted children started clustering in recall only after the training.

These findings reflect that even young children, if they are children of high intelligence, could have a good understanding of the usefulness of strategies and use them spontaneously to perform the given tasks without explicit instruction. These findings are contrary to those of studies by Flavell et al. (1993) and by Fabricius and Hagen (1984).

The findings also showed that the 5-year-old gifted children are superior in metacognitive abilities to the 7-year-old nongifted children. The 5-year-old gifted children could understand the nature and demand of the task and strategies necessary for successful performance. The 5-year-old gifted children could either generate or select appropriate strategies for the given task even without external cuing, suggestion, or enforcement. These results do not support the findings by Carr

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and her associates (1996), where gifted children do not tend to consistently use strategies on their own, maintain the strategy over a longer period of time, or use strategies that they were taught. Moreover, Gaultney (1998) found that gifted children did not benefit from the strategy training, while children of average intelligence did. However, her findings are different from this study in the sense that both groups benefited from strategy use.

Rather, this study corroborates the research findings by Alexander and Schwanenflugel (1994) indicating gifted children tend to have optimal recall through a comprehensive understanding of the usefulness of strategies. The 5-year-old gifted children were equipped with better metacognitive abilities shown by their spontaneous generation or selection of appropriate strategies for the given task and could adjust their behavior to meet the demands of the newly given task.

IMPLICATIONS FOR PRACTICE

This study has direct theoretical and methodological implications for the education of gifted students. When providing gifted children with educational experiences or assigning tasks to them, it is necessary to consider their metacognitive capabilities in learning which were revealed in this study.

The 5-year-old gifted children did not need strategy instruction to perform the memory task at a level similar to that attained by 7-year-old nongifted children, as has been indicated by the positive training effects for the 7-year-old nongifted children but not for the 5-year-old gifted children. It is necessary to consider the metacognitive capabilities of 5-year-old gifted children in designing educational programs for them. In other words, the 5-year-old gifted children appear to have a good understanding of the utility and significance of various optional actions and the ability to spontaneously meet the demands of the task. Therefore, gifted children probably do not need direct and specific instructions on how to perform the task efficiently, because they can voluntarily generate or select efficient strategies for specific learning tasks even before the training.

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Manuscript received February 2002; accepted December 2002.