

The Role of Children's Expertise in a Strategic Memory Task

JANE F. GAULTNEY AND DAVID F. BJORKLUND

Florida Atlantic University

AND

WOLFGANG SCHNEIDER

University of Würzburg, Institut für Psychologie, Wittelbachplatz 1, D-8700

Würzburg, Germany

In a study intended to replicate and extend the findings from a recent experiment by Schneider and Bjorklund (1992), the expert/novice paradigm was used with second- and fourth-grade children in a sort/recall task. Children were classified as experts or novices for their knowledge of baseball, then given two sort/recall tasks, with a list consisting of either baseball or nonbaseball terms. Experts recalled more than novices on the baseball list only. While both groups used organizational strategies at sorting on the nonbaseball list, experts were marginally more strategic than novices on the baseball list, and no differences were found between the groups on either list for clustering. Baseball experts used more adultlike categories, suggesting that their enhanced levels of recall were attributed in part to strategy use, although there was also evidence that most of the substantial recall difference between the groups was attributed to item-specific effects associated with a more elaborated knowledge base. A second experiment using fifth-grade children on a multitrial sort/recall task using the baseball list also found increased recall by experts, and also found evidence of strategic behavior at the sort phase for trials 3 and 4. © 1992 Academic Press, Inc.

There seems to be little debate that differences in children's knowledge base contribute significantly to developmental differences in memory performance (See Bjorklund, Muir-Broadus, & Schneider, 1990; Ornstein, Baker-Ward, & Naus, 1988; Schneider & Pressley, 1989). Having a detailed knowledge base for to-be-remembered information facilitates mem-

This research was funded by a grant from the Spencer Foundation. We thank the staff and students of Boca Raton, A. D. Henderson, and Wellington Elementary Schools for their cooperation in conducting this study, Mary Ann Scugoza and Nancy Hack for her help in data collection, and William S. Cassel, Thomas Coyle, Katherine K. Harnishfeger, and Claudia Roeber for comments on earlier drafts of the manuscript. We also thank Donna Recht for making her test of baseball knowledge available to us. Requests for reprints should be sent either to David F. Bjorklund, Department of Psychology, Florida Atlantic University, Boca Raton, FL 33431 (E-mail address bjorkldf@fauvax) or to Wolfgang Schneider, Institut für Psychologie, Wittelbachplatz 1, D-8700 Würzburg, Germany (E-mail address wschneider@vax.rz.uni.wuerzburg.dpe.de).

ory by making individual items more accessible (Bjorklund & Bjorklund, 1985), by the relatively automatic activation of categorical relations (e.g., Bjorklund & Zeman, 1982), or by facilitating the use of mnemonic strategies (Ornstein *et al.*, 1988). The more effective use of memory strategies for highly familiar information has been attributed to increased efficiency of information processing, with children expending less of their limited mental resources to access familiar (relative to less familiar) information, thereby leaving more resources to be applied for the use of strategies (see Bjorklund *et al.*, 1990).

That prior knowledge plays a vital role in the educational process was emphasized by Pressley, Johnson, Symons, McGoldrick, and Kurita (1989), who noted that prior knowledge affects what children understand and remember of what they read. These authors suggested that it was essential to activate prior knowledge in order to learn as efficiently as possible.

Some of the most impressive evidence for the effects of knowledge base on children's memory performance comes from studies using the expert/novice paradigm. The elaborated knowledge base of the experts relative to the novices, independent of age, permits more efficient allocation of limited capacity, which in turn facilitates recall. Metaphorically, the expert is able to compact the clutter, leaving more room for incoming items to be retained long enough to reach long-term store or to be acted upon by strategies. Alternatively, Chi and her colleagues propose that knowledge allows experts to use more inclusive and therefore efficient categorical information (Chi, Hutchinson, & Robin, 1989; Gobbo & Chi, 1986). Experts, according to Chi, are more likely to have available and to use superordinate information to guide their categorization decisions, while novices' lack of knowledge requires them to rely on attributes that are more superficial.

The effect of an elaborated knowledge base, however, is limited to experts' area of expertise. For example, children who are experts at chess perform much like adult experts on memory span tests involving the position of chess pieces, although their memory span for digits is more comparable to that of children (Chi, 1978; Opwis, Gold, Gruber, & Schneider, 1990). In other research, children who are experts at soccer (Schneider, K orkel, & Weinert, 1989) or baseball (Recht & Leslie, 1988) perform significantly better than novices on text comprehension tests involving their area of expertise. In fact, in the Schneider *et al.* study (1989), third-grade soccer experts recalled more soccer information from a soccer story than did fifth- and seventh-grade novices. Moreover, in that study, the effects of intelligence were overridden by the effects of knowledge, in that low-IQ experts performed as well as did high-IQ experts and better than high-IQ novices, suggesting that knowledge can play an important role indeed in memory performance.

Although there is evidence that children's memory performance is more apt to be strategic when they recall more typical or familiar information than less familiar information (e.g., Bjorklund, 1988; Rabinowitz, 1984), there have been few developmental studies examining the role of expertise in children's strategic memory. One exception is a recent study by Schneider and Bjorklund (1992), in which second- and fourth-grade German children were classified according to their knowledge of soccer. The children were given two sort/recall tasks, one list consisting of categorizable soccer words and the other list consisting of words from familiar natural language categories. As expected, there were no differences between the soccer expert and novice children in recall or strategy use for words on the nonsoccer list, but soccer expert children recalled more words from the soccer list than did soccer novices. However, contrary to predictions, experts did not demonstrate more strategic behavior on the soccer list than did novices, as reflected either by sorting or by clustering. This failure to find strategy differences between experts and novices is surprising in light of previous research using typical and atypical words, in which greater familiarity of target words was associated with greater strategy use and generalization (e.g., Bjorklund, 1988).

In the present study, we investigated further this counterintuitive finding by Schneider and Bjorklund (1992) of a lack of strategic advantage for expert children dealing with information in their area of expertise. Using American children in a related but different area of expertise, we attempted to partially replicate the study by Schneider and Bjorklund, again using the expert/novice paradigm with second- and fourth-grade children in a sort/recall task. Children were classified as experts or novices for their knowledge of baseball. They were then given two sort/recall tasks, with items on one list consisting of baseball terms that could be grouped into various categories (e.g., equipment, types of plays), and items on the second list consisting of nonbaseball items from one of four natural language categories (e.g., fruits, clothing). It was predicted that children who were experts at baseball would show an advantage relative to the novice children only on the baseball list, with this advantage being due, in part, to a greater use of organizational strategies.

EXPERIMENT 1

Method

Design

In an initial session, children from the second and fourth grades were administered a test of baseball knowledge, which was used to classify them as baseball experts or novices. In a second session, children were administered one trial on each of two sort/recall tasks, in

counterbalanced order. Each task included a list of categorically-related words (i.e., four categories, five items per category), with one list containing baseball words and the second list consisting of 20 nonbaseball words.

Subjects

Subjects were 42 second-grade children (19 boys and 23 girls, mean age = 99.65 months) and 55 fourth-grade children (24 boys and 31 girls, mean age = 122.5 months) from three schools in southern Florida. Children of these ages were chosen because there is evidence that children acquire organizational strategies between the ages of 8 and 10 (cf. Schneider & Pressley, 1989), and because these were the ages tested in the Schneider and Bjorklund (1992) study. The families of the children represented a broad socioeconomic range, but most were from lower-middle to upper-middle income homes. Achievement test scores were available for all children. Although the achievement tests used varied by school and grade, making direct comparison by this variable problematic, it was possible to conclude that the novice and expert children participating in the study were academically comparable, demonstrating an average range of performance on the various achievement tests.

Materials, Tasks, and Procedures

A pretest of baseball knowledge was adapted from a test devised by Recht and Leslie (1988). The items from the Recht and Leslie test of baseball knowledge were reworded for younger children and then administered to known baseball expert and novice second- and fourth-grade children. Children in the pilot study were designated baseball experts if, according to their parents, they had knowledge of baseball rules and plays, either from playing on a team or watching baseball games on television. Those items that best discriminated between the experts and novices were retained in the final version of the test, which contained 20 multiple-choice questions tapping knowledge of baseball rules and terminology. This test was administered in groups in the classrooms, with the experimenter reading each question aloud along with the possible answers as the children read along and marked their answers. Examples of test questions are given below.

The batter steps into the *batter's box*. The batter's box is:

- *a. a rectangle on either side of home plate.
- b. the area where the batter waits for his turn.
- c. where the umpire stands behind the catcher.
- d. another name for home plate.

When a play is called a *passed ball*, who has lost control of the ball?

- a. the hitter
- *b. the catcher
- c. the pitcher
- d. the umpire

Children were classified as baseball experts or novices based on median splits, computed separately at each grade level. Mean scores on the baseball pretest, along with standard deviations, were 4.94 (1.06), 10.00 (2.07), 9.38 (1.98), and 16.39 (2.31) for the second-grade novices and experts and fourth-grade novices and experts, respectively. For the second graders, there were 14 boys and 9 girls classified as experts, and 4 boys and 14 girls classified as novices. Among the fourth graders there were 19 boys and 9 girls classified as experts, and 4 boys and 22 girls classified as novices.

Twenty baseball and nonbaseball words were generated, with each word printed on individual 3.5 × 5-in. cards. Each list comprised five words in each of four categories. The nonbaseball categories included animals, fruit, tools, and transportation, whereas the baseball categories consisted of equipment (e.g., glove, baseball), places (e.g., second base, outfield), players (e.g., pitcher, catcher), and plays (e.g., homerun, single).¹

The items on the two test lists were not equated for word length and relative familiarity. The nonbaseball list used standard stimuli comparable to those used in other memory studies (e.g., Bjorklund, 1988; Rabinowitz, 1984). The baseball list was constructed so that the items came from four well-designed categories. Adults familiar with baseball were able to identify these categories unequivocally. In this respect the baseball categories and words chosen were comparable to the soccer items in the Schneider and Bjorklund (1992) study. In order to compile the baseball list, it was necessary to use items lower in the word frequency and to use a number of two-word items. Thus, performance could be expected to be higher for the nonbaseball than the baseball list for all populations of subjects. However, the intent of this study was to examine recall and sorting differences between experts and novices, not between baseball and nonbaseball words for different groups. Using a more difficult baseball list made the expert–novice comparison more extreme, maximizing the potential discrimination between the two groups.

Children were administered the test of baseball knowledge in an initial session and were given the two sort/recall tasks in a separate session 2 to 3 weeks later. Children were told that they would be shown a set of words printed on cards that they were to sort into groups to help them remember the words for later on. The experimenter showed each card to the child, identified the word, and then placed the card on the table in front of the child in a 5 × 4 matrix. Children repeated each word after the experimenter. Items were presented in one of two predetermined random orders. Following the presentation of the last target word, children were given 2 min and told to “put the cards into groups of things that belong together, and do whatever would help you remember the words.”² Following the 2-min sorting period, the cards were covered by a black cloth and children were asked to recall as many of the words as possible in any order they wished. If a child remained silent for 10 s, the experimenter asked if he or she could remember any more items. After another 10-s silent interval, or when the child announced that he or she could remember no more, the trial was ended. Following a brief interpolated task (digit span), the second sort/recall task (the baseball list if the nonbaseball list had been presented first and vice versa) was then presented following the same procedure. Children received an eight-item practice trial prior to the experimental lists to familiarize them with the sort/recall task.

Results

Unless otherwise specified, results reported are significant at the .05 level, and analyses are reported with expertise based on median splits,

¹ The materials used in this study are available upon request from the second author, David F. Bjorklund, at the address in the authors' note.

² There were some children who did not sort all of the items into groups by the end of the 2-min sorting period. The number of experts and novices who did and did not finish sorting was examined by χ^2 analyses at each grade level. The number of fourth-grade children who did not sort was comparable for experts and novices (10 and 19%). Among second graders, significantly more novices than experts failed to sort all cards during the time limit (44 and 16%). These data are not surprising because it was likely that the second-grade novices were less familiar with these groups and therefore slower to identify meaningful groups. Items left ungrouped were treated as a single undefined category.

computed separately at the second and fourth grades. Comparable results were obtained, however, when expertise was defined in terms of a median split of the entire sample (i.e., collapsed across grade).

Recall

Mean number of words recalled (maximum = 20) by grade, expertise, and task are presented in Table 1. These data were analyzed in a 2 (grade: second vs fourth) \times 2 (expertise: baseball experts vs baseball novices) \times 2 (sex) \times 2 (list: baseball list vs nonbaseball list) analysis of variance, with repeated measures on the list factor.³ The analysis produced significant main effects of grade, $F(1,89) = 24.05$, $MS_e = 10.11$ (fourth > second), expertise, $F(1,89) = 7.06$ (experts > novices), and list, $F(1,89) = 74.40$, $MS_e = 5.6$ (nonbaseball > baseball). The only interaction to reach significance was that of expertise \times list, $F(1,89) = 4.58$. Subsequent inspection of this interaction revealed no difference in recall between experts and novices for the nonbaseball list (baseball experts = 13.28; baseball novices = 13.25). However, baseball experts recalled significantly more from the baseball list ($M = 10.74$) than did the baseball novices ($M = 8.45$), $t(196) = 4.02$.

Sorting and Clustering

As in the Schneider and Bjorklund study, strategic behavior was examined both at sorting and at recall (i.e., clustering). Chi (1985) has suggested that, at least for young children, sorting and clustering may be attributed to separate although related cognitive activities. The degree to which subjects grouped items according to adult-defined categories during the sort phase of the experiment (sorting), and the extent to which children clustered their recall according to their self-defined sorts (i.e., the sorts each child generated during the sorting phase) (clustering), were assessed separately using the Adjusted Ratio of Clustering (ARC) measure (Roener, Thompson, & Brown, 1971). This measure was chosen because it does not vary systematically with amount recalled. Chance clustering (or sorting) for ARC is 0, with maximum clustering (or sorting) being reflected by a score of 1.0. The clustering measure reflects the extent to which an organizational strategy was used at recall, and is based on the groupings each child made during the sorting phase. It measures which adjacent words at recall were classified in the same group during sorting. When child-generated categories are the basis of the clustering

³ Given the fact that the two word lists were not equated for word length and familiarity, these analyses were also run separately for each list. The results were statistically the same.

TABLE 1
 MEAN NUMBER RECALLED, SORTING (ARC), AND CLUSTERING (ARC) BY GRADE,
 EXPERTISE, AND TASK—EXPERIMENT I

	List	
	Baseball	Nonbaseball
	Second grade	
Experts ($n = 24$)		
Recall	9.17 (2.82)	11.75 (2.86)
Sorting	.22 (.30)	.66 (.45)
Clustering	.18 (.44)	.56 (.33)
Novices ($n = 18$)		
Recall	7.56 (2.71)	11.56 (2.86)
Sorting	.05 (.15)	.90 (.13)
Clustering	.23 (.43)	.71 (.35)
	Fourth grade	
Experts ($n = 29$)		
Recall	12.03 (3.06)	14.55 (2.80)
Sorting	.44 (.36)	.97 (.08)
Clustering	.27 (.26)	.87 (.18)
Novices ($n = 26$)		
Recall	9.08 (2.23)	14.42 (3.31)
Sorting	.34 (.28)	.95 (.10)
Clustering	.34 (.45)	.76 (.25)

Note. Standard deviations are in parentheses.

measure, the child determines the nature of the categories. Mean sorting and clustering scores are presented in Table 1.

Separate 2 (grade) \times 2 (expertise) \times 2 (sex) \times 2 (list) analyses of variance were conducted for both the sorting and the clustering measures. The analysis of the sorting data yielded significant main effects of grade, $F(1,88) = 20.11$, $MS_e = .085$ (fourth > second), and list, $F(1,88) = 194.3$, $MS_e = .06$ (nonbaseball list > baseball list). The expertise \times list interaction approached significance, $F(1,88) = 3.42$, $p = .07$, with subsequent tests indicating no difference in sorting between the experts and novices

for the nonbaseball list, $t(196) = 1.82$, but that the experts sorted the items of the baseball list according to adult-defined categories to a significantly greater extent ($M = .34$) than the novices ($M = .22$), $t(196) = 2.00$.

Children's clustering at recall was computed based on the categories they generated during the sorting phase (i.e., self-defined categories).⁴ The analysis of the clustering data produced significant main effects of grade, $F(1,89) = 10.58$, $MS_e = .10$ (fourth > second), and list, $F(1,89) = 53.01$, $MS_e = .13$ (nonbaseball list > baseball list). Also significant were the grade \times expertise \times list, $F(1,89) = 5.25$, and the grade \times expertise \times sex \times list, $F(1,89) = 6.10$, interactions. Inspection of the significant four-way interaction revealed that clustering was significantly greater on the nonbaseball list than the baseball list for all grade \times expertise \times sex cells except the fourth-grade novice boys ($n = 4$). The small number of subjects in this cell, however, precludes a meaningful interpretation of this effect. When collapsing across sex, there were no significant differences in clustering between the experts and the novices for the baseball lists, and in each case clustering was significantly greater for the nonbaseball than the baseball list, $t_s(89) \geq 3.67$. Thus, unlike the recall and sorting data, in which experts showed an advantage relative to novices on the baseball list, no such advantage was found for clustering.

The terms "expert" and "novice" were used in this study in a relative way. Children were classified as experts or novices based on median splits within each grade level. In fact, unlike other expert/novice studies in which experts perform exceedingly well on tasks dealing with their area of expertise, the baseball list in this study was recalled less well by both experts and novices alike, a finding that replicates that of Schneider and Bjorklund for their soccer list. Thus, expertise must be used in a relative sense here. Had the baseball-expert children truly been experts, perhaps more dramatic effects would have been obtained.

To investigate this possibility, we examined recall, sorting, and clustering between the fourth grade children whose performance on the baseball knowledge test fell within the top quartile of scores ($n = 13$) and the bottom quartile of scores ($n = 11$) for their grade level. (Second grade children were not included in this analysis because few had scores high enough to be considered "extreme experts.") These data are presented in Table 2. As can be seen, there were no changes in the pattern of performance for either the baseball or the nonbaseball list, although the magnitude of the differences for the baseball list was considerably larger

⁴ An identical analysis was run examining the clustering at recall based on adult-defined categories. This analysis produced a similar statistical pattern of results, and therefore is not reported separately.

TABLE 2
 MEAN NUMBER RECALLED, SORTING (ARC), AND CLUSTERING (ARC) BY EXPERTISE
 AND TASK FOR EXTREME FOURTH-GRADE EXPERTS AND NOVICES

	List	
	Baseball	Nonbaseball
Experts ($n = 17$)		
Recall	13.08 (2.98)	14.92 (2.78)
Sorting	.36 (.38)	.97 (.06)
Clustering	.30 (.28)	.89 (.19)
Novices ($n = 11$)		
Recall	8.18 (2.32)	14.27 (3.20)
Sorting	.25 (.19)	.98 (.05)
Clustering	.23 (.52)	.70 (.29)

Note. Standard deviations are in parentheses.

(particularly for recall) for the extreme groups, indicating that more extreme knowledge differences between experts and novices produce more extreme differences in recall performance. However, as in the analyses of the total data set, the list \times expertise interaction for the sorting and clustering data was not significant in the analyses using the extreme groups.

Discussion

The contrasts of interest in this study were between memory performance and strategy use of baseball expert and novice children for lists of categorizable baseball and nonbaseball words. Like other studies using the expert/novice paradigm, children who were classified as experts had higher recall than children classified as novices for information from their area of expertise only. There was no difference in memory performance between experts and novices when the to-be-remembered items were equally familiar to both sets of children (i.e., the nonbaseball words).

The pattern of recall data in this study was nearly identical to that reported by Schneider and Bjorklund (1992) for soccer expert and novice German children. Similarly, evidence of a strategic advantage for expert children for items from their area of expertise was minimal, as in the Schneider and Bjorklund experiment. In both studies, experts and novices showed comparable levels of clustering on the baseball (or soccer)

list. Unlike the Schneider and Bjorklund study, however, there was a marginal ($p < .07$) advantage for baseball experts on the baseball list for sorting. Although the absolute difference between the experts and novices was relatively small ($M_s = .34$ and $.22$, respectively), this finding does indicate a limited strategic advantage for expert children, with the baseball experts' greater knowledge base facilitating the use of an organizational strategy. Yet, given the nonsignificant differences in clustering between the baseball experts and novices for the baseball list, it is not likely that all of the substantial recall difference between the groups can be attributed to differences in strategy use. Rather, most of the expert/novice difference in recall for the baseball list (and for the soccer list in the Schneider and Bjorklund study) is likely attributed to item-specific effects (i.e., greater ease of activating and/or retrieving words from semantic memory) associated with a more elaborated knowledge base (Bjorklund & Bjorklund, 1985).

Subjects may have failed to perceive some of the baseball words as categorizable. This is reflected by the relatively low sorting scores in contrast to those obtained for the nonbaseball list (similar to the results of Schneider and Bjorklund for the soccer list). Thus, experts' greater recall may owe less to deliberate categorization at encoding and retrieval and more to their elaborated knowledge of the baseball terms that required less mental effort for activation of the words, thereby facilitating recall independent of strategy use.

We are reluctant to conclude, however, that having a detailed knowledge base has a minimal impact on the implementation and efficiency of strategy use. Research has clearly shown that children are more apt to use strategies effectively when they are highly familiar with the to-be-remembered items and the relations among items (e.g., Bjorklund, 1988; Rabinowitz, 1984). Other research has shown enhanced effects of knowledge base on multitrial memory tasks (e.g., Bjorklund, 1988), and it is likely that the single free-recall trial given to subjects in this experiment and the Schneider and Bjorklund study was not sufficient to prompt expert subjects to implement an organizational strategy, either at input or at output. For this reason a second study was conducted to examine changes in strategy use across trials by experts and novices using the baseball list.

EXPERIMENT 2

Method

Subjects

Subjects were 36 fifth-grade children (19 boys and 18 girls, mean age = 129.4 months) from a laboratory school in southern Florida. The families of the children were from middle

to upper-middle income homes. IQ scores were available for all children, indicating that all the children fell within an average range of intelligence.

Materials, Tasks, and Procedures

The test of baseball knowledge utilized in Experiment 1 was again used to determine level of expertise. Mean scores were 18.1, 17.7, 11.5, and 10.0 for expert males and females and novice males and females, respectively.

Using the list of baseball words and following the procedure from the first experiment, children were given four sort/recall trials using the same words on each trial. Different random orders were used on each trial.

Results and Discussion

Mean recall, sorting, and clustering over the four trials for the expert and novice children are presented in Table 3. As can be seen, levels of recall were greater for the experts than for the novices for each trial, demonstrating the experts' superior memory performance for sets of baseball words, $F(1,34) = 9.92$, $MS_e = 29.73$.

An analysis of the sorting data yielded a significant group \times trial interaction, $F(3,102) = 3.47$, $MS_e = .05$, with the experts having significantly higher sorting scores than the novices on trials 2 and 3, but not on trials 1 and 4. Also, for the experts, sorting increased significantly between trials 1 and 2, and then decreased significantly between trials 3 and 4. Sorting did not vary over trials for the novices.

Overall, clustering based on each child's self-generated groupings made during the sorting phase was higher for the experts ($M = .46$) than the

TABLE 3
MEAN RECALL, SORTING, AND CLUSTERING FOR FIFTH-GRADE BASEBALL EXPERTS AND NOVICES OVER TRIALS—EXPERIMENT 2

	Trials			
	1	2	3	4
Experts				
Recall	12.71 (3.55)	14.35 (4.12)	15.18 (2.86)	15.71 (3.35)
Sorting	.39 (.46)	.62 (.36)	.51 (.40)	.38 (.48)
Clustering	.38 (.34)	.47 (.29)	.54 (.29)	.43 (.32)
Novices				
Recall	9.11 (2.96)	11.16 (2.75)	13.11 (2.75)	13.11 (2.45)
Sorting	.35 (.33)	.32 (.32)	.36 (.35)	.37 (.35)
Clustering	.23 (.47)	.28 (.45)	.33 (.36)	.42 (.35)

novices ($M = .32$), although this difference did not reach significance, $F(1,34) = 2.62$, $MS_e = .26$, $p = .11$.

These results replicate the findings from the first experiment and from the Schneider and Bjorklund study, demonstrating significantly higher recall for experts than for novices for materials from their area of expertise. While no group differences were found for clustering, the use of multiple trials did reveal group differences in strategy use as reflected by sorting. As in Experiment 1, no group differences in sorting were seen on trial 1; however, experts demonstrated more adultlike, strategic sorting on subsequent trials (2 and 3).

GENERAL DISCUSSION

The major results of these experiments generally replicate the counter-intuitive findings recently reported by Schneider and Bjorklund (1992), indicating that expert children's advantage on a strategic memory task is mediated primarily by nonstrategic factors. The marginal strategic benefit for baseball experts for sorting in Experiment 1 and the increased sorting scores for experts on trials 2 and 3 in Experiment 2 do indicate that some of memory advantage of expert children can be attributed to a greater use of strategies; but, in general, the results of his experiment echo those of Schneider and Bjorklund and point to the item-specific effects of an elaborated knowledge base as the major contributor to expert children's advantage on a sort/recall memory task. It is possible that expert children were, in fact, behaving strategically (i.e., effortfully and deliberately), but in such a way that was not tapped by these measurements. For example, expert children may have rehearsed the baseball terms in a more elaborate way relative to novice children (cf. Ornstein & Naus, 1985). Although we do not doubt that this may have occurred, there were only small differences on the initial trial for the most obvious and facilitative strategy customarily used by children when explicitly told to sort items into meaning-based groups (i.e., sorting). Moreover, group differences in sorting were found on later trials, suggesting the appropriateness of the organizational mnemonic in a contrast of strategic functioning of expert and novice children on a sort/recall task.

It does seem clear, however, that the memory advantage expert children have over novice children is limited to their area of expertise and has a substantial nonstrategic component to it. These results, along with other findings (e.g., Chi, 1978; Recht & Leslie, 1988; Schneider *et al.*, 1989), argue that children can acquire information best when they have a detailed knowledge for the domain under study. The present findings, however, make it clear that the mechanisms for the cognitive advantage of "expert" children are many, and future research must delineate these

mechanisms and examine ways in which educators can best make use of what children already know to facilitate future learning.

REFERENCES

- BJORKLUND, D. F. (1988). Acquiring a mnemonic: Age and category knowledge effects. *Journal of Experimental Child Psychology*, *45*, 71–87.
- BJORKLUND, D. F., & BJORKLUND, B. R. (1985). Organization versus item effects of an elaborated knowledge base on children's memory. *Developmental Psychology*, *21*, 1120–1131.
- BJORKLUND, D. F., MUIR-BROADBENT, J. E., & SCHNEIDER, W. (1990). The role of knowledge in the development of children's strategies. In D. F. Bjorklund (Ed.), *Children's strategies: Contemporary views of cognitive development* (pp. 93–128). Hillsdale, NJ: Erlbaum.
- BJORKLUND, D. F., & ZEMAN, B. R. (1982). Children's organization and metamemory awareness in their recall of familiar information. *Child Development*, *53*, 799–810.
- CASE, R. (1985). *Intellectual development: Birth to adulthood*. New York: Academic Press.
- CHI, M. T. H. (1978). Knowledge structures and memory development. In R. S. Siegler (Ed.), *Children's thinking: What develops?* (pp. 73–96). Hillsdale, NJ: Erlbaum.
- CHI, M. T. H. (1985). Interactive roles of knowledge and strategies in the development of organized sorting and recall. In S. Chipman, J. Segal, & R. Glaser (Eds.), *Thinking and learning skills: Current research and open questions* (Vol. 2, pp. 457–485). Hillsdale, NJ: Erlbaum.
- CHI, M. T. H., HUTCHINSON, J. E., & ROBIN, A. F. (1989). How inferences about novel domain-related concepts can be constrained by structured knowledge. *Merrill-Palmer Quarterly*, *35*, 27–62.
- GOBBO, C., & CHI, M. T. H. (1986). How knowledge is structured and used by expert and novice children. *Cognitive Development*, *1*, 221–237.
- HARNISHFEGER, K. K., & BJORKLUND, D. F. (1990). Strategic and nonstrategic factors in gifted children's free recall. *Contemporary Educational Psychology*, *15*, 346–363.
- OPWIS, K., GOLD, A., GRUBER, H., & SCHNEIDER, W. (1990). Zum Einfluss von Expertise auf Gedächtnisleistungen und ihre Selbsteinschätzung bei Kindern und Erwachsenen [The impact of expertise on memory performance and performance prediction in children and adults]. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, *22*, 207–224.
- ORNSTEIN, P. A., BAKER-WARD, L., & NAUS, M. J. (1988). The development of mnemonic skill. In F. E. Weinert & M. Perlmutter (Eds.), *Memory development: Universal changes and individual differences* (pp. 31–50). Hillsdale, NJ: Erlbaum.
- ORNSTEIN, P. A., & NAUS, M. J. (1985). Effects of the knowledge base on children's memory strategies. In H. W. Reese (Ed.), *Advances in child development and behavior* (Vol. 19, pp. 113–148). Orlando: Academic Press.
- PRESSLEY, M., JOHNSON, C. J., SYMONS, S., MCGOLDRICK, J. A., & KURITA, J. A. (1989). Strategies that improve children's memory and comprehension of text. *Elementary School Journal*, *90*, 3–32.
- RABINOWITZ, M. (1984). The use of categorical organization: Not an all-or-none situation. *Journal of Experimental Child Psychology*, *38*, 338–351.
- RECHT, D. R., & LESLIE, L. (1988). Effect of prior knowledge on good and poor readers' memory of text. *Journal of Educational Psychology*, *80*, 16–20.

- ROENKER, D. L., THOMPSON, C. P., & BROWN, S. C. (1971). Comparison of measures for the estimation of clustering in free recall. *Psychological Bulletin*, *76*, 45–48.
- SCHNEIDER, W., & BJORKLUND, D. F. (1992). Expertise, aptitude, and strategic remembering. *Child Development*, *63*, 461–473.
- SCHNEIDER, W., KÖRKEL, J., & WEINERT, F. E. (1989). Domain-specific knowledge and memory performance: A comparison of high- and low-aptitude children. *Journal of Educational Psychology*, *81*, 306–312.
- SCHNEIDER, W., & PRESSLEY, M. (1989). *Memory development between 2 and 20*. New York: Springer-Verlag.