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Effectiveness of Elaboration Strategies for Grade School Children as a Function of Academic Achievement

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This experiment examined elaborative strategy use in grade-school children who differed in level of academic achievement. Academically low-, average-, and high-achieving grade-five students were presented with factual information about animals. Students were randomly assigned to one of three strategy conditions: elaborative interrogation (EI), repetition (R), and provided elaboration (PE). In the EI condition, children answered "why" each fact would be true of the particular animal. Repetition students rehearsed each fact aloud. Students in the PE condition studied facts containing an additional experimenter-provided elaboration. These elaborations made the relation between the animal and the behavior less arbitrary. Average- and high-achieving EI students outperformed the repetition group. There were no differences across conditions in the low-achievement group. A likely explanation for the differential results is that low achievers have less relevant knowledge to access when generating elaborations.

Over the past decade, research has highlighted developmental differences in the ability to use strategies. For example, there is greater spon-

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taneous use of elaborative strategies in adolescence and adulthood than in childhood (Beuhring & Kee, 1987a, 1987b; Pressley, 1982; Pressley & Levin, 1977; Rohwer & Bean, 1973); adolescents and adults are more consistent in their ability to use imagery than children (Pressley, Borkowski & Johnson, 1987; Schneider & Pressley, 1989); adolescents and adults are better organized and make better use of their short-term memory than younger children (Case, Kurland & Goldberg, 1982; Pressley, Cariglia-Bull, Deane & Schneider, 1987; Siegler, 1991). As a result of these findings, many recent studies have been devoted to facilitating learning in young children through strategy instruction.

Young children are especially targeted because they are considered to be less skilled and less efficient strategy users (Miller & Pressley, 1989). Even among young children, however, there is considerable variation in performance when they are instructed to use sophisticated strategies. Some of this variance may be attributable to individual differences in the ability to execute strategies (Schneider & Pressley, 1989). For example, more academically successful children might be expected to use strategies more easily than their less successful peers (Stein & Bransford, 1979). The purpose of the study reported here was to investigate the impact of achievement level on the use of elaboration strategies among elementary school children.

Instruction via elaboration strategies has been approached from two directions: providing students with preconstructed elaborations (as is found in elaborated text) or asking students to generate their own elaborations. For example, Stein, Bransford, Franks, Owings, Vye, and McGraw, (1982; Stein & Bransford, 1979) presented students with mutually interfering, arbitrary sentences (e.g., *The tall man bought the crackers*). Memory for the facts was facilitated if students were given elaborations by the experimenter that precisely explained *why* that type of man would do that particular activity (e.g., *The tall man bought the crackers <u>that were on the top shelf</u>*). However, Pressley and his associates (Pressley, McDaniel, Turnure, Wood, & Ahmad, 1987; Pressley, Symons, McDaniel, Snyder, & Turnure, 1988) found that students who *self-generated* elaborations for such sentences (after responding to a question such as "Why would that man do that type of activity?") outperformed those who were given elaborations by the experimenter. Generating elaborations (called elaborative interrogation) is thought to enhance learning because it encourages learners to access their knowledge base and make connections between what they already know and what they have to learn (Woloshyn, Willoughby, Wood, & Pressley, 1990; Willoughby, Waller, Wood, & MacKinnon, 1993; Wittrock, 1974).

Elaborative interrogation has produced significant learning gains for both adult and child populations. Adults often experience learning gains in excess of 1 SD (Pressley et al., 1987, 1988) relative to those who engage in the normal default strategy (repetition) or those who are provided with elaborations by the experimenter (as in Stein & Bransford's study, 1979). Wood, Pressley, and Winne (1990) replicated the positive learning gains from elaborative interrogation with children in grades four to eight. Wood et al. also noted developmental differences in performance. The enhanced recall performance of the older children was attributed to their ability to generate more effective and meaningful elaborations; however, Wood et al. did not assess individual differences in their study.

We suspected that differences in verbal competence might affect childrens' ability to generate appropriate elaborations, and hence, their subsequent learning. This study examines differences in achievement to determine its impact on learning. Related research suggests that verbal competence is related to successful memory performance when using an elaboration strategy (Pressley et al., 1987), such that greater competence results in greater performance. We expected that verbal competence would be important because elaborative interrogation relies heavily on verbal information for the generation of a response to the why-question. We explicitly tested the relation between verbal competence and performance in this study.

Other researchers also suggest that the learner's knowledge base plays a key role in the successful execution of the elaborative interrogation strategy (Willoughby et al., 1993; Woloshyn, Pressley, & Schneider, 1992; Wood, Miller, Symons, Canough, & Yedlicka, in press). For example, memory for material that is more easily integrated with existing knowledge (e.g., novel facts about common animals) produces greater recall relative to less easily integrated materials (e.g., novel facts about rare or unfamiliar animals, Willoughby et al., in press). When there is little or no prior knowledge, no advantage is found for elaborative interrogation over rote repetition. Another way of assessing knowledge base is by considering students' general world knowledge rather than their specific knowledge for the to-be-remembered facts. Because low-achieving students' general knowledge may be less developed than that of their more successful peers, it was hypothesized that these students would be less likely to benefit from instruction in the elaborative interrogation strategy.

In contrast to previous studies (Stein et al., 1982; Bransford, Stein, Vye, Franks, Auble, Mezynski, & Perfetto, 1982; Wong and Sawatsky, 1985) that compared only academically successful and less academically successful children, this study included a full range of ability levels (high, average, and low). In addition, the study expanded on previous research by using a more global achievement assessment for screening children as opposed to the more limited reading achievement tasks previously used.

We expected that students who differed in academic achievement would experience the elaboration strategies in different ways. For example, providing successful and average-achieving students with a strategy that activates their knowledge base (elaborative interrogation) should maximize their potential for learning by encouraging them to use their available resources. Low-achieving students, in contrast, may be less able to generate appropriate elaborations because of their more limited general knowledge and less advanced verbal skills (Perfetti, 1983). Providing these students with elaborations which clarify the associations among the facts may compensate for some of these difficulties (Bransford et al., 1992). In summary, this study assessed general achievement, verbal reasoning, and general world knowledge and their relation to memory performance across three strategies (elaborative interrogation, provided-elaborations, and repetition).

METHOD

Subjects and Design

One hundred eighty children were drawn from fifth graders attending one of six schools in a mid-sized Canadian city. All students were screened for achievement level, and based on their performance on these measures, they were grouped into one of three achievement categories (low, average, high) with 60 children in each group. Students ranged in age from 10 to 12 years (mean age = 10 years, 6.5 months; *SD* = 4 months). Males and females were distributed approximately equally across groups.

Subjects within each achievement level were then randomly assigned to one of three experimental conditions: elaborative interrogation, provided-elaborations, or repetition control, thus creating a 3 × 3 factorial design. Approximately equal proportions of males and females were represented in each condition. Assignment of subjects to groups was balanced across the schools.

Materials and Procedure

This study involved two phases: mass achievement screening of subjects and participation of selected subjects in the experimental portion of the study.

Phase I—Screening phase. To obtain a measure of the academic achievement levels, the following three subtests from the Stanford Achievement Test (SAT, 8th ed.; Madden, Gardner, Rudman, Karlsen & Merwin, 1989) were administered: Reading Vocabulary, Concepts of Number, and Spelling.

Of the 200 students who completed the screening test, 180 subjects were then grouped into one of three achievement categories based on their percentile ranking from norms for the fifth grade: "low" (scores below the 30th percentile), "average" (scores between the 30th and 70th percentile), and "high" (scores above the 70th percentile).

Phase II—Experimental phase. Subjects were given instructions and practice, presented with the study materials, and then given a memory test for the study materials. The experimental phase was approximately 30 to 45 min in duration.

Three sets of stimulus materials were constructed, with one set for each of the three conditions: elaborative interrogation, provided-elaborations, and repetition control. All sets contained stories with six declarative sentences about nine animals. The materials were taken from Wood et al. (1990) and had been pretested by these researchers to ensure that students of this age would have some appropriate general knowledge for the animals (see Appendix for a sample set of facts). Each sentence described one attribute of the animal: for example, preferred living environment, diet, major source of predation. All statements were typed in capital letters and underlined on 12- by 19-cm cards. Three cards in each set served as training examples that were used when instructions were provided to the subjects. The remaining 54 sentences were the critical to-be-learned information. The instructions and procedures were consistent with those devised by Wood et al. (1990).

For the elaborative interrogation condition, an orienting direction describing the subjects' task was typed below each base statement (e.g., "WHY WOULD THAT ANIMAL DO THAT?"). For the provided-elaborations condition, each sentence contained a nonunderlined explanatory elaboration that specified why the animal had the specified attribute. In the repetition control condition, the declarative statement was presented on its own. The following is one practice item from each condition:

Elaborative Interrogation:
BEARS LIKE TO LIVE NEAR THE WATER.
WHY DOES THAT ANIMAL DO THAT?
Provided Elaboration:
BEARS LIKE TO LIVE NEAR THE WATER SO THAT THEY CAN CATCH FISH TO EAT AND SWIM TO COOL OFF IN THE HOT WEATHER
Repetition:
BEARS LIKE TO LIVE NEAR THE WATER.

An audiotaped voice read the statements on each card in all conditions to ensure that all children were exposed to the complete fact. This was also incorporated to minimize difficulties resulting from reading ability. Before each animal set was presented, a color photograph of the animal was given to the subjects and was present throughout all the facts for that animal. The picture presentation was consistent with Wood et al. (1990), who argued that pictures would serve as a referent to ensure that all children recognized the animals.

Students were tested individually. Participants were told that they would be shown nine sets of sentences one at a time and that the sentences contained true facts about animals. They were instructed that they would hear the sentence read from an audiotape, and that they would be able to view a picture of the animal. All subjects were told that it was their "job" to remember the type of animal and the things that they heard about the animal in the story, because they would be asked to remember it later. All subjects were instructed to listen to the audio presentation and read along silently. The specific strategy instruction varied as a function of condition.

Participants in the elaborative interrogation condition were instructed to answer out loud the why-question that was asked by the tape and written below each statement. The answer was to include why that fact was true of the specific animal being discussed and not another similar animal. Repetition control students were asked to repeat the sentence aloud for the full time it was presented at a rate that would allow them to understand that the fact was true for the animal. Subjects in the provided-elaborations condition were instructed to repeat the sentence meaningfully (as in the repetition control condition) after understanding how the provided elaboration explained why the animal would do that particular activity.

Children in each group were first presented with the three sample sentences. Feedback was provided about whether their performance was consistent with the strategy instructions. For example, students in the elaborative interrogation condition were prompted to elaborate their answer additionally or generate another elaboration if their answer did not explain the relation between the animal and its habit. Similarly, repetition control and provided-elaborations students were prompted to read the sentences clearly for the full time that they were presented. Students were then given a practice memory test involving experimenter presentation of each fact in the form of a question; for example, "Which animal likes to live near the water?" Students were asked to select the appropriate animal from a typed list of the three animal names. Feedback about performance was provided for these three items.

The study stories were then presented on audiotape without feedback. After each sentence was presented on the audiotape, the child had 15 s to either read it out loud or to provide a response to the why-question. Sentences were presented in a constant order across subjects and conditions.

After studying the 54 sentences, students were given a 2-min distracter task to permit decay from short-term memory. Children answered general questions, such as: "Do you have any pets, Do you like animals, What is your favorite animal?" Students then completed the 54-item memory test. Questions were presented orally in a different random order for each child. No feedback was provided during the memory test.

TABLE 1
MEAN CORRECT MATCHING SCORES AS A FUNCTION OF CONDITION AND ACHIEVEMENT LEVEL

Achievement level	EI	PE	R
Low			
Mean	29.40	27.45	28.30
SD	7.06	7.08	6.67
Average			
Mean	36.65	30.85	30.00
SD	5.16	6.91	7.85
High			
Mean	38.80	34.55	32.10
SD	6.51	7.21	10.50

Note. Maximum score = 54 for each group; EI, elaborative interrogation; PE, provided elaboration; R, repetition; $n = 20$ for each condition within each achievement level.

RESULTS

Memory Data

The main analyses were performed on the memory test data. The means were analyzed using 18 Dunn-Bonferroni planned comparisons with an overall error rate of .15 corresponding to the overall Type I rate if a 3 × 3 analysis of variance (ANOVA) had been used with <.09 for each of the two main effects and the two-way interaction. Thus, the per-comparison error rate was $p < .008$, cutoff $t(3, 171) = 2.67$ (Kirk, 1982; Marascuilo & Serlin, 1988).

The three means (see Table 1) within each of the achievement groups were compared using three pairwise comparisons (i.e., elaborative interrogation vs provided-elaborations, elaborative interrogation vs repetition control, provided-elaborations vs repetition control). With the high-achieving students, performance in the elaborative interrogation condition significantly exceeded performance in the repetition control condition, $t = 2.89$. There were no other significant differences within the high-achieving groups. In the average group, the elaborative interrogation condition significantly outperformed the repetition control condition, $t = 2.87$. Therefore, there was strong support in these data for the hypothesis that for both average- and high-achieving students, elaborative interrogation facilitates learning relative to rehearsal. With the low achievement group, there were no significant differences among the three conditions, largest $t = .84$ for the elaborative interrogation and provided-elaborations comparison.

Within each condition, the three levels of achievement were contrasted. For elaborative interrogation, both the average- and high-achieving students outperformed the low-achieving students, smaller $t = 3.13$ for the average versus low comparison. Average- and high-achieving students did not differ significantly, $t = .93$. In the provided-elaboration condition, memory performance for the high-achieving students was significantly greater than that for the low-achieving students, $t = 3.06$. No other comparisons were significant in this condition. No significant differences were found between the three achievement levels in the repetition control condition, largest $t = 1.64$ for the low versus high comparison.

The hypothesis that the effectiveness of elaborative interrogation might vary with the ability of students was supported. We believed that the failure of the low-achieving students to benefit from elaborative interrogation might relate to their less well-developed prior knowledge (or at least, less easily accessed prior knowledge). Analyses of the quality of responses to the why-questions in the elaborative interrogation condition were undertaken to illuminate this possibility.

Relation between Quality of Answers to the Why-Questions and Memory Performance

Consistent with coding approaches used in previous elaborative interrogation research (e.g., Willoughby et al., 1993; Wood et al., 1990), responses in the elaborative interrogation condition were classified into one of three categories: adequate (i.e., logical explanations of the fact–animal association); inadequate (i.e., any elaboration that was not an explanatory elaboration; e.g., the blue whale is only found in the Arctic and Antarctic Oceans *because he only likes that water*); and failure to respond. Adequate elaborations were further scored as correct (i.e., they were logical explanations that were consistent with true facts about the animal), incorrect (i.e., they were logical explanations, but based on information not factually correct for that animal), or pat (i.e., they were explanations that were too general, for example, the western spotted skunk eats corn because that food is available in the area that it lives). Thirty-three percent of the responses were scored for adequacy by three raters with 88% agreement. There was 94% agreement for correctness. Differences between raters were resolved by discussion.

In general, the elaborations tended to be logical and correct (see Table 2 for means). Post hoc comparisons among achievement groups within response categories were evaluated using Tukey's HSD procedure, cutoff $t(57) = 2.40$, $p < .05$. High achievers produced significantly more adequate responses than low achievers (71% versus 56%, respectively), $t = 2.58$, and low achievers responded with significantly greater inadequate elaborations than the high-achieving group, $t = 3.69$. High achievers also generated more adequate correct elaborations than did low achievers, $t = 3.46$, suggesting a less-developed knowledge base for the low achievers. All other comparisons were nonsignificant.

A series of item-by-item conditional probabilities was calculated to determine the relation between the quality of answers provided at study

TABLE 2
MEAN NUMBER AND PROBABILITY OF CORRECT RECALL AS A FUNCTION OF ADEQUACY OF ANSWERS TO THE WHY-QUESTIONS IN THE ELABORATIVE INTERROGATION CONDITION

Achievement level category	Frequency		Probability of recall	
	Mean	*SD*	Mean	*SD*
Low achievement				
Inadequate	20.60	9.15	.46	.17
No response	2.95	3.83	.54	.39
Adequate	30.45	10.20	.60	.13
Correct adequate	16.95	7.13	.64	.17
Incorrect adequate	8.15	4.28	.63	.24
Pat adequate	5.35	3.01	.48	.23
Average achievement				
Inadequate	18.20	9.21	.68	.16
No response	2.85	3.59	.57	.39
Adequate	32.95	9.53	.68	.14
Correct adequate	21.80	7.94	.70	.11
Incorrect adequate	5.85	2.87	.72	.20
Pat adequate	5.30	3.10	.56	.34
High achievement				
Inadequate	13.10	9.15	.66	.20
No response	2.60	6.61	.62	.40
Adequate	38.30	9.15	.76	.11
Correct adequate	25.45	8.20	.77	.12
Incorrect adequate	8.15	3.22	.78	.14
Pat adequate	4.95	2.63	.65	.25

and subsequent memory performance (see Table 2 for means). There were no differences in the comparisons across categories within each achievement level, largest $t(57) = 2.35$ for the correct versus pat comparison in the low-achieving group.

Information and Similarities Data

The general knowledge (i.e., Information) and verbal reasoning (i.e., Similarities) subtests were scored according to the criteria provided by Weschler (1974) and were converted to age-based standard (scaled) scores ($M = 10$, $SD = 3$). For the Information subtest, an analysis of variance (ANOVA) indicated that there was a main effect for achievement level, and as predicted, there was no main effect for condition (since assignment was random), $F(2, 171) = 32.63$, $p < .001$ and $F(2, 171) = 2.62$, $p = .08$, respectively. There was also a main effect for achievement level and no main effect for condition for the Similarities subtest, $F(2, 171) = 18.09$, $p < .001$ and $F(2, 171) = .83$, $p = .44$, respectively. Pairwise comparisons across achievement levels for both subtests using post hoc

TABLE 3

CORRELATIONS OF INFORMATION AND SIMILARITIES SCORES AS A FUNCTION OF ADEQUACY OF ANSWERS TO THE WHY-QUESTIONS IN THE ELABORATIVE INTERROGATION CONDITION IN EXPERIMENT 1

Category	Information	Similarities
Inadequate	−.39*	−.44**
No response	−.16	−.21
Adequate	.44**	.51**
Correct adequate	.41**	.51**
Incorrect adequate	−.16	.19
Pat adequate	.16	.07

* $p < .01$.
** $p < .001$.

Tukey HSD procedure ($p < .05$) indicated that the high-achieving group scored significantly better than both the average- and the low-achieving groups on the Information subtest, smaller $t(3, 171) = 3.51$, and on the Similarities subtest, smaller $t(3, 171) = 3.20$. In addition, the average-achieving group's performance on the Information and Similarities subtests was significantly higher than the performance of the low-achieving group, $t(3, 171) = 2.80$ and $t(3, 171) = 4.52$, respectively. In summary, these findings suggest that high achievers had more general knowledge than either the average or low achievers, and the average achievers, in turn, knew more than the low achievers. This same pattern was true for the test of verbal reasoning skills. Together, these findings for ability support the outcomes of the Stanford Achievement Measure that was used to assign students to achievement groups.

Correlational Analysis

Correlations involving the animal matching test scores and the Information and Similarities subtests were conducted. Overall matching scores were positively correlated with both the Information ($r = .42$, $p < .001$) and the Similarities ($r = .41$, $p < .001$) scores. However, for analyses within achievement group, significant correlations were found with the low-achieving group for both subtests (smaller $r = .42$, $p < .001$ for the correlation with the Similarities subtest) and the average-achieving group for the Information subtest ($r = .34$, $p < .01$. There were no other significant correlations.

Overall, the Information and Similarities scores were positively related to the quality of responses given during the elaboration interrogation strategy (see Table 3 for correlations). That is, there was an increase in the number of adequate and correct responses and a decrease in the number of inadequate responses as Information and Similarities scores increased. The remaining correlations were not significant. Together, these findings support the hypothesis that verbal competence and knowledge contribute to memory performance and the generation of elaborations when using elaborative interrogation.

DISCUSSION

The potency of elaborative interrogation was strongest for average and high achievers. Elaborative interrogation was not as powerful with low achievers. Lower performance with the elaborative interrogation strategy could be a product of its complexity—where the task demands and lack of familiarity with these demands may have overwhelmed the low-achieving students (see Swing & Peterson, 1988; Pressley, 1986; Ghatala, Levin, Pressley, & Goodwin, 1986, for commentary on importance of adequate training). Academically successful students, on the other hand, are probably more familiar with elaboration strategies and, as a result, are able to adapt quite easily to the learning situation presented here.

Research has shown that low achievers rarely use sophisticated strategies (Garner, 1990a; 1990b). Extensive training with strategies such as elaborative interrogation may be necessary before memory facilitation can occur. For example, Wong and Sawatsky (1985) demonstrated considerable performance gains for low achievers when these learners were provided with more extensive training. In our study, however, even when students were supported with provided elaborations, learning was not facilitated beyond elaborative interrogation and repetition. Pressley et al. (1987) suggested that for some learners, providing elaborations may not supply information to the students that is congruent with their knowledge base, thus making the task confusing and difficult.

There was no difference in memory performance between the average and the high groups in the elaborative interrogation condition. It might be argued that the elaborative interrogation strategy artificially deflated the high-achieving students' performance because these more active learners (Bransford et al., 1982; Franks, Vye, Auble, Mezynski, Perfetto, Bransford, Stein, & Littlefield, 1982; Rohwer, Rabinowitz & Dronkers, 1982) would spontaneously generate other more sophisticated strategies. If this were true, it could be expected that high achievers might demonstrate higher performance if they were permitted to select their own study strategy. However, a recent study by Wood and Hewitt (in press) found that there was no difference between elaborative interrogation and a self-study condition for gifted children. The equivalent performance of the high and average achievers in the present study, therefore, appears to be a function of the elaborative interrogation strategy bolstering performance in the average group rather than deflating performance of the high-achievers.

High scores on the general knowledge and verbal reasoning measures were related to high levels of achievement. There was a similar positive relation between these measures and adequacy of response to the why-questions in the elaborative interrogation strategy. Good elaborations were more often generated by students who had more general knowledge and high verbal scores. In contrast, the generation of inadequate elaborations was related to lower general knowledge and verbal competence. The poor elaborations of the low achievers may be a function of their reduced verbal and general knowledge. This finding supports the interpretation proposed by Willoughby et al. (1993) and Woloshyn et al. (1992) that access to a well-developed knowledge base may be an important predictor of the successful implementation of the elaborative interrogation strategy.

Elaborative interrogation can promote integration and organization of new information by encouraging learners to make connections with their existing knowledge base. Our study suggests that some learners may reap great gains if they use the strategy to facilitate the continual addition and reevaluation of information throughout their educational experience but it also indicated that some learners may not exhibit the same advantages. Clearly, strategic learning is a complex activity. While this article was an initial attempt to outline the interaction between academic achievement and strategy use in the early school years, we join with other researchers in continuing to uncover the processes involved in strategic learning.

APPENDIX

Example of Grey Seal (Precisely Elaborated) Passage (Base Sentence Italic)

The grey seal lives on exposed rocky coasts so that the sun can warm the rocks before it lies on them. *Each seal within the group lives on one special spot or rock* on which it can raise its family. *The grey seal likes to live on the Maritime Coast* where there are many rocky areas for the seal to consider home. *The grey seal eats fish that are found on the bottom of the sea* which it can easily dive down to get. *The grey seal sleeps in shallow water* so that it can come to the surface without having to wake up. *The one big danger for the grey seal is the killer whale* which is one of the biggest meat eaters.

REFERENCES

Beuhring, T., & Kee, D. W. (1987a). Developmental relationships among metamemory, elaborative strategy use, and associative memory. *Journal of Experimental Child Psychology*, **44**, 377–400.

Beuhring, T., & Kee, D. W. (1987b). Elaborative propensities during adolescence: The relationships among memory knowledge, strategy behavior, and memory performance. In M. A. McDaniel & M. Pressley (Eds.), *Imagery and related mnemonic processes: Theories and applications* (pp. 257–273). New York: Springer-Verlag.

Bransford, J. D., Stein, B. S., Vye, N. J., Franks, J. J., Auble, P. M., Mezynski, K. J., & Perfetto, G. A. (1982). Differences in approaches to learning: An overview. *Journal of Experimental Psychology: General,* **111**(4), 390–398.

Case, R., Kurland, D. M., & Goldberg, J. (1982). Operational efficiency and the growth of short-term memory span. *Journal of Experimental Child Psychology,* **33,** 386–404.

Franks, J. J., Vye, N. J., Auble, P. M., Mezynski, K. J., Perfetto, G. A., Bransford, J. D., Stein, B. S., & Littlefield, J. (1982). Learning from explicit versus implicit texts. *Journal of Experimental Psychology: General,* **111,** 414–422.

Garner, R. (1990a). Children's use of strategies in reading. In D. F. Bjorklund (Ed.), *Children's strategies: Contemporary views of cognitive development* (pp. 245–268). Hillsdale, NJ: Erlbaum.

Garner, R. (1990b). When children and adults do not use learning strategies: Toward a theory of settings. *Review of Educational Research,* **60**(4), 517–529.

Ghatala, E. S., Levin, J. R., Pressley, M., & Goodwin, D. (1986). A componential analysis of the effects of derived and supplied strategy-utility information on children's strategy selections. *Journal of Experimental Child Psychology,* **41,** 76–92.

Kirk, R. E. (1982). *Experimental design: Procedures for the behaviorial sciences* (2nd ed.). Monterey, CA: Brooks/Cole.

Madden, R., Gardner, E., Rudman, H., Karlsen, B., & Merwin, J. (1989). *Manual for the Stanford Achievement Test—8th ed.* San Antonio, TX: The Psychological Corporation.

Marascuilo, L. A., & Serlin, R. C. (1988). *Statistical methods for the social and behavioral sciences.* New York: Freeman.

McDaniel & M. Pressley (Eds.). *Imagery and related mnemonic processes: Theories, individual differences, and applications* (pp. 274–297). New York: Springer-Verlag.

Martin, V., & Pressley, M. (1991). Elaborative interrogation effects depend on the nature of the question. *Journal of Educational Psychology,* **83,** 113–119.

Miller, G., & Pressley, M. (1989). Picture versus question elaboration on young children's learning of sentences containing high and low probability content. *Journal of Experimental Child Psychology,* **48,** 431–450.

Perfetti, C. A. (1983). Individual differences in verbal processes. In R. F. Dillon and R. R. Schmeck (Eds.). *Individual differences in cognition* (Vol. 1, pp. 65–104). Academic Press: New York.

Prescott, G. A., Balow, I. H., Hogan, T. P., & Farr, R. C. (1985). *Metropolitan Achievement Test.* New York: Harcourt Brace Jovanovich.

Pressley, M. (1982). Elaboration and memory development. *Child Development,* **53,** 296–309.

Pressley, M., Borkowski, J. G., & Johnson, C. J. (1987). Development of good strategy use: Imagery and related mnemonic strategies. In M. A. McDaniel & M. Pressley (Eds.), *Imagery and related mnemonic processes: Theories and applications.* New York: Springer-Verlag.

Pressley, M., Cariglia-Bull, T., Deane, S., & Schneider, W. (1987). Short-term memory, verbal competence, and age as predictors of imagery instructional effectiveness. *Journal of Experimental Child Psychology,* **43,** 194–211.

Pressley, M., & Levin, J. R. (1977). Developmental differences in subjects' associative learning strategies and performance: Assessing a hypothesis. *Journal of Experimental Child Psychology,* **24,** 431–439.

Pressley, M., McDaniel, M. A., Turnure, J. E., Wood, E., & Ahmad, M. (1987). Generation and precision of elaboration: Effects on intentional and incidental learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition,* **13**(2), 291–300.

Pressley, M., Symons, S., McDaniel, M. A., Snyder, B. L., & Turnure, J. E. (1988). Elaborative interrogation facilitates acquisition of confusing facts. *Journal of Educational Psychology,* **80**(3), 268–278.

Rohwer, W. D., & Bean, J. P. (1973). Sentence effects and noun-pair learning: A developmental interaction during adolescence. *Journal of Experimental Child Psychology,* **15,** 521–533.

Rohwer, W. D., Rabinowitz, M., & Dronkers, N. F. (1982). Event knowledge, elaborative propensity, and the development of learning proficiency. *Journal of Experimental Child Psychology,* **33,** 492–503.

Schneider, W., & Pressley, M. (1989). *Memory development between 2 and 20.* New York: Springer-Verlag.

Siegler, R. S. (1991). *Children's thinking* (2nd ed.). Englewood Cliffs, NJ: Prentice–Hall.

Stein, B. S., & Bransford, J. D. (1979). Constraints on effective elaboration: Effects on precision and subject generation. *Journal of Verbal Learning and Verbal Behavior,* **18,** 769–777.

Stein, B. S., Bransford, J. D., Franks, J. J., Owings, R. A., Vye, N. J., & McGraw, W. (1982). Differences in the precision of self-generated elaborations. *Journal of Experimental Psychology: General,* **111**(4), 99–405.

Stein, B. S., Littlefield, J., Bransford, J. D., & Persampieri, M. (1984). Elaboration and knowledge acquisition. *Memory and Cognition,* **12**(5), 522–529.

Swing, S., & Peterson, P. (1988). Elaborative and integrative thought processes in mathematics learning. *Journal of Educational Psychology,* **80**(1), 54–66.

Willoughby, T., Waller, T. G., Wood, E., & MacKinnon, G. E. (1993). The effect of prior knowledge and prose structure on immediate and delayed recall following training in elaboration. *Contemporary Educational Psychology,* **18,** 36–46.

Wittrock, M. C. (1974). Learning as a generative process. *Educational Psychologist,* **11,** 87–95.

Woloshyn, V., Pressley, M., & Schneider, W. (1992). Elaborative interrogation and prior knowledge effects on learning of facts. *Journal of Educational Psychology,* **84**(1), 115–124.

Woloshyn, V., Willoughby, T., Wood, E., & Pressley, M. (1990). Elaborative interrogation facilitates adult learning of factual paragraphs. *Journal of Educational Psychology,* **82**(3), 513–524.

Wong, B. Y. L., and Sawatsky, D. (1985). Sentence elaboration and retention of good, average and poor readers. *Learning Disability Quarterly,* **7,** 229–235.

Wood, E., & Hewitt, C. (in press). Differential efficacy of strategies among gifted learners. *Exceptionality.*

Wood, E., Miller, G., Symons, S., Canough, T., & Yedlicka, J. (in press). Examining elaborative interrogation as an instructional tool for the young learner. *Elementary School Journal.*

Wood, E., Pressley, M., & Winne, P. R. (1990). Elaborative interrogation effects on children's learning of factual content. *Journal of Educational Psychology,* **82**(4), 741–748.

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