Understanding and Remembering: Children's Knowledge about the Differential Effects of Strategy and Task Variables on Comprehension and Memorization

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Lovett, Suzanne B., and Flavell, John H. Understanding and Remembering: Children's Knowledge about the Differential Effects of Strategy and Task Variables on Comprehension and Memorization. Child Development, 1990, 61, 1842–1858. Developmental changes in knowledge about the differences between the mental processes of comprehension and memory were investigated in 3 studies using first graders, third graders, and undergraduates as subjects. 2 types of knowledge were assessed: (a) knowledge about the types of strategies appropriate to achieving the goals of comprehension, memorization, or a combination of the 2; (b) knowledge about how different task variables differentially affect comprehension and memorization tasks. With respect to the former, only the 2 older groups showed some understanding of the differential effectiveness of rehearsal and word familiarity for memory versus comprehension and thus showed some understanding of the comprehension-memory distinction with respect to strategy knowledge. As for the latter, only undergraduates correctly differentiated between the 2 mental processes with respect to the task variables of list length, item familiarity, and the categorical organization of the items.

Children's developing theories of mind are receiving a great deal of attention (Aston-tom, Harris, & Olson, 1988). One major focus has concerned young children's understanding of the distinction between their own mental processes and the objective reality of the external world. Children's ability to distinguish between real and imagined objects (Wellman & Estes, 1986) and their ability to distinguish between an object's appearance and its reality (Flavell, Flavell, & Green, 1983; Taylor & Flavell, 1984) are examples of this distinction. Wellman (1988) claims that by 3 years of age children understand the basic distinctions between objective and mental phenomena and thus have a rudimentary theory of mind. However, as Wellman notes, this is only one of the first steps in children's developing theories of mind. Subsequent steps involve the acquisition of "knowledge about the variety of distinct mental processes (e.g., the relevant differences between remembering, dreaming, guessing), . . . and about cognitive variables (e.g., factors such as item difficulty, which influence mental processes, such as remembering)" (Wellman & Estes, 1986, p. 922). Children's ability to distinguish between seeing and hearing (Flavell, 1988), seeing and knowing (Taylor, 1988a, 1988b), perceiving and memorizing (Appel et al., 1972; Yussen, Gagne, Gargiulo, & Kunen, 1974; Yussen, Kunen, & Buss, 1975), and remembering and forgetting (Johnson & Wellman, 1980; Wellman & Johnson, 1979) are all examples of these subsequent acquisitions. To further explore children's understanding of their own cognitive processes, the present set of experiments examined children's knowledge about the differences between understanding and remembering.

When reading, following directions, or studying for an exam, we are simultaneously engaged in at least two cognitive processes, comprehension and memorization. Although these two processes are highly interconnected in many cognitive tasks, they are distinctly different phenomena. In fact, the inter-
The interconnectedness of these two mental processes may make it particularly difficult for children to understand that these are distinct mental processes, each process having its own unique characteristics. For example, some strategies that help us to remember (e.g., rehearsal) are of little help in understanding. Conversely, some strategies that help us to understand (e.g., looking unfamiliar words up in a dictionary) can be of relatively little help in remembering. Although some strategies can be used effectively for either process, some cannot. Another difference between comprehension and memorization involves the type of material that can be memorized versus comprehended. Although almost any type of material can be memorized (e.g., number series, CVCs, stories), only structured or organized material such as words, sentences, paragraphs, and stories can be said to be understood (Markman, 1981). A further difference is that particular task variables can have a relatively large impact on one process, but a relatively small impact on the other. For instance, while the ease of memorization can be substantially influenced by the quantity of information to be remembered, quantity need not affect one's ability to understand the information.

Although it is important to examine children's understanding of the interconnectedness of these two processes, failing to see where the interconnectedness ends may lead to serious processing errors. Thus, in the present experiments, we investigated children's knowledge about the differences between comprehension and memory by examining their knowledge about the differential impact of particular strategy and task variables on comprehension versus memorization. Because we were interested in children's knowledge about the differences between comprehension and memorization, we selected unique representatives of each of these processes. First, for the representative memory process, we selected a task that involved as little comprehension as possible, rote recall. Second, the to-be-remembered/comprehended material that was selected was structured enough to make it a proper object of understanding, but simple enough that a child would not, for instance, automatically think of elaborative or comprehension-type strategies when asked about the best way to memorize the material. That is, words were chosen as the object of memorization. Because the confusion of comprehension (in any form) with the rote recall of word lists would seem to be the most serious and the most extreme form of this confusion, the selection of rote recall as the representative memory process and words as the object of memorization/comprehension should have provided a sensitive test of children's ability to distinguish between comprehension and memory.

Third, for the representative comprehension process, we selected a task that would involve as little memorization as possible, the comprehension of individual words. This task involved presenting subjects with a single word and asking them which picture among a set of pictures best denoted the meaning of that word (a task somewhat analogous to a picture vocabulary test). Because word comprehension is one of the most elementary forms of comprehension, it should be readily available to even young children. Researchers in the comprehension-monitoring literature have argued that word comprehension is one standard against which comprehension can be judged (Baker, 1982, 1984; Markman, 1981), and that even 5-year-olds have the necessary cognitive skills required for the effective application of a lexical standard (Baker, 1984). Moreover, others have argued that "determining the meaning of unknown words . . . is a crucial aspect of reading" (Meyers & Paris, 1978, p. 687). In sum, the word comprehension task demanded that subjects understand (but not necessarily remember) words on a list, while the recall memory task demanded that subjects remember (but not necessarily understand) the words from the list.

Children's knowledge about the differences between word comprehension and rote recall was investigated by assessing both their knowledge about the types of strategies appropriate to achieving the goals of word comprehension versus rote recall and their knowledge about the effects that particular task variables (e.g., list length, word familiarity) have on memorizing versus understanding a list of words. Previous work has shown that by 6–7 years of age, children can, and sometimes do, use rehearsal as an effective strategy to achieve memorization (Keeney, Cannizzo, & Flavell, 1967; Kennedy & Miller, 1976). In contrast, although children of this age can readily detect unfamiliar words, they may not have developed an effective means for achieving word comprehension. Meyers and Paris (1978) found that 7–8-year-olds did not think of using a dictionary to determine the meaning of unfamiliar words, and most (60%) could only suggest inappropriate or irrelevant strategies such as sounding out the word. Thus, when asked to prepare for a word com-
preparation for a word comprehension test? That is, are they aware that preparing to pictorially define a long list of familiar words can be just as easy as preparing to pictorially define a short list of familiar words? Similarly, by 9 years of age, children are aware that categorization can facilitate memorization (Moynihan, 1973), but are they aware that categorization need not facilitate comprehension? Finally, if list length and word familiarity are pitted against one another (comparing a long list of familiar words to a short list of unfamiliar words), are children able to evaluate the interaction of these variables with respect to the ease of memorization versus comprehension?

**Experiment 1**

The first task used in this experiment was a Strategy-Comparison task in which subjects were asked to decide which of three strategies was the best way (and which was the second best way) to prepare for each of the following tests: a rote recall Memory test, a word Comprehension test (subjects heard a series of words, and after each word were asked to point to its pictorial referent), and a test involving a combination of these two tasks (a Memory and Comprehension test; subjects were asked to recall a series of words, and then for each recalled word they were asked to point to its pictorial referent). The three strategies were Rehearsal; Word Definition, which provided a verbal description of unfamiliar words; and Word Definition and Rehearsal, which was a combination of the previous two strategies.

Each strategy was uniquely suited to one of the three tests. The goal of the Memory test was to be able to recite all the words on the test list. Rehearsal allowed subjects to achieve this goal with the least amount of effort. Although Word Definition and Rehearsal could be used to achieve this goal, it would involve more effort than was necessary; thus, Word Definition and Rehearsal was considered to be the second best way to prepare for the Comprehension test. The goal of the Comprehension test was to understand all the words on the list so that when the test-taker heard a word, he or she could pick out its referent from a two-picture display. To achieve this goal, subjects had to determine the meaning of unfamiliar words. Word Definition was best suited to this task. Again, Word Definition and Rehearsal could be used to achieve this goal, but it would involve more effort than was necessary; thus, Word Definition and Rehearsal was considered to be the second best way to prepare for the Comprehension test. The goal of the Memory and Comprehension test was twofold: (a) to be able to recite all the words on the test list, and (b) to understand all the words on the list so that each word’s referent could be picked out from a two-picture display. The Word Definition and Rehearsal strategy was best suited to achieving this goal. There was no obvious correct second choice for the Memory and Comprehension test since each individual strategy (Rehearsal and Word Definition) was only partially facilitative.

As previously mentioned, past researchers have reported that although 6–7-year-olds are aware that rehearsal can aid memorization, few 7–8-year-olds are aware of effective strategies to aid comprehension. However, these researchers asked children to generate appropriate strategies, and this may not have been sensitive enough to detect underlying knowledge or abilities. In the present study, we did not ask the children to generate effective strategies; rather, we presented them with various alternatives to choose from. Thus, the children only had to recognize the appropriate strategy; they did not have to generate the strategies themselves. It should also be noted that nonverbal, comparative judgment tasks such as these have been shown to be less problematic than other assessment methods (Brown, Bransford, Ferrara, & Campione, 1983; Cavanaugh & Perlmutter, 1982). Moreover, the task was structured such that the demands of the task should, if anything, bias children to select different strategies for the different tests. Thus, because of the nature of our task, 8–9-year-olds (at least) were expected to select the appropriate strategy for each of the tests and thus show an understanding of the comprehension-memory distinction. However, because 6–7-year-olds may have only just be-
come aware of the effectiveness of rehearsal for recall and may or may not be aware of the importance of resolving word comprehension failures for comprehension, it would not be surprising if they had some difficulty selecting the appropriate strategies for memorization versus comprehension.

The second task used in this experiment was a List-Comparison task in which subjects were asked to compare lists of words and decide which of two lists would be easier to learn for a Memory test and which would be easier to learn for a Comprehension test. The lists varied with respect to either length, length and word familiarity (i.e., a short list of unfamiliar words or a long list of familiar words), or the categorical organization of the list items (i.e., intracategory or intercategory items). Children 8–9 years old (at least) were expected to correctly predict the effect that each variable would have on the ease of learning the lists for each of the two types of tests. More specifically, for the lists that varied only with respect to length, 8–9-year-olds should know that a shorter list would be easier to memorize than a longer list, but that both lists would be equally easy to learn for the Comprehension test (since both lists contained only familiar words). While 6–7-year-olds were expected to know that a short list of words would be easier to memorize than a long list of words, they were not expected to be aware of the relative lack of importance of list length for comprehension; they were not expected to differentiate between the two tests.

Finally, for the lists that varied with respect to their categorical organization, only 8–9-year-olds were expected to know that an intracategory list of words would be easier to memorize than an intercategory list of words, but that both lists would be equally easy to understand (since both lists contained only familiar words). Children 6–7 years old were not expected to select the correct list for either of the tests; they were not expected to differentiate between the two tests in their list selections.

**Method**

**Subjects**

Twenty-four first graders (M = 7-0) and 24 third graders (M = 8-10) from a middle-class public school in northern California and 24 undergraduates participated in the experiment. Ten first graders, nine third graders, and 15 undergraduates were male.

**Materials**

**Strategy-Comparison task.**—The majority of list items were one-syllable words; all words were easily pronounceable and denoted common, concrete objects. All strategies and word lists were recorded on individual cassette tapes. The practice word list contained two familiar words (house, book) and two unfamiliar words (vole, truss). The test list contained 10 familiar words (e.g., leg, truck, crib) and four unfamiliar words (zarf, fob, shard, taw). The unfamiliar words were randomly distributed among the familiar words.

Three strategy (cassette) tapes were used in the experiment: Rehearsal, which repeated the words from the practice word list three times; Word Definition, which described the two unfamiliar words from the practice list (i.e., “vole, a vole is a kind of mouse that is brown”); and Word Definition and Rehearsal, which described the unfamiliar words from the practice list and repeated the whole list three times. A card pictorially depicting the contents of the tape was attached to each tape. For example, pictures of each of the unfamiliar words from the practice word list were attached to the Word Definition tape.

**List-Comparison task.**—Three different types of lists (each containing two sets of comparison lists) were used in the List-Comparison task. Length lists contained words that were familiar to the subjects and varied only with respect to length (a three-item list of familiar words vs. a six-item list of familiar words). Length/Familiarity lists varied with respect to both the length of the list and the familiarity of the words on the list (a three-item list of unfamiliar words [e.g., rasp, drag, teal] vs. a 10-item list of familiar words). Cate-
gory lists varied only with respect to the categorical organization of the words on the list (a five-item list of familiar, intracategory words [e.g., different kinds of fruit] vs. a five-item list of familiar, intercategory words). All list words were easily pronounceable and denoted common, concrete objects.

The Comprehension test and the comprehension portion of the Memory and Comprehension test were two alternative, forced-choice, picture-selection tasks in which a picture of the object denoted by each word on a list was paired with a distractor picture of a common but unrelated object.

The unfamiliar words in both tasks were deemed unfamiliar to the children since most were unfamiliar to undergraduates. Five randomly selected undergraduates (who did not participate in the experiment) were asked whether they knew the 10 unfamiliar words used in the experiment (burl was mentioned during the protocol as an example of an unfamiliar word), and all responded that 8–10 of the words were unfamiliar.

Design

Each subject was tested individually and participated in all phases of the experiment. The two tasks were presented in the order given below.

Strategy-Comparison task.—The order of presentation of the strategy tapes and the order of presentation of the different types of tests was such that each tape and each test was presented first, second, and third equally often.

List-Comparison task.—Each pair of comparison lists was presented equally often for the Memory test and for the Comprehension test, with one comparison made during the first half of the task and the second comparison made during the second half of the task (the order being counterbalanced across subjects). Each individual list in a pair was presented first and second equally often across subjects.

Procedure

Strategy-Comparison task.—Subjects were told that they were going to hear a list of words, and that some of the words on the list were words that they knew, like man, and some were words that they did not know, like burl. After listening to the practice list, subjects were told about each of the three types of strategy tapes. For example, for the Word Definition and Rehearsal strategy tape they were told, “First it tells you what the words on the list mean that you don’t know and then it has all the words from the list repeated over and over. . . . It’s called a Finding Out and Repeating Over tape because you find out what the words on the list mean that you don’t know and you also hear the whole list of words repeated over and over.” Subjects were asked to name each strategy tape after it was presented and then again after all three strategy tapes had been presented. If any subject could not supply the name for any tape, the above protocol was repeated.

Subjects were then told that they were going to pretend that they were going to receive a particular kind of test on a list of words. Subjects were told that their job was to decide which of the three strategies (i.e., “ways to get ready for the test”) would be the most effective and the most efficient means of preparation for the test (i.e., “the way that will help you to do your very best—so you don’t get any answers wrong on the test—and where you spend your time only doing things that you need to do to get ready for the test—you don’t want to do anything extra”). An example of “not doing anything extra” was given in reference to getting ready to play a game.

One of the tests was then described to the subjects. They were told either that (a) for the Saying test (i.e., Memory test), they would have to recite, in any order, all the words that were on the test list; (b) for the Pointing test (i.e., Comprehension test), the experimenter would say the words from the test list, one at a time, and each time show them two pictures and ask them to point to the picture of the word; or (c) for the Saying and Pointing test (i.e., Memory and Comprehension test), they would have to recite, in any order, all the words on the test list, and each time they said a word they would have to point to its picture. Following the description of the test, subjects practiced taking that type of test using the practice list as the test list. Based on their performance, all subjects seemed to understand the different requirements of the tests.

Subjects were then asked to listen to the test list of words and pretend they were going to be tested on this list as they had just been tested on the practice list. After listening to the test list, each strategy tape was described again. The test instructions were repeated, and before the subjects made their choice, they were asked once again to name each of the strategy tapes. Subjects were then asked to select the best way to prepare for the test and to justify their choice (i.e., “Which is the best way to get ready for a [name of test]
test—repeating over, where you hear all the words from the list repeated over and over; finding out, where you find out what the words on the list mean that you don’t know; or finding out and repeating over, where you find out what words on the list mean that you don’t know and you hear the whole list of words repeated over and over? Why did you pick this one?”). They were also asked for a second choice and for a justification of that choice (i.e., “Let’s make believe that I didn’t have this tape. If I only had these two tapes, which of these would be the best way to get ready for the test? Why did you pick this one?”). This procedure was repeated for the remaining two tests.

List-Comparison task.—Subjects were asked to help the experimenter decide which of two lists would be the easier for a particular kind of test. They were told that the experimenter wanted to give these lists to some children in another school and wanted to be sure that she gave them the ones that were the easiest to learn. Subjects were told that they could choose either one of the two lists or say that both of the lists were just as easy to learn.

For each of the six pairs of lists, subjects were told what kind of test (Memory or Comprehension) went with the pair of lists. They were then asked to listen to the lists and think about which list would be easier to learn if they were going to receive that particular kind of test. The different types of lists were introduced as follows: (a) Length lists: “Here is the first list, and here is the next list”; (b) Length and Familiarity lists: “The first list is a list of words that you know [don’t know], and the next is a list of words that you don’t know [do know]”; (c) Category lists: “The first list is a list of fruit/vegetables [different kinds of things], and the next is a list of different kinds of things [fruit/vegetables].” After subjects listened to both lists, a description of the test was given, and subjects were again told that they could select either one of the lists or say that both lists were just as easy to learn. They were also asked to justify their list selections.

Each session lasted approximately 30 min. Undergraduates received a less redundant version of the procedure.

RESULTS AND DISCUSSION

Strategy-Comparison Task

Preliminary analyses revealed no effects of gender, strategy order, or test order, so these variables were omitted from further analyses.

Strategy choices.—A two-part assessment procedure was undertaken to analyze children’s ability to differentiate between the processes of comprehension and memorization with respect to strategy effectiveness. This two-part assessment procedure first involved an examination of subjects’ strategy selections across both the Memory test and the Comprehension test, and then separate examinations of subjects’ performance on each individual test. The separate assessments were deemed necessary because it is possible for a group of children to have the correct pattern of strategy selections across both tests while only selecting the appropriate strategies above chance on one of the two tests.

Additionally, this two-part assessment procedure was undertaken first using relatively conservative criteria for determining correct strategy selections, and then using relatively less conservative criteria. To meet the conservative criteria, subjects had to choose the correct strategies in the correct order (i.e., Rehearsal followed by Word Definition and Rehearsal for the Memory test, and Word Definition followed by Word Definition and Rehearsal for the Comprehension test); to meet the less conservative criteria, subjects simply had to choose the correct pair of strategies (order of selection was ignored). Although the conservative measure provides an unambiguous assessment of children’s understanding of the comprehension-memory distinction, it may result in an underestimation of their true underlying knowledge. Recall that children had the option of choosing Word Definition and Rehearsal as the best way to prepare for the tests. This strategy would allow them to effectively prepare for any of the tests, but it was an inefficient means of preparation for both the Memory test and the Comprehension test. However, some children may have been unduly tempted to select this strategy as their first choice regardless of its inefficiency. They may have been less concerned with efficiency than with thoroughness. But if these children subsequently selected an appropriate strategy as their second choice (i.e., Rehearsal for the Memory test and Word Definition for the Comprehension test), they have shown some understanding of the differential effectiveness of Rehearsal and Word Definition for the two types of tests. The following analyses report the results first using the conservative and then using the less conservative criteria for determining correct strategy selections for each part of the two-part assessment procedure, respectively.
The first column of Table 1 shows the number of subjects in each age group who chose the correct strategies in the correct order for both the Memory test and the Comprehension test (i.e., the conservative criteria). Given the low a priori probability of showing this pattern of responding by chance, we can be quite certain that these subjects conceptually differentiated between these two tests. An overall chi-square analysis yielded a significant age effect, $\chi^2(2, N = 72) = 24.41, p < .001$, with all subsequent age-wise comparisons being significant, smallest Yates's $\chi^2(1, N = 48) = 4.36, p < .05$. Although third graders (and undergraduates) selected the correct strategies in the correct order for each type of test significantly above chance, $p < .001$ by binomial test, less than half of the third graders unambiguously displayed an understanding of the comprehension-memory distinction.

The above analyses showed surprisingly poor performance by even third graders, but a somewhat different pattern emerged when the less conservative criteria were used (i.e., selection of the correct strategies regardless of order). In particular, the difference between third graders and undergraduates was no longer significant; 75% of the third graders showed some understanding of the differential effectiveness of rehearsal and word familiarity for memory versus comprehension (see parenthetical data in Table 1).

A separate examination of the numbers of subjects who chose the correct strategies in the correct order for the Memory test (alone) revealed a significant age effect, $\chi^2(2, N = 72) = 21.69, p < .001$ (see Table 1). Both third graders and undergraduates met the conservative criteria significantly more often than first graders, smallest Yates's $\chi^2(1, N = 48) = 12.01, p < .001$, and significantly above chance, $p < .001$ by binomial test. Thus, third graders and undergraduates unambiguously displayed an understanding of the effectiveness of Rehearsal for memorization (i.e., approximately 80% selected the correct strategies in the correct order). The first graders, however, did not show such an unambiguous understanding of the effectiveness of Rehearsal for memorization. Even using the less conservative criteria, only 54% of the first graders showed some understanding of the differential effectiveness of Rehearsal over Word Definition for memorization, $p = .05$ by binomial test.

For the Comprehension test (alone), the numbers of subjects who chose the correct strategies in the correct order (see Table 1) increased significantly with age, $\chi^2(2, N = 72) = 27.77, p < .001$, with all age-wise comparisons being significant, smallest Yates's $\chi^2(1, N = 48) = 5.58, p < .025$. However, both third graders and undergraduates selected the correct strategies in the correct order significantly above chance, $p < .001$ by binomial test. When the less conservative criteria were used, the difference in frequency between third graders and undergraduates was no longer significant. That is, almost 80% of third graders showed some understanding of the differential effectiveness of Word Definition over Rehearsal for comprehension, $p < .001$ by binomial test. However, even using the less conservative criteria, the number of first graders selecting the correct strategies did not exceed chance responding, $p > .05$ by binomial test.

For the Memory and Comprehension test (see Table 1), the numbers of subjects who

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<th>Comprehension Test</th>
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<td>6 (13*)</td>
<td>5 (10)</td>
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<td>19* (22*)</td>
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Note.—Numbers in parentheses represent the numbers of subjects who selected the correct pair of strategies regardless of the order in which they were selected for those tests which had an appropriate second choice—the Memory test and the Comprehension test.

* $n = 24$.

* Significantly above chance by a binomial test.
chose the correct strategy (i.e., Word Definition and Rehearsal for their first choice; recall that there was no appropriate second choice) increased significantly with age, \( \chi^2(2, N = 72) = 5.73, p < .05 \). However, the only significant age-wise comparison was between first graders and undergraduates, Yates’s \( \chi^2(1, N = 48) = 4.36, p < .05 \). Only third graders and undergraduates chose Word Definition and Rehearsal significantly more often than chance, \( p < .001 \) by binomial test. The first graders showed no significant strategy preference.

**Strategy justifications.**—Unfortunately, children’s justifications of their strategy selections were not very informative and did not provide much insight into children’s understanding of the comprehension-memory distinction. Children rarely compared and contrasted the strategies in their justifications, and even less often explicitly compared and contrasted comprehension and memorization. Often they either described the selected strategy tape (e.g., “because it has the words over and over again”) or described how that strategy would help them prepare for the test (e.g., “you get to hear everything over so you could just remember them”). However, even if the strategy justifications do not provide much information about children’s understanding of the comprehension-memory distinction, they do supply information about children’s understanding of the task itself. Thus, subjects’ justifications of each of their six strategy choices were simply coded with respect to whether they were (a) task-appropriate (e.g., described the chosen strategy), or (b) task-inappropriate (e.g., “I don’t know”). The first author coded all justifications, while a second individual, blind to the age of the subjects, coded 25% of the protocols. The intercoder agreement ratio, computed by dividing the number of coding agreements by the sum of the agreements and the disagreements, was .93. Differences were resolved by discussion.

Approximately 57% of the first graders’ justifications, and approximately 96% of the third graders’ and the undergraduates’ justifications, were task-appropriate. In addition, all third graders and 75% of the first graders gave at least one task-appropriate justification. Because the children were able to give task-relevant justifications, we have one important piece of evidence that they understood the task.

**Summary and conclusions.**—Taken together, the results of the Strategy-Comparison task suggest that only undergraduates had a clear understanding of the comprehension-memory distinction. They were the only subjects who consistently and unambiguously showed an understanding of the differential effectiveness of rehearsal and word familiarity for memory versus comprehension. Although it cannot be argued that third graders similarly understood the comprehension-memory distinction, the results do suggest that by 8–9 years of age, children are at least beginning to understand this distinction with respect to strategy effectiveness. Third graders consistently choose the correct strategy above chance. Moreover, when a somewhat less conservative measure of strategy knowledge was used, they performed as well as the undergraduates. Interestingly, it seems that third graders may have had somewhat less difficulty selecting an effective strategy for memorization than for comprehension. On the Memory test, they consistently performed as well as the undergraduates even when the most conservative measure of strategy knowledge was used. On the Comprehension test, they only performed as well as the undergraduates when the less conservative measure was used. It may be that the 8–9-year-olds had a clear conception of memory (at least with respect to strategies) but were still in the process of developing a distinct conception of comprehension and thus had difficulty clearly distinguishing between memory and comprehension. Later in the article we will discuss some possible reasons why children had difficulty with the comprehension-memory distinction, and, in particular, why comprehension may be such a difficult concept for children to acquire.

Although the results of the Strategy-Comparison task provided evidence that 8–9-year-olds were beginning to differentiate between comprehension and memory with respect to strategy knowledge, it provided no such evidence for 6–7-year-olds; they rarely showed any clear understanding of the comprehension-memory distinction. However, a criticism repeatedly made of developmental research is that any developmental finding may simply be a reflection of the younger children’s lack of understanding of the task itself. There are at least three reasons why this does not seem to be the case here. First, all tests were practiced with the children in an attempt to ensure that they understood the basic requirements of each test. Second, all subjects, including first graders, were able to label all strategy tapes. Third, only 25% of the first graders were unable to give at least one task-appropriate justification; for the remaining 75%, at least half of their justifications
were task-appropriate. This evidence suggests that first graders understood the task.

However, even though first graders seem to have understood what was demanded of them, there is still the possibility of a response bias on their part. In fact, this possibility is supported by the relatively great frequency with which they chose Word Definition and Rehearsal for their first strategy choice across all the tests (i.e., approximately 50% of the time). A response bias of this type may reflect some implicit rule they have that the most extensive preparation for some task is the best preparation for that task regardless of the inefficiency of that preparation. Thus, if the Word Definition and Rehearsal strategy were removed, 6-7-year-olds’ performance might improve. In Experiment 2 we examined this possibility by removing the Word Definition and Rehearsal strategy tape (and the Memory and Comprehension test) from the Strategy-Comparison task. If first graders are able to differentiate between comprehension and memory, it should be readily apparent in this much simplified task.

List-Comparison Task

Preliminary analyses revealed no effects of sex, test order, or item. Further analyses were collapsed over these factors.

List choices.—The first column of Table 2 shows the numbers of subjects in each age group who correctly differentiated between the Memory test and the Comprehension test by choosing the correct list for each test for each of the three types of lists (i.e., Short list, Short/Unfamiliar list, Categorized list for the Memory test; and both lists, Long/Familiar list, both lists for the Comprehension test). Given the low a priori probability of correct differentiation by chance for any of the list types, we can be fairly certain that these subjects conceptually differentiated between the Memory test and the Comprehension test for that list type. For each list type, an overall chi-square analysis of the numbers of subjects who selected the correct lists across both tests yielded a significant age effect, smallest $\chi^2(2, N = 96) = 7.13, p < .05$. For all three list types, undergraduates correctly differentiated between the tests more often than either group of children, smallest Yates’s $\chi^2(1, N = 48) = 4.20, p < .05$. For the Length lists, only first graders and undergraduates chose the short list significantly above chance, smallest $p = .05$ by binomial test. While third graders tended not to select the short list, $p < .05$ by binomial test, they did not have a distinct preference for the short list. For the Length/Familiarity lists, both first and third graders selected the long list of familiar words, smallest $p < .001$ by binomial test, while undergraduates chose the short list of unfamiliar words, $p < .001$ by binomial test. For the Category lists, third graders seemed to respond randomly. While first graders tended not to select the uncategorized list, $p < .05$ by binomial test, they did not have a distinct preference for the categorized list. Although 75% of the undergraduates preferred the categorized list, $p < .001$ by binomial test, a somewhat surprisingly large percentage (25%) stated that both lists would be equally easy to memorize. These undergraduates commented that the two lists were the same length and were relatively short. Upon further probing at the end of the experiment, most of these undergraduates added that if the list lengths had been increased, they would have chosen the Categorized list as the easier to memorize.

Interestingly, although the children’s pattern of list selections for the Memory test was very unlike that of the undergraduates, their pattern of list selections for the Comprehension test was very much like that of the undergraduates (see Table 2). This seems mostly due to the fact that although undergraduates changed their list selections as the test in question changed, the children rarely did so in any consistent fashion. The numbers of subjects who selected the correct list for the Comprehension test did not significantly vary with age for any of the list types. For the Length lists, children had a tendency to choose either the short list or state that both lists would be equally easy to understand. Undergraduates stated that both lists would be equally easy to understand, $p < .05$ by binomial test, yet a surprisingly large percentage stated that the short list would be easier to understand. These undergraduates justified this response by stating simply that the list was shorter. For the Length/Familiarity lists,
<table>
<thead>
<tr>
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<th></th>
<th>Comprehension Test</th>
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<td></td>
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</tbody>
</table>

* Correct list choice.

b Third graders from Experiment 3.

* Significantly above chance by a binomial test.
TABLE 3
PROPORTION OF SUBJECTS IN EACH AGE GROUP WHOSE CORRECT LIST SELECTION JUSTIFICATION WAS EITHER APPROPRIATE OR INAPPROPRIATE

<table>
<thead>
<tr>
<th>Grade</th>
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<th>Comprehension Test</th>
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<td></td>
<td>Length</td>
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<td>List Justifications</td>
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<tr>
<td></td>
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<td>Inappropriate</td>
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<td>.00</td>
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<tr>
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<td>.25</td>
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Length/Familiarity List Justifications

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Category List Justifications

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<tr>
<td>3a</td>
<td>.36</td>
<td>.64</td>
</tr>
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</table>

Note.—n varies by test, list, and age (see Table 2).

* Third graders from Experiment 3.

all subjects correctly selected the long list of familiar words, smallest $p < .01$ by binomial test. For the Category lists, all three age groups correctly selected the categorized list, smallest $p < .05$ by binomial test. But again, a somewhat surprisingly large percentage of undergraduates (25%) stated that one of the two lists would be easier to understand. Two undergraduates selected the categorized list and argued that because the words were from the same category it would be easier to perform the task since they would only have to point at the pictures that depicted fruit or vegetables (i.e., distractors were always unrelated objects). Six undergraduates selected the uncategorized list and argued that because the words on the nonselected list were from the same category, one may be more likely to get them confused on the Comprehension test.

**List justifications.**—Unfortunately, as with the strategy justifications, children's list justifications of each of their correct list choices were not wholly informative. They rarely discussed the importance of the different task variables for the different tests. Thus, their list justifications for each of their correct list choices were simply coded with respect to whether they were (a) appropriate (i.e., justified their list selection by mentioning the relevant variable for the test in question, such as stating "because it has less words," "all the words on the list are the same kind of thing," or "because I know all these words and I don't know the words on the other list"), or (b) inappropriate (e.g., "I don't know"). The first author coded all justifications, while a second individual, blind to the age of the subjects, coded 25% of the protocols. The intercoder agreement ratio, computed by dividing the number of coding agreements by the sum of the agreements and the disagreements, was .98. Differences were resolved by discussion.

Table 3 presents the proportion of subjects in each age group whose coded justifications were classified into each of the two categories. For the Length and the Length/ Familiarity list justifications, the cell frequencies were too small to perform the desired 3 x 2 chi-square analyses. However, sign tests performed for each age group separately revealed that most of the time both third graders and undergraduates gave significantly more appropriate than inappropriate justifications, smallest $p = .063$ (the sole exception to this was the third graders' Length list comparison for the Memory test, $p = .172$). Although first graders often gave more appropriate than inappropriate justifications, the differences did not reach significance.
For the Category list justifications for the Comprehension test comparison, a 3 × 2 chi-square analysis revealed no significant age differences; in all three age groups, subjects gave approximately the same proportion of appropriate and inappropriate justifications. For the Memory test comparison, the cell frequencies were too small to do the overall chi-square analysis, but they were large enough to allow a children versus undergraduate comparison. This analysis revealed a significant age effect, Yates’s χ²(1, N = 37) = 12.31, p < .001, such that the children gave mostly inappropriate justifications while undergraduates gave mostly appropriate justifications. Thus, the justification data reflect children’s difficulty with this task, and, in particular, it reflects their difficulty in attending to the relevant task variables.

Summary and conclusions.—Although the results of the Strategy-Comparison task provided evidence that 8–9-year-olds were clearly beginning to work out the differences between comprehension and memorization, the results of the List-Comparison task did not. Neither first nor third graders seemed to respond differently to the two types of tests for any of the different list types. In itself, this suggests that children have little knowledge of how these task variables differentially affect comprehension and memorization. Thus, third graders only differentiated between comprehension and memorization tasks in their strategy choices while failing to do so when asked how certain variables differentially affect preparing for the two tasks.

However, a closer examination of the subjects’ responses as well as a comparison of the present results to those of previous studies suggest two preliminary alternative interpretations based on potential methodological problems. First, in comparing the children in the present experiment to those in other studies, some inconsistencies emerge. For instance, previous research has shown that third graders are likely to predict that a list of categorized items would be easier to memorize than a list of uncategorized items (e.g., Mynahan, 1973), and even first graders are able to predict that it would be easier to memorize three items than nine items (Wellman, 1978). However, the lists used in the present experiment were shorter than those used in past studies. Because the number of items per list in the present experiment fell within what children and adults generally predict to be their memory span, they may have felt that the manipulated variables would not affect memorization of the list items. In fact, as previously mentioned, undergraduates explicitly used this reasoning to justify their “incorrect” list selections for the category lists. If the experiment were modified such that at least one member of each pair of lists exceeded predicted memory span, then different results may be found (i.e., third graders may select correctly on the Memory test).

Second, a closer examination of the subjects’ justifications for some of their list selections on the Memory test suggests that some children only paid attention to word familiarity and ignored the other relevant list variables. For the Length lists and the Category lists, 57% and 50% of the first and third graders, respectively, who stated that both lists were equally easy to memorize said it was because they were familiar with all the words on both lists. For the Length/Familiarity lists, 74% of the children who stated that the long list of familiar words would be easier to memorize said it was because they were familiar with all the words on the list. This possible bias to overemphasize the importance of word familiarity may have been an artifact of the experimental procedure, in particular, the consistent presentation of the Strategy-Comparison task before the List-Comparison task. From the very beginning of the Strategy-Comparison task, subjects were warned that they would be hearing words that they did not know; in fact, the first thing that subjects were told was that they would hear a list of words, and that some of the words were words that they did not know, like burl. Thus, subjects were implicitly told to pay attention to word familiarity. It is possible that the children did not realize that word familiarity should only influence some of their list selections. If there was a word-familiarity bias that was artificially created by the noncounterbalanced presentation order of the two tasks, this would inevitably lead to adult-like responding on the Comprehension task and non-adult-like responding on the Memory task. Thus, if the List-Comparison task were presented in isolation, third graders might be more likely to display some understanding of how particular task variables affect memorization, and thus display some understanding of the comprehension-memorization distinction with respect to task variables as they did with respect to strategy variables. Furthermore, lengthening the lists may also eliminate any predisposition children have to base their responses on whether or not they knew the list items, to the exclusion of the other variables such as list length. In Experiment 3 we examine these two possible interpretations of the
results by presenting third graders with a version of the List-Comparison task in which a number of the lists were increased in length.

**Experiment 2**

First graders’ knowledge of the differential effectiveness of rehearsal and word familiarity for comprehension versus memorization may have been underestimated in Experiment 1 due to a possible response bias to select Word Definition and Rehearsal across all tests. If 6–7-year-olds are asked to choose between Rehearsal and Word Definition, their performance might improve.

**METHOD**

**Subjects**

Twenty-four first graders (mean age 6-9) from largely middle-class public schools served as subjects. Eleven of the children were male.

**Procedure**

We used the materials, design, and procedure from the Strategy-Comparison task of Experiment 1 with the exception that the Memory and Comprehension test and the Word Definition and Rehearsal tape were eliminated. Consequently, subjects were asked to decide which of the two strategies (Rehearsal or Word Definition) would be the most effective and efficient means of preparation for each of two tests (Memory test and Comprehension test).

**RESULTS AND DISCUSSION**

Preliminary analyses revealed no effects of sex, school, strategy order, or test order, so these variables were omitted from further analyses.

Twelve of the 24 first graders correctly differentiated between the Memory test and the Comprehension test by choosing the correct strategy tape for each of the two types of tests, \( p < .01 \) by binomial test. Thus, at first glance, it would seem that removing the Word Definition and Rehearsal strategy tape and the Memory and Comprehension test improved somewhat the first graders’ performance. However, as stated previously, to reasonably claim that a group of children have some understanding of the comprehension-memory distinction, they must not only show the correct pattern of strategy selections across both tests, but they must also show the correct pattern for each test individually. Examining each strategy selection on each test separately, it is clear that substantial improvement (relative to Experiment 1) occurred only on the Comprehension test. While Word Definition was chosen significantly above chance for the Comprehension test (i.e., 19 out of 24 subjects, \( p < .005 \) by sign test), Rehearsal was only chosen at chance level for the Memory test (i.e., 14 out of 24 subjects).

**Justifications.**—Subjects’ justifications of each of their two strategy choices were coded as in Experiment 1. The first author coded all justifications, while a second individual coded 25% of the protocols. The intercoder agreement ratio, computed by dividing the number of coding agreements by the sum of the agreements and the disagreements, was .90. Differences were resolved by discussion. Seventy-one percent of the justifications were coded as task-appropriate. In addition, 100% of the first graders gave at least one task-appropriate justification, an increase of almost 25% from Experiment 1.

In sum, the results of this experiment do not provide evidence that first graders clearly distinguished between comprehension and memorization with respect to strategy selection. Although a significant number of first graders selected the correct strategy across both tests, it is possible that this was in part due to guessing correctly on the Memory test.

**Experiment 3**

Third graders’ poor performance on the List-Comparison task in Experiment 1 may have occurred because (a) the list lengths may not have exceeded the children’s predicted memory span, and/or (b) this task was always preceded by the Strategy-Comparison task. In this experiment, we examine these two possible methodological problems by presenting third graders with a version of the List-Comparison task in which a number of the lists are increased in length.

**METHOD**

**Subjects**

Twenty-four third graders (mean age 8-9) from largely middle-class public schools served as subjects. Eight of the children were male.

**Materials**

We used the materials from the List-Comparison task of Experiment 1, with the exception that a number of the lists were increased in length. For the Length lists, the long list was increased from six to 15 words in length, while the short list remained three words long. For the Length/Familiarity lists, the long list of familiar words was increased from 10 to 15 words in length, while the short
list of unfamiliar words remained three words long. For the Category lists, all lists were increased from five to 10 words in length.

Procedure

We used the design and procedure of the List-Comparison task of Experiment 1, with the exception that the Memory test and the Comprehension test were described to and practiced by the children at the outset of the task. The order in which the tests were described was counterbalanced across subjects.

RESULTS AND DISCUSSION

Preliminary analyses revealed no effects of sex, school, test order, or item, so these variables were omitted from further analyses.

Third graders' list selections for each of the three types of lists are shown in Table 2. As can be seen, the pattern of results for these third graders looks very much like the pattern obtained for the original third graders. With respect to the third graders' ability to justify their correct list selections, there is, in general, only a slight improvement (see Table 3). If there is a word familiarity bias, it was not artificially produced by the noncounterbalanced ordering of the Strategy- and List-Comparison tasks.

Therefore, the results of this experiment seem to replicate the results of the original experiment. Together, these experiments provide converging evidence that although third graders are beginning to differentiate between comprehension and memorization with respect to strategy knowledge, they are not doing so with respect to task variables. There are two alternative explanations as to why this developmental sequence occurred. One explanation is that these results reflect a "true" developmental sequence. Children's understanding of the differences between the processes of comprehension and memorization may not be an all-or-none phenomenon. It may be that strategy knowledge is acquired prior to task knowledge. In fact, such developmental asynchronies are not uncommon (see Flavell, 1988). It is possible that children understand the differences between different mental processes in some domains before others. In fact, if one examines the skills and knowledge that are necessary to complete each task, the results are more understandable. For the Strategy-Comparison task, subjects were supplied with various strategies and simply asked to compare their relative effectiveness for achieving comprehension versus memorization. However, for the List-Comparison task, subjects were asked to compare two lists of words with respect to how easy they would be to memorize or comprehend. In order to successfully complete such a comparison, subjects had to (a) figure out how the lists were different, (b) decide how to memorize or comprehend the lists (i.e., generate a strategy), and (c) decide whether the way(s) in which the lists differed was important given the chosen memorization/comprehension strategy. Given that children, especially first graders, had difficulty simply recognizing an appropriate strategy (a simpler form of step [b] above), it is not surprising that the List-Comparison task was so difficult. More generally, we are proposing that understanding the effect of task variables on comprehension and memorization may entail at least some preliminary understanding of the different kinds of strategies that are used to achieve these two different goals. Once this is known, children can then begin to figure out how different task variables may differentially affect achieving these two goals. In fact, some preliminary support for such an interpretation is available in the present study: (a) 100% of the third graders who selected the appropriate lists for the Memory test also selected the appropriate strategies for the Memory test, and (b) over 80% of the third graders who selected the appropriate lists for the Comprehension test also selected the appropriate strategies for the Comprehension test. That is, while strategy knowledge was not a sufficient condition for correct list selections, it may have been a necessary one. However, given the speculative nature of this interpretation, it should be viewed cautiously.

In addition to the above analysis, the fact that almost 70% of the tested children stated that it would be easier to memorize 10–15 familiar words than to memorize rasp, dray, and teal suggests an alternative explanation as to why the children had so much difficulty with the List-Comparison task. It suggests that most children (even 8–9-year-olds) had a strong desire to avoid unfamiliar words, and that word familiarity was an overwhelmingly salient dimension that took precedence over other task variables such as list length and list organization regardless of the goal of the task. While the design of the present experiment does not allow for an adequate assessment of the validity of these two alternative interpretations, it is our opinion that both played some role in the present experiment. Moreover, if comprehension task variables other than word familiarity had been used in the present experiment, we believe that the List-Comparison task would have still been the more difficult.
General Discussion

The present research gives us some insight into children's beliefs about two very important mental activities, comprehension and memory, and possibly some insight into children's underlying theories of mind. The results of these experiments can be summarized as follows: (a) 6–7-year-olds showed no understanding of the comprehension-memory distinction; they were not able to distinguish between strategies/variables that were relevant to comprehension and strategies/variables that were relevant to memorization; and (b) while 8–9-year-olds were unable to distinguish between variables that were relevant to comprehension and variables that were relevant to memory, they did display a rudimentary understanding of the differential effectiveness of rehearsal and word definition for memorization and comprehension, respectively (i.e., when the relatively less conservative criteria were used, third graders performed as well as undergraduates).

Because we have already offered some possible explanations as to why children performed so poorly on the List-Comparison task, we will now offer some possible explanations as to why children failed to unambiguously distinguish between comprehension and memorization with respect to strategy effectiveness. This result, especially with respect to the 8–9-year-olds, was particularly surprising given the chosen strategies, the way in which comprehension and memory were operationalized, and the fact that all children practiced taking the different tests before making any judgments; these things should have provided a sensitive measure of children's understanding of the comprehension-memory distinction. Thus, what is it about this distinction that makes it difficult for children (even 8–9-year-olds) to comprehend? Perhaps third graders' incorrect strategy selections will provide an answer.

In Experiment 1, two interesting phenomena seem to have occurred. First, as previously mentioned, third graders seem to have had relatively more difficulty selecting appropriate strategies when asked how to prepare for comprehension than when asked how to prepare for memorization. This suggests that memory may be a more well-defined and more easily acquired concept for children. Second, of those children who failed to select the correct pair of strategies when asked how to prepare for comprehension, 80% selected the pair of strategies that would have been appropriate had the test been one of memorization and not comprehension (by chance, one would expect only 50% to have selected this way). (Incidentally, this finding was also true of first graders.) These two findings suggest that children may have a tendency to adopt memorization as a criteria for comprehension. One reason they may do this is because memory and memory strategies are better understood than comprehension and comprehension strategies. In fact, such a statement is somewhat supported by the present results and is not inconsistent with past research in the metamemory and metacomprehension domains (see Keeney et al., 1967; Meyers & Paris, 1978). More speculatively, children may misapply memory criteria to comprehension because they believe that memorization entails comprehension but not vice versa. Adoption of memorization as a criterion of comprehension ensures, from the child's point of view, comprehension as well as memorization. Perhaps because there is some overlap between the two processes (i.e., things that are easy to remember are generally easy to comprehend), children do not realize the necessity of adopting criteria specific to one of two overlapping tasks when asked to perform one task and not the other. Although the results of the present study only allow mere speculation as to the possible causes of children's difficulty with respect to the comprehension-memory distinction, future research directly testing these possible explanations will help us to delineate the true cause(s) of children's difficulty with this distinction.

The results of the present study also raise the issue of the extensiveness of children's difficulty in distinguishing between the processes of comprehension and memory. In the present study, we attempted to make the criteria for perfect understanding as clear and concrete as possible, and despite this effort, children nevertheless seemed to confuse understanding with remembering. However, what if instead of using word comprehension we had used story comprehension, a task not wholly distinct from story recall and much less clearly defined than word comprehension? It is our suspicion that even much older children may have confused comprehension with memorization in such a situation. More generally, what situations and task factors lead children to successfully adopt comprehension criteria for a comprehension task and what factors lead them to adopt memorization criteria instead? Given how important an understanding of the comprehension-memory distinction can be for successful learning in
an academic setting, it is important to examine the extent to which, and the situations in which, children (and even college students) sometimes fail to realize that although some material has been memorized, it has not yet been understood.

Future research in this area also needs to focus on explaining how children come to distinguish between the two processes. One explanation is that children may have many metacognitive experiences that help them come to understand the differences between these two interconnected mental processes. For example, when children first learn the Pledge of Allegiance, it is often by rehearsal and rote memorization. Such children may not realize that although they have memorized the Pledge of Allegiance, they do not understand it. Later, perhaps when trying to explain it to their parents, they may come to realize that they do not understand that which they can readily recite. Another concrete example may occur for those children who, when they first learn the alphabet, believe that LMNOP is a single letter. Later, as they learn to write the letters of the alphabet, they realize that they have misunderstood the alphabet. These experiences and the metacognitive feelings they generate may be just the types of experiences during which children gain some insight into the comprehension-memory distinction (for a more extensive discussion of how metacognitive experiences can give insight into cognitive functioning, see Brown et al., 1983; Flavell, 1985; and Pillow, 1988).

In sum, the results of the present study provided evidence that by 8–9 years of age, children are beginning to work out the comprehension-memory distinction. The difficulty that children have with this distinction may lie in the nature of comprehension. Further insight into children’s developing theories of mind and their difficulties with the comprehension-memory distinction would benefit from investigations that not only explore children’s understanding of the comprehension-memory distinction but (also) explore how their understanding of comprehension and memory is related to their understanding of other mental processes (such as perception, attention, inference). In addition, future research should include an examination of the relation of these aspects of children’s theories of mind to their cognitive behaviors. For example, how does a child’s understanding of the comprehension-memory distinction influence or mediate his or her cognitive behaviors and activities? This latter question is one that researchers in this domain ultimately need to address.

References

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