Children's Thinking

Developmental Function and Individual Differences

Third Edition

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1997; Meltzoff, 1995). These results suggest that preverbal infants and toddlers do in fact represent events in their long-term memories, and, under the right conditions, can access those memories months later.

Start here.

Implicit Memory

The memory shown by infants in the preference for novelty task or in Rovee-Collier's conditioning experiments do not seem to require conscious awareness. That is, unlike most of the memory we will discuss in this chapter, it was not *explicit*—it did not involve children consciously retrieving information from their long-term stores. It is less clear whether the memory of older infants in the deferred imitation task was explicit or not. Many researchers believe it is (Bauer, 1997), but others think otherwise (Nelson, 1996). The alternative to explicit memory is **implicit memory,** or memory for some information without being consciously aware that one is remembering (see Schacter, 1992). This is "memory without awareness," and it is not limited to preverbal infants and toddlers but occurs also in older children and adults.

One test commonly used to assess implicit memory is the *word-stem task*. Here, participants are shown a series of words (perhaps for a recognition memory test), and some time later, after being tested for recognition, are given the first three letters of words and asked to complete each word stem with the first word that comes to mind (for example, cab___ for "cable"). Some of the word stems can be completed with "old" items (that is, words that were seen on the initial task), whereas others are "new" words. Implicit memory is demonstrated when participants complete more stem words that they had experienced earlier (or complete them faster) than for the new words, despite not recognizing these "old" words. That is, although they have no awareness of experiencing the words in the previous task, their performance is nonetheless influenced by the experience.

There has been relatively little developmental research on implicit memory, but what research has been done presents a consistent picture. Although substantial age differences are found on tests of deliberate memorization (for instance, in the previous example, recognition of the words), few age differences are found when implicit memory is tested (Ausley & Guttentag, 1993; Naito, 1990; Perez, Peynircioglu, & Blaxton, 1998).

One procedure used to assess implicit memory in children involves the use of fragmented pictures of the type discussed in Chapter 6 (see Figure 6-13, page 183). Here, a fragmented picture is presented and children are asked to identify it. This is very difficult to do initially, but as more of the picture is completed, it becomes increasingly easier to identify the object. In experiments using this task, children are shown the series of degraded pictures and later given another task involving those pictures. Do children perform this second task better (faster or more accurately) for pictures they had previously seen, despite the fact that they might not remember seeing those pictures before? The answer is generally "yes," and, more important, there are few age differences in magnitude of the effects (Drummey & Newcombe, 1995; Hayes & Hennessy, 1996; Russo et al., 1995).

Let me provide an example of a study using this procedure. Hayes and Hennessy (1996) showed 4-, 5-, and 10-year-old children a series of pictures on one day and asked the children to identify the pictures (fragmented pictures) or to answer some questions about each item (for example, "What would you use an X for?"). Two days later the children were shown some of the previous pictures and some new ones to identify in a fragmented picture task. Children were also asked if they had remembered seeing each picture two days earlier. Although older children identified more pictures than the younger children, the *priming effect* (that is, the degree to which children identified "old" pictures sooner than "new" pictures) was equal for children of all ages. Also, there was no relation between how many pictures children of any age recognized (their explicit memory) and priming effects (their implicit memory). In other words, although children exhibited substantial differences in explicit memory, no developmental differences were found in implicit memory.

One interesting study of implicit memory involved showing 9- and 10-year olds pictures of preschool children, including some who had been their classmates 4 and 5 years earlier (Newcombe & Fox, 1994). Children were asked to determine whether or not each picture they were shown was that of a former classmate (an explicit recognition memory task); changes in the electrical conductance of their skin was also recorded. Greater changes in skin conductance for former classmates' pictures relative to pictures of unfamiliar children was used as a reflection of implicit recognition memory (that is, requiring no conscious awareness). Not surprisingly, children's performance was relatively poor on both the explicit and implicit tasks (although greater than expected by chance, indicating some memory of both the explicit and implicit types). However, there was no difference in skin conductance between children who performed well on the explicit task and those who performed poorly. This suggests that even the children whose performance on the explicit memory task was no greater than chance still "recognized" as many of their former classmates as those children who had performed better did. This pattern of data indicates that some children "remembered" (implicitly) more than they "knew" (explicitly). Similar results of greater implicit than explicit recognition of former classmates, using a different method of implicit memory, have been reported by Lie and Newcombe (1999).

These findings suggest that implicit memory is an early developing ability, perhaps more related to the development of semantic memory than to episodic memory (Tulving, 1987). Some theorists have speculated that implicit memory is under the control of automatic as opposed to effortful processes (Jacoby, 1991), and, following the theorizing of Hasher and Zacks (1979, see Chapter 5), that these processes show little development across childhood (Ausley & Guttentag, 1993). In fact, the procedures used to assess memory in infants (habituation/dishabituation and conditioning techniques) are likely more similar in nature to the tests used to assess implicit memory in older children than are the tests used to assess explicit memory. Recall from Chapter 6, Haith's (1993) comments of the need to bridge the gap between cognition in infancy and cognition in childhood by developing new research techniques and theories. Research using implicit memory techniques might be that bridge. In this spirit, Ausley and Guttentag (1993) suggested that "research using indirect [implicit] methods of memory assessment with children probably does provide a real avenue of continuity with infancy research, because these tests do not require an awareness of the previous occurrence of events for successful performance" (p. 254).

Remembering Events

Much of what we remember is for *events,* things that happen to us during the course of everyday life. Unlike implicit memory, **event memory** is explicit. We are aware that we are remembering. For most aspects of event memory, however, we did not specifically *try* to remember the event when we experienced it. In other words, for most event memories, the encoding of the event was unintentional. Because we had no intention of learning new information, our unintentional memory is not influenced by the use of deliberate encoding strategies, which accounts for much of the age differences observed on intentional memory tasks (see discussion of strategic memory later in this chapter). Rather, memory representations can be laid down involuntarily as part of ongoing activity, and several researchers have speculated that, in some cases, such "naturalistic learning" could actually produce higher levels of memory performance than more deliberate memorization attempts will, especially for young children (Istomina, 1975; Piaget & Inhelder, 1973).

The issue at hand is when and how it is that children remember the experiences of their everyday lives? How are these memories organized? How long do they last? And how is it that children come to acquire them?

The Development of Event Memory

A young child must master many aspects of memory if he or she is to remember important events. First, an event must be attended to and perceived. Then, the child must make some sense of that event so that it can be represented in his or her mind and recalled later on. If a child doesn't attend to the important aspects of an event or cannot make sense of what he or she experienced, there is really nothing to remember. One important thing to remember is that young children pay attention to different aspects of events than adults do and do not necessarily know what aspects of an event are important and which are trivial. For example, as adults, we know that the purpose of a baseball game is to watch the players on the field play ball. We automatically pay less attention to the field maintenance staff, the players on the bench, and most of the other spectators. However, young children don't always select the "right" things to pay attention to. At a baseball game they might spend more time watching the hot dog vendors, the bat boys, and the second base ump. What they remember of the game will thus be very different than what an older child or adult remembers.

Script-Based Memory

What is it that young children remember? One thing they tend to remember well is recurring events—what typically happens on a day-to-day basis. Katherine Nelson and her colleagues have demonstrated that preschool children tend to organize events in terms of **scripts,** which are a form of schematic organization with real-world events organized in terms of their causal and temporal characteristics (Nelson, 1993, 1996; Fivush, 1997). For example, a "fast-food restaurant" script might involve driving to the restaurant, entering the restaurant and standing in line, ordering, paying the cashier, taking the food to the table, eating, and then throwing away the trash before leaving. Scripts develop most readily for routine, repeated events. Children learn what "usually happens" in a situation, such as what happens at snack time at school, at a birthday party, or at a fast-food restaurant, and remember novel information in the context of these familiar events (Farrar & Goodman, 1992; Nelson & Gruendel, 1981).

Substantial research during the past decade or so demonstrates that even very young children organize information temporally in a script-like fashion (Bauer, 1997; Fivush, Kuebli, & Clubb, 1992), and that such schematic organization for events doesn't change appreciably into adulthood (see Fivush & Hudson, 1990; Nelson, 1996 for reviews of this literature). Perhaps even more impressive is the evidence that even preverbal infants use temporal order to remember events. Research by Patricia Bauer and Jean Mandler (1989, 1992) tested infants ranging in age from 11.5 to 20 months on imitation tasks. The toddlers were shown a sequence of events (for example, putting a ball in a cup, inverting a smaller cup on top of the larger one, and shaking the cups) and later given the opportunity to interact with the materials again. Bauer and Mandler reported that the children re-enacted the sequence of events in the same temporal order they had been shown. This finding argues for the existence of a script-style memory organization long before children are able to talk.

Young children's tendencies to organize information following familiar scripts seems to result in their tendency *not* to remember much in the way of specific (that is, nonscript) information. For example, in a study by Robyn Fivush and Nina Hamond (1990), 2.5-year-old children were asked specific questions about recent special events, such as a trip to the beach, a camping trip, or a ride on an airplane. Rather than recalling the novel aspects of these special events, the children were more apt to focus on what adults would consider to be routine information. Take, for instance, the following conversation reported by Fivush and Hamond between an adult and child about a camping trip. The child first recalled sleeping out side, which is unusual, but then remembered very routine things:

> *Interviewer:* You slept outside in a tent? Wow, that sounds like a lot of fun.
> *Child:* And then we waked up and eat dinner. First we eat dinner, then go to bed, and then wake up and eat breakfast.
> *Interviewer:* What else did you do when you went camping? What did you do when you got up, after breakfast?
> *Child:* Umm, in the night, and went to sleep. (p. 231)

It seems strange that a child would talk about such routine tasks as waking up, eating, and going to bed when so many new and exciting things must have happened on the camping trip. But the younger the child, the more he or she might need to embed novel events into familiar routines. According to Fivush and Hamond, everything is new to 2-year olds, and they are in the process of learning about their surroundings.

Why should young children's memory be so tied to recurring events? One way to answer this question is to ask what the function of memory is for young children. Katherine Nelson (1996) has taken such a functional view (consistent with ideas from evolutionary psychology discussed in Chapter 2) and believes that memory has an adaptive value of permitting children to predict the likelihood of events in the future. Basically, by remembering the likelihood of an event's occurrence in the past, one can predict its likelihood of occurring in the future. From this perspective, some events (recurring ones) are more likely to be remembered than others (single events). According to Nelson (1996), "Memory for a single, one-time occurrence of some event, if the event were not traumatic or life-threatening, would not be especially useful, given its low probability. Thus, a memory system might be optimally designed to retain information about frequent and recurrent events—and to discard information about unrepeated events—and to integrate new information about variations in recurrent events into a general knowledge system" (p. 174). Nelson makes the point that memory for routine events makes it possible for infants to anticipate events and to take a part in, and possibly control of, these events. There is no such pay-off for a novel event, and thus it makes sense to forget it.

But children do eventually remember specific events, not just some generalized event memory. In fact, although 2- and 3-year-old children may rely heavily on scripts, they have been shown to remember specific information over extended periods of time (Fivush & Hamond, 1989; Hamond & Fivush, 1991). Before presenting research evidence for this, let me provide an anecdote. Two-and-one-half-year-old Kiesha, upon seeing an ice cube wrapped in a wash cloth, began a detailed account of a bee sting she received well over six months earlier, complete with time of day, where she and the bee had been when the unfortunate incident occurred, and what Mom had done to soothe the pain. This is all the more remarkable, because Kiesha was only beginning to talk six months ago, and the accurate account she now gave was far more detailed than she could have given at the time of the sting. It must be noted that Kiesha's memory was prompted by the ice cube. Although all memory is prompted by some type of cue (Mandler, 1990), young children typically require very specific (and often repeated) cues before recalling information.

Research that demonstrates how long memories for specific events can last was presented by Hamond and Fivush (1991), who interviewed children 6 or 18 months after they had gone to Disney World. Children were either about 3 years old or 4 years old when they visited Disney World. All children recalled a great deal of information about their trip, even after 18 months. The older children recalled more details and required fewer prompts (cues) to generate recall than did the younger children. Nevertheless, recall for this single, special event was quite good, even though it did not fall nicely into a familiar routine.

The Role of Parents in "Teaching" Children to Remember

Hamond and Fivush also noted that children who talked more about the trip with their parents recalled more information about the trip. This suggests that parents can play an important role in children's early remembering, a point that has recently been made by several theorists (Fivush, 1997; Nelson, 1993) and consistent with the theorizing of Vygotsky (1978) and the sociocultural perspective discussed in Chapter 3 (Rogoff, 1998). For example, Judith Hudson (1990) has argued that children learn how to remember by interacting with their parents, that "remembering can be viewed as an activity that is at first jointly carried out by parent and child and then later performed by the child alone" (p. 172).

In most families, Hudson proposes, parents begin talking with young children about things that happened in the past. They ask questions such as, "Where did we go this morning?," "What did we see at the zoo?," "Who went with us?," "What else did we see?" From these interchanges, children learn that the important facts to remember about events are the whos, whats, whens, and wheres of their experiences. Through these conversations with their parents, they are learning to notice the important details of their experiences and to store their memories in an organized way that will be easily retrieved when needed.

In studying these interchanges between parents and preschoolers, Hudson found that parents do more than just ask the right questions. They also give the right answers when the child can't remember, showing children how the conversation should go. Young children generally show low levels of free recall, but can remember much more when specific cues are presented (Price & Goodman, 1990). In fact, Fivush and Hamond (1990) stated that "young children recall as much information as older children do, but they need more memory questions in order to do so" (p. 244). By asking repeated questions to children, adults are structuring the conversation, showing children how "remembering" is done. Moreover, by providing the missing information, children also learn that their parents will help them out when they can't seem to retrieve the information called for.

A good example of this was a conversation I overheard while riding on the Metro in Washington, D.C. A young mother and her 19-month-old daughter, Tanya, were returning home after a trip to the zoo.

Mother: Tanya, what did we see at the zoo?
Tanya: Elphunts.
Mother: That's right! We saw elephants. What else?
Tanya: (shrugs and looks at her mother)
Mother: Panda bear? Did we see a panda bear?
Tanya: (smiles and nods her head)
Mother: Can you say "panda bear?"
Tanya: Panda bear.
Mother: Good! Elephants and panda bears. What else?
Tanya: Elphunts.
Mother: That's right, elephants. And also a gorilla.
Tanya: Go-rilla!

The importance of these parent-child conversations is illustrated in research by Hilary Ratner (1984). She observed 2- and 3-year-old children interacting with their parents at home and recorded the number of times the mother asked the child about past events. She then tested the children's memory abilities. The children who showed better memory abilities at that time, and also a year later, were those whose mothers had asked them many questions about past events. Other research has shown that mothers who provide their preschool children with more evaluations of their memory performance and who use more elaborative language when talking about memory with their children, have children who remember past events better than do children with less elaborative mothers (Reese, Haden, & Fivush, 1993). That is, after making a statement about some previous event (for example, "Then we ate the cake"), elaborative mothers are more likely to provide comments that confirm or negate a child's statement (such as "That's right," "Yes," or "No") than less elaborative mothers.

The results of recent research point to the interactive role of parents and children in the process of "learning" how to remember. Thus, remembering becomes a cultural phenomenon, consistent with the ideas of Vygotsky and others who propose a sociocultural perspective of development (see Chapter 3). Parents teach children how to construct narratives (that is, create stories) in which to embed the important things that happen to them. This, in turn, allows them to share their experiences with others, a point we will return to later in this chapter. This is a practice characteristic of parents in postindustrial societies, such as ours, but it is not universal. For example, Mullen and Yi (1995) examined how frequently Korean and American mothers talked to their 3-year-old children about past events. They reported that the American mothers talked about the past with their young children nearly three times as often as the Korean mothers. This is consistent with reports that American children talk about past events more than Korean children (Han, Leichtman, & Wang, 1998), and that American adults report earlier childhood memories than Korean adults do (Mullen, 1994). This suggests that early language experience might contribute to the onset of autobiographical memory, a topic we will return to shortly.

It is also worth noting that there are differences in the event memories reported by girls and boys. When asked to remember information about earlier experienced events, girls tend to remember more information than boys (Haden & Reese, 1994; Reese, Haden, & Fivush, 1996; but not always, see Weber & Strube, 1999). For example, in a study by Haden and Reese (1994), children between the ages of 40 and 70 months participated in several sessions in which their mothers, fathers, or an experimenter asked them to recollect about salient events that had occurred in the recent past. Regardless of who interviewed the children (that is, their mothers, fathers, or the experimenter), girls remembered more details about past events than boys. These gender differences were related to ways in which parents converse with their sons and daughters about the past. Girls generally received more evaluations of their memory responses than boys. These findings suggest that the roots of females' greater event memory lie early in development and might be partly because of the way parents talk to boys and girls during attempts at remembering, with daughters being encouraged to embellish their memories more than sons are. Other research indicates that mothers talk to their male and female preschool children about different topics. For example, Flannagan, Baker-Ward, and Graham (1995) reported that in their conversations about school, mothers talked to their sons more about learning and instruction, whereas they tended to talk to their daughters more about social interactions. Thus, there are differences both in how parents talk to boys and girls about remembering events and what they are asked to remember, both of which seemingly affect what and how well children remember.

Stop here!

Children as Eyewitnesses

One topic in event memory that has attracted substantial research attention lately concerns the reliability of children as eyewitnesses. Not surprisingly, much of the recent interest has come about because of children's increasing participation in the legal system, either as victims of or as witnesses to purported crimes (Ceci & Bruck, 1993, 1995, 1998). Some of the issues of interest both to psychologists and to the legal profession are "How much do children of different ages remember of events they witnessed?," "How long do these memories last?," "How accurate are their memories?," and "How susceptible are children to suggestion?."

Age Differences in Children's Eyewitness Memories

Although there is much variability from study to study, most investigations of children's eyewitness memory begin by showing children a video of some event, having them observe some activity in their school, or involving them personally in an activity. Usually, children are not told that they will be asked to remember what they view. At some later time, often minutes after the event but in some cases days or weeks later, children are asked what they remembered (for example, "Tell me what happened in the video you saw" or "Tell me what happened in your classroom yesterday morning"). This is essentially a request for free recall. Typically, children will then be asked some more specific recall questions (for example, "What was the girl in the video wearing?" or "What did the man who came into your class yesterday morning do?"), which constitute cued recall. Often times, children will be asked some recognition memory questions (for example, "Was the girl wearing a white t-shirt?" or "Did the man play with the teddy bear?"). In some studies, the same or similar questions may be repeated, and in others questions are often intentionally suggestive, sometimes directing children to a "correct" answer ("Did the man play nicely with the teddy bear?") and sometimes leading to an "incorrect" answer ("Did the man rip the book?"). There are, of course, many variations, depending on the purpose of the study, but in most cases, children's memories for specific events are probed, often with the purpose of seeing how likely children are to change their answers or to be swayed by leading questions posed by an interviewer (see Ceci & Bruck, 1993, 1995, 1998; Qin et al., 1997 for reviews).

the remainder of their recall ("Hey, all those kids sit in the same row. I think I'll remember the rest of the kids by where they sit"). Peter Ornstein and his colleagues have championed this position, proposing that an elaborated knowledge base for sets of items allows the effective use of mnemonics (Folds et al., 1990; Ornstein, Baker-Ward, & Naus, 1988). The researchers propose that the use of memory strategies is facilitated by the automatic execution of certain parts of a task, even in very young children. Later in development, when children have a more sophisticated knowledge base and more experience, entire problem-solving routines can become automated. In support of this, several studies have demonstrated that children (and adults) more readily acquire strategies, both spontaneously and through training, and generalize a learned strategy to a new set of materials, when more familiar rather than less familiar stimulus items are used (Best, 1993; Bjorklund & Buchanan, 1989; Rabinowitz, Freeman, & Cohen, 1992).

The evidence is incontrovertible that age differences in knowledge base greatly influence age differences in memory performance. In research that specifically contrasts the role that various factors have on memory performance, such as intelligence and metamemory, knowledge base consistently accounts for more of the differences in memory performance than any other single factor (Alexander & Schwanenflugel, 1994; Hasselhorn, 1992).

Quantitative versus Qualitative Differences in Knowledge and Memory Performance

However, all knowledge is not created equal. Qualitative (rather than strictly quantitative) differences in how knowledge is structured will also influence how that knowledge is used (Ackerman, 1987; Muir-Broaddus & Bjorklund, 1990). Merely acquiring a set of "facts" about a topic does not provide the same cognitive advantage as when those "facts" are well integrated with each other and with related concepts. Research by Darlene DeMarie-Dreblow (1991) illustrates this position. In her study, second- through fifth-grade children were pretested on their knowledge of birds and their ability to remember sets of birds. Children viewed five 10- to 15-minute videos about various species of birds during a one-week period. They were then tested again for their knowledge of birds and their ability to remember sets of birds. The training was successful, in that the children demonstrated significantly greater knowledge of birds than they had on the pretest. But their memory performance was no different than it had been initially. In this case, increased knowledge did *not* result in increased memory performance (see also Muir-Broaddus et al., 1995). There are several possible reasons for this pattern of results, including that greater exposure is needed before knowledge positively influences memory (possibly through increased speed of processing) and that knowledge must be appropriately structured before any benefits to cognition are observed. The latter interpretation suggests that *qualitative* differences in the structure of knowledge are as important as *quantitative* differences in determining the effect that knowledge has on children's thinking.

Start here.

Metamemory

Metamemory refers to a knowledge of the workings of one's memory. If I were to ask you to recall your previous telephone number, for example, you would know that the information was there and that it was worth searching your memory for it. If I were to ask you for the telephone number of Bill Clinton, however, you would not bother to try to find it in the recesses of your mind. It is not there and never was, making any attempt at retrieving it ridiculous. This is an example of metamemory, knowing what you know, what you might know, and what you definitely do not know. Robert Kail (1990) described the process of remembering as occurring in a three-part sequence: diagnosis (deciding what needs to be done), treatment (executing the appropriate operations to do the job), and monitoring (checking how things are progressing). The use of strategies, discussed in earlier sections, falls within the realm of treatment. Diagnosis and monitoring are in the realm of metamemory. In general, the conclusion of research conducted over the past three decades is that metamemory knowledge increases with age, mirroring the increases typically reported for actual memory behavior (for reviews see Joyner & Kurtz-Costes, 1997; Schneider & Pressley, 1997).

How do we know what children know about their memories? One straightforward way of finding out is simply to ask them. This is essentially what was done in an interview study by Kreutzer, Leonard, and Flavell (1975). They asked children in kindergarten and the first, third, and fifth grades a series of questions about memory. For example, the children were asked if they ever forget things, if it would be easier to remember a phone number immediately after being told the number or after getting a drink of water, and if learning pairs of opposites (for example, boy/girl) would be easier or harder than learning pairs of unrelated words (for example, Mary/walk). Some kindergarten children asserted that they never forgot things, and fewer than 50% believed that phoning the friend immediately would yield more accurate recall. About half of the kindergarten and first-grade children believed that the arbitrary pairs would be easier to learn than the opposites or just as easy.

Young children's problems in evaluating task difficulty are illustrated in other situations also. For example, there are age-related improvements in making estimates of memory span (Yussen & Levy, 1975). There are similar improvements in knowing that it is easier to remember the gist of a story than to recall it verbatim (Kreutzer et al., 1975), that more study time should be apportioned to previously missed items than to previously recalled items (Masur et al., 1973), that the length of delay before testing should affect the amount of time one spends studying the target items (Rogoff, Newcombe, & Kagan, 1974), and that sets of categorized items are easier to recall than sets of noncategorized items (O'Sullivan, 1996).

In many situations, however, young children display metamnemonic competence. Even 3- and 4-year-olds realize that remembering many items is more difficult than remembering just a few (Yussen & Bird, 1979), and 4-year-olds pay more attention to the target information when they are given instructions to remember than when they are not (Baker-Ward , et al., 1984). One group of researchers reported that kindergarten and first-grade children understood reasonably well that re-learning something is faster than learning that same information for the first time and that the longer one studies something, the better one is likely to remember it (Kreutzer et al., 1975). When asked what they normally do to remember a phone number, even a majority of the kindergarten children mentioned writing it down, illustrating that they were aware of external devices for remembering information.

Children also show greater metamnemonic competence when they are in familiar surroundings. For instance, Ceci and Bronfenbrenner (1985) required 10- and 14-year-old children to perform a task in the near future (for example, take the cupcakes out of the oven) and observed their strategic time monitoring, the frequency with which they checked a clock during a waiting period. The children showed less strategic time monitoring when tested in a laboratory than in their homes, indicating to the authors that children might display greater metamemory competence in real-world versus contrived, laboratory settings (see also Wellman & Sommerville, 1980). Children might also have the metamemory knowledge but be unable to articulate it. For example, research by Cunningham and Weaver (1989) replicated preschool children's poor prediction of their memory spans when asked how many words they thought they could remember. Predictions were more accurate, however, when the children listened to a tape recording of words, stopping the tape when they had heard as many words as they thought they could recall.

One important aspect of metamemory knowledge concerns the role of strategies in facilitating memory performance. Young children are often unaware of strategies such as organization and rehearsal, or at least they are not conscious that these and related techniques can be useful when they are given a specific memory task (Justice, 1985). Children who are aware of the connection between strategic behavior and recall often remember more information than do children who do not posses such awareness (Justice et al., 1997). Furthermore, young children who have been taught a strategy are often unaware that using it facilitated their memory performance. This is illustrated in an experiment by

Ringel and Springer (1980). They trained first-, third-, and fifth-grade children to use an organizational strategy. The children were given pictures and instructed to sort them into groups on the basis of meaning and to use the groupings to help them remember the pictures. Each group of children showed improved memory performance as a result of training (relative to an earlier baseline phase). The children were then given a third memory task to assess transfer of training. After completing training but before beginning the transfer list, some of the children were provided with explicit feedback concerning their improved performance on the task, whereas others were not. The fifth-grade children transferred the organizational strategy to the new task under all conditions, whereas there was no evidence of significant transfer for any group of first graders. For the third-grade children, however, feedback made a difference. Those third graders who had received feedback concerning their memory performance transferred the organizational strategy to a new set of pictures. Third graders receiving no feedback did not, but, for the most part, reverted to a nonorganizational style characteristic of their pretraining behavior. In other words, knowing how well they were doing influenced the third-graders' generalization of a strtegy. The older children, apparently being better able to assess their own progress, did not require such feedback to transfer the strategy, and the younger children either were unable to transfer the strategy or at best needed more intensive instructions before generalization would take place. Other researchers have emphasized the role of metamemory in the effectiveness of strategy use and transfer, demonstrating that training in memory monitoring or other aspects of metamemory is responsible for the effectiveness and maintenance of strategy training (Ghatala et al., 1986; Leal, Crays, & Moely, 1985; Melot, 1998).

Given the impressive findings of the training studies, it seems reasonable that improvements in metamemory knowledge must be causally related to improvements in memory behavior, or metamemory knowledge → memory behavior. Yet, an argument can be made that metamemory knowledge grows out of memory behavior, or memory behavior → metamemory knowledge. That is, children perform memory strategies effectively and, as a result, acquire knowledge about strategies.

Research aimed at elucidating the relationship between metamemory knowledge and memory behavior in development was conducted by Cavanaugh and Borkowski (1980). They administered extensive memory and metamemory interviews to children in kindergarten and the first, third, and fifth grades. They reported that both metamemory knowledge and memory behavior increased with age but that, within a grade level, there was little significant relationship between the two factors. That is, knowing a child's level of metamemory knowledge did not predict well his or her level of memory performance when age was held constant.

Other research has shown that the relation one finds between metamemory and memory depends on the age of the child and the nature of the questions (Cantor, Andreassen, & Waters, 1985; Schneider, in press). For example, studies looking at metamemory/memory relations in categorization and elaboration tasks do not yield strong connections between the two factors until the elementary school years (Lange et al., 1990), and not consistently until about age 10 (Hasselhorn, 1992). However, when the task is simple and the metamemory questions are highly related to successful task performance, even preschool children show a significant relationship between metamemory knowledge and memory behavior. For example, in a study by Wolfgang Schneider and Beate Sodian (1988), 4- and 6-year-old children were asked to remember 10 objects that they placed in each of 10 play houses. Each house was associated with a picture of a person (for example, doctor, farmer, policeman, soccer player, sailor), and some of the items were related to the people (for example, syringe, tractor, police car, soccer ball, and ship), whereas others were not (for example, comb, letter, key, flower, and lamp). For both the 4- and 6-year-olds, children who were aware of the importance of associating the objects (syringe, tractor) with the people (doctor, farmer) performed better on the memory test. Thus, the relation between metamemory and memory is significant even for 4-year-olds when the task is sufficiently simplified and the metamemory questions are immediately pertinent to the memory behavior.

In general, the research evidence points to a bidirectional relationship between metamemory knowledge and memory behavior (Borkowski, Milstead, & Hale, 1988; Schneider & Bjorklund, 1998). Metamemory knowledge can result in improved memory performance, which, in turn, results in enhanced metamemory knowledge. Metamemory is obviously an important component in children's memory development. However, research findings suggest that metamemory competence is as much a consequence as it is a cause of competent memory behavior, the two being intimately entwined, and that this relationship varies as a function of age and task variables. Also, metamemory interacts with other factors. For example, as we noted earlier, children who are experts in a domain will remember more in that domain than will less-expert children. However, expert children's memory performance will be greatest when they also have substantial metamnemonic knowledge (Schneider, Schlagmüller, & Visé, 1998).

Motivation

Although every school teacher and most folks without Ph.D.s in cognitive psychology know that motivation is an important factor in learning and remembering, it is only recently that developmental psychologists have considered this in studies of memory development (Guttentag, 1995; Renninger, Hidi, & Krapp, 1992). Perhaps motivation was not seen as a "cognitive" factor and thus only indirectly related to "real" memory. This oversight has begun to be rectified in recent years, as researchers examine the role of motivation in children's memory performance.

Scott Paris (1988) outlined a model of memory based on **subjective expected utility,** which, in this context, basically refers to a person's beliefs about the usefulness of implementing any particular strategy. Paris notes that people of all ages often use memory strategies because they believe they will improve task performance (recall that strategies are defined as cognitive operations that are goal directed with the purpose of enhancing task performance). Moreover, young children often have misconceptions about the usefulness of strategies. That is, they might be unaware that a particular strategy is or is not effective. As a result, task performance can be hindered until children acquire a better "feel" for the usefulness of a strategy. In some situations, however, children's faulty beliefs about the effectiveness of a strategy can be beneficial, such as in utilization deficiencies, in which children use a strategy without apparent benefit (Miller, 1990). In such situations, children might believe that the strategy is indeed helping them, which might cause them to continue using it, which in turn could eventually lead to more effective (and beneficial) strategy use (Bjorklund et al., 1997).

Several studies have looked at motivation by providing explicit rewards to children. For example, in an experiment by Anthony Cuvo (1974), children were given sets of words to rehearse and remember. Some words were identified as 10-cent items (that is, children would get a dime if they remembered them) whereas others were identified a 1-cent items. Fifth-grade children recalled more 10-cent words than 1-cent words, apparently because they rehearsed the former more than the latter. Similar findings have been reported for second-grade children, reflecting the fact that even 7- and 8-year-olds can modify their strategy use given the proper motivation (Kunzinger & Witryol, 1984).

In other research, children's study time has been influenced by the provision of specific incentives (Guttentag, 1995; O'Sullivan, 1993). For example, in a study by Julia O'Sullivan (1993), 4-year-old children used more sophisticated strategies and spent less time engaged in off-task behavior (that is, not paying attention) when the incentive for "good" memory performance was a highly valued toy (a box of crayons) versus a less-valued toy (a pencil). What is interesting is that the more sophisticated study behaviors did not result in enhanced memory performance, a finding similar to that reported by Robert Guttentag (1995) for third-grade children. Whether children in these experiments realized the limited effectiveness of their strategy use was not assessed, but these findings provide further evidence of children's poor metamemory concerning strategy use. However, they also provide support for the argument that strategy use is effortful and might not immediately improve task performance. Presumably, their continued use of the strategy would eventually lead to improved task performance. Thus, their poor metacognition, in this case, might be adaptive (Bjorklund, 1997a), in that were the children aware that their increased efforts were not leading to enhanced task performance, they might have resorted to an easier, but nonstrategic approach. Instead, their poor self-monitoring led to increased practice with the (currently) ineffective strategy, which, in time, should increase in effectiveness.

Closely related to the concept of motivation is that of *interest*. Children will presumably spend more time on tasks involving topics that are interesting to them. This might seem obvious, but until recently relatively little research has been done in this area. In general, there is evidence that working with interesting as opposed to uninteresting materials produces "deeper" cognitive processing (see Renninger et al., 1992; Tobias, 1994; but see O'Sullivan, 1997). More specifically, recent research has emphasized the importance of interest, particularly in instruction. According to Michael Pressley and his colleagues (1992), "many aspects of good strategies instruction are designed to increase interest in acquiring strategies" (p. 352). Interest breeds success, which in turn should increase children's interest in learning even more complex and effective strategies (see also Renninger, 1992).

Another factor that has been related to motivation is children's self-attributions of success and failure. That is, do children see their performance primarily as the result of effort, innate ability, or luck. Several researchers have demonstrated that children's attributions of success and failure influence their performance on a wide range of cognitive tasks, including memory (see Borkowski et al., 1988).

Culture and Memory Strategies

Cultures clearly differ in the extent to which they support and encourage particular memory strategies (Kurtz, 1990; Mistry, 1997). Rehearsal, organization, and elaboration, for example, are especially helpful to children from Western industrialized societies, whose school activities involve a great deal of rote memorization and list learning. Yet, these same strategies might not be so useful to unschooled children from nonindustrialized societies, whose most important memory tasks might involve recalling the location of objects (water; game animals) in a natural setting or remembering instructions passed along in the context of proverbs or stories.

For example, in list-learning experiments, Western children rely heavily on strategies acquired at school and clearly outperform their unschooled peers from nonindustrialized societies (Cole & Scribner, 1977; Rogoff & Waddell, 1982). The picture is much different, however, when the memory task is embedded in a meaningful and structured context. When tests are structured so that people must recall organized prose (as in a story) or items from spatially organized arrays (as in familiar scenes), few cultural differences in memory performance are found (see Rogoff, 1990).

A particularly clear demonstration of the importance of cultural context on memory performance is provided by a study by Rogoff and Waddell (1982). Previous research had shown that Guatemalan Mayan children's memory for lists of items was significantly worse than that of American children of the same age (Kagan et al., 1979). Rogoff and Waddell (1982) showed 9-year-old Guatemalan Mayan and U.S. children three-dimensional, culturally appropriate scenes of a model town. Twenty objects, such as animals, cars, people, and household items, were placed within the scene, and children were asked to remember the objects and their location. The 20 objects were then mixed into a pool of 80 objects, and, after a brief delay, the children were asked to reconstruct the scene. Counter to the earlier list-learning experiment, the Mayan children actually performed slightly *better* than the U.S. children did on the reconstruction task. These results clearly illustrate that the nonschooled, rural children's poor memory performance on the list-learning tasks was not caused by deficient memory abilities, but rather by the context in which memory was studied.

Greater performance for unschooled relative to schooled children have been found in other tasks as well. For example, unschooled Australian aboriginal children were better than their Anglo-Australian peers at remembering the location of objects in natural settings (Kearins, 1981), and African adolescents displayed better recall for orally transmitted stories than American adolescents (Dube, 1982). Indeed, Western children actually remember less if they try to rehearse or to organize information in these latter kinds of memory tasks (Rogoff, 1990).

These findings make perfectly good sense when viewed through the "lens" of Vygotsky's sociocultural theory (see Chapter 3): Cognitive development always occurs within a particular cultural context, which not only defines the kinds of problems that children must solve, but also dictates the strategies (or "tools of intellectual adaptation") that will enable them to master these challenges (Ellis, 1997).

Not all cultural differences in strategic memory functioning are between children in schooled and nonschooled societies. For example, studies have linked differences in American and German attitudes toward intellectual development to differences in memory strategy use (Carr et al., 1989; Kurtz et al., 1990). In these studies, second and third graders in Germany and the United States were trained to use a memory strategy (specifically, to recall related items together in clusters). Before training, children were given a battery of tests assessing their verbal and nonverbal intelligence, academic self-esteem, metamemory, spontaneous use of strategies, and attributional beliefs about learning (whether they attributed success and failure to luck, their own effort, or some inherent ability). Children's parents and teachers also answered questionnaires regarding their beliefs about children's academic success or failure and the extent of instruction in or encouragement of strategic thinking that occurred in the home and at school.

An initial finding was that the German children were significantly more strategic on their own than the American children were, although the American children did benefit from the memory training. Despite the German children's superiority on the memory task, however, the American children had more positive academic self-esteem and were more apt to attribute academic outcomes to effort (that is, hard work) than the German children were, something that has been associated with enhanced academic achievement (Borkowski & Turner, 1988; Dweck & Leggett, 1988). The German children, on the other hand, were more apt to believe that their success or failure in school-related tasks was due to ability (that is, inborn traits). Moreover, American children who believe in effort perform better than American children holding other views, and German children who believe in natural ability perform better than German children who hold other views (Kurtz, 1990). This shows that when studies of American children report that belief in effort is related to higher academic achievement, it is culturally dependent—holding only for that culture. Different patterns of performance are found for children from different cultures.

The source of this cultural difference in strategy use and attribution of success can be traced to the behaviors and attitudes of children's parents and teachers. German parents give children more direct strategy training, buy them more games that require strategic thinking, and check their homework more than do American parents. German teachers reported more direct strategy instruction than did American teachers (Carr et al., 1989; Kurtz et al., 1990). German parents and teachers were more likely to attribute children's academic performance to ability, whereas their American counterparts were more likely to attribute it to effort.

Consistency and Stability of Memory

With a chapter titled "Memory," your expectation may be that we are talking about a single cognitive skill. Memory can be tapped in different ways (recognition, recall), can occur in different situations (event memory, school- or laboratory-type tasks), and can involve deliberate strategies or be indirect and unintentional, but the implication is that there is a single, underlying "memory" ability. This, of course, is an empirical question, and there is every reason to believe that the phenomenon we call "memory" is not a domain-general skill but, rather, comprises different domain-specific abilities.

Is "Memory" a Domain-General Faculty or a Set of Domain-Specific Abilities?

The way to assess this question is to administer different memory tasks to children and note the intertask correlations. That is, do children who do well on one memory task perform well on others, and do children who perform poorly on one task perform poorly on others? Early developmental studies using this technique reported relatively high correlations among tasks, with the correlations increasing with age (Cavanaugh & Borkowski, 1980; Kail, 1979). These studies used strategic, laboratory tasks, and the results suggest that not only is there a general memory ability, but also a general strategy ability, at least for children 8 years of age and older. (Recall that young children show little spontaneous strategic behavior, at least on the tasks used in these investigations.)

Later research used a wider variety of tasks, including laboratory tasks such as digit-span and sort-recall, and "everyday" memory tasks, such as story recall (Kurtz-Costes, Schneider, & Rupp, 1995; Schneider & Weinert, 1995). These studies reported lower intertask correlations, suggesting that deliberate memory could better be thought of as a set of specific abilities rather than as a domain-general faculty. For example, Kurtz-Costes and colleagues (1995) administered a set of 12 memory tasks to 5-, 7-, and 9-year-old children, including several reflecting everyday activities (for example, remember to remind the interviewer of something at the end of the session; "shopping" for items at a store), school-related tasks (for example, remembering a geography "lesson"; recalling a story), and laboratory tasks (sort-recall and paired associates). The researchers reported little intertask consistency among the 12 tasks at any age, with only slightly more correlations reaching statistical significance than would be expected by chance. The average correlations among tasks did increase slightly with age (average correlations = .07, .08, and .13 for 5-, 7-, and 9-year-olds, respectively), but, overall, little developmental differences were observed.

In related research, Schneider and Weinert (1995) expanded the type of tasks given to children, including a variety of memory-span tasks (word span, sentence span), sort-recall, and several story-recall tasks. As part of a longitudinal study, they assessed the intertask correlations in the same group of children at 4-, 6-, 8-, and 10-years old. Schneider and Weinert reported few developmental patterns. But they did find relatively high intertask correlations among the two span tasks and the two story-recall tasks. That is, consistency was high only when the parallel measures of story recall and word span were used. Like the results of Kurtz-Costes and her colleagues, these findings are consistent with the position that there is no unitary "memory" construct, nor little change in the relationship among memory tasks with development.

How Stable Is Memory Performance over Time?

One issue of interest to developmental psychologists is that of *stability*. In this case, stability refers to maintaining the same rank order with respect to ability over time. That is, will children who remember well at one age also remember well on a similar task several years later? Research investigating stability requires longitudinal assessment, and such expensive and laborious work has rarely focused on basic cognitive processes such as memory. One notable exception is the Munich Longitudinal Study on the Genesis of Individual Competencies (LOGIC) (Schneider & Sodian, 1997; Weinert & Schneider, 1986, 1992), which has followed children over a 10-year period and did extensive assessments of memory performance.

When looking at the stability of children's performance on a sort-recall task, Wolfgang Schneider and Franz Weinert (1995) reported relatively low long-term stability, with correlations of recall, sorting (the degree to which participants sort items into categories), and clustering never exceeding

TABLE 8-2 Stability of memory performance over time (long-term and short-term stability) obtained for strategy and recall measures for the sort-recall task from the Munich Longitudinal Project.

Variable	*Two-year stability (4–6)*	*Two-year stability (6–8)*	*Two-year stability (8–10)*	*Four-year stability (4–8)*	*Six-year stability (4–10)*	*Short-term stability*
Recall	.36	.29	.39	.20	.16	.68
Sorting	.17	.12	.07	.08	.02	.85
Clustering	.12	.16	.12	.08	.19	.64

SOURCE: Schneider, W., & Weinert, F. E. (1995). Memory development during early and middle childhood: Findings from the Munich longitudinal study (LOGIC). In F. E. Weinert & W. Schneider (Eds.), *Memory performance and competencies: Issues in growth and development*. Hillsdale, NJ: Erlbaum.

.20 over four-years time and .39 over a two-year period (Schneider & Sodian, 1991; Schneider & Weinert, 1995). Table 8-2 presents the pattern of correlations for different intervals and at different ages from the LOGIC sample. The column labeled "short-term stability" present correlations between tasks given to the same children within a two-week period. The high correlations here suggest that children's performance is stable when given over very brief intervals, suggesting that the tests themselves are reliable. What is not reliable is performance over longer periods.

Schneider and Weinert (1995) noted that long-term stability is higher for other memory tasks, however. For example, the correlations over a two-year period for sentence span, word span, and several measures of story recall were usually quite high (most in the .40 to .70 range), suggesting relatively high stability for these tasks. Schneider and Weinert suggested that the lower stabilities for the sort-recall tasks, in comparison with the memory-span and story-recall tasks, is related to the substantially greater strategic component required for the sort-recall tasks. That is, stability is relatively high for tasks involving relatively little in the way of deliberate strategic functioning (memory span and story recall), but lower when strategies play a crucial part in task performance.

Part of the problem with strategies is that they do not seem to develop in a gradual, step-by-step fashion, but rather change relatively abruptly. As part of the Munich Longitudinal Study, Sodian and Schneider (1999) observed changes in strategy use over time by individual children. The researchers noted that only about 8% of the children showed a gradual improvement in the use of organizational memory strategies (sorting and clustering), with 81% "jumping" from chance sorting or clustering scores at one test interval to near perfect scores at the following measurement point. Thus, although cross-sectional data can give the impression of a gradual change in strategic functioning over childhood (with the implication of stability of individual differences), longitudinal data indicate that, for most children, the transition from astrategic to strategic, at least for organizational strategies, occurs relatively quickly, and at different ages for different children.

Stop here!

Forgetting and Reminiscence

All the information presented in this chapter to this point has dealt with remembering. But each of us is familiar with another side of memory—**forgetting.** Forgetting refers to failing to remember some information that one knew, or had previously remembered, some time earlier. Forgetting is not the same as never knowing. If a child is given 20 words to remember and recalls only 10 of them, the remaining 10 were not forgotten. They were never learned. Forgetting would occur when, some time following the initial test, the child was asked again to remember as many of the 20 words that he or she had seen