Although rare, some people have one or more vivid memories from infancy or early childhood. One of us (DB), for example, recalls a memory stemming from the first year of life. My memory is of me as a sick baby. I had the croup (something like bronchitis). When I recall this memory, I can feel the congestion in my chest, hear the vaporizer whir, smell the Vicks VapoRub, and see the living room of my grandparents’ house while looking through the bars of my crib. The memory is like a multisensory snapshot. I have no story to tell, only the recall of an instant of my life as a sickly baby. My mistake was relating this vibrant and personally poignant memory to my mother. She listened carefully and then told me that I had never had the croup; my younger brother Dick had the croup as a toddler. I was about 4 years old at the time. My “memory” was a reconstruction—and of an event I had only observed, not one I had actually experienced. Most memories of infancy, it seems, are like mine—reconstructions of events that never happened or, perhaps, that happened to someone else, but what one is remembering is the retelling of that event by other people.

It’s hard to overestimate the significance of memory for our lives. Our memories define for
us what we've done, who and what we know, and even who we are. Nearly all acts of cognition involve memory. A 4-month-old looks longer at a new picture than at one he has seen repeatedly, a 3-year-old recounts her class field trip to a bakery, a 7-year-old lists for her mother the names of all her classmates in preparing to send Valentine's Day cards, and a high school sophomore attempts to remember everything his father asked him to get at the corner store. Each of these diverse activities involves memory. The 4-month-old can recognize a new stimulus only if he has some notion that it is different from a previously experienced but currently unseen one. The memory requirements for the three older children are more demanding, but all involve retrieving from memory some previously stored information.

Memory is not a unitary phenomenon. Information must be encoded and possibly related with other information known to the individual. What knowledge already resides in memory influences the ease with which new information is stored and later retrieved.

Memory development is one of the oldest, continuously researched topics in the field of cognitive development. But how it is researched, and the theoretical focus of the researchers, is much different today than it was 30 years ago. In the previous chapter, we discussed that how much children remember is influenced by developmental differences in basic information-processing abilities of encoding, storage, and retrieval and by the strategies they use to intentionally learn information. Today, however, there is an increasing awareness that memory is used for specific purposes and in specific social contexts (Ornstein & Light, 2010). It is not enough merely to assess children's memory behavior in one context, particularly a context devoid of social meaning. How and what children remember depends on a host of dynamically interacting factors that vary over time. Despite the wealth of information we have about children's memory today, we are just beginning to develop an appreciation for the factors and contexts that influence children's memory performance and the development of those abilities.

In this chapter, we examine research and theory dealing with the development of memory in children. We open the chapter with a brief examination of the different ways knowledge can be represented in memory. We then examine memory development in infancy, followed by a look at children's implicit memory. Children's memories for events—specifically, autobiographical memories—are discussed next. We also review research on children as eyewitnesses and the factors that influence their suggestibility. This is followed by a brief look at the development of “remembering to remember,” or prospective memory. Throughout the chapter we describe social-cultural influences on memory, as well as the adaptive nature of memory, from an evolutionary perspective.

**REPRESENTATION OF KNOWLEDGE**

As we saw in Chapters 5 and 6, how people represent information changes with age, and this is a central issue in cognitive psychology. We take it for granted that knowledge is represented somehow in our brains and that we can access it whenever we want. But knowledge is not quite so simple. Is everything we know represented in such a way that we can easily (and consciously) retrieve it on demand? Might there be some things we know that affect our thoughts and behavior that are
difficult or impossible to bring to consciousness? And if so, how do these things develop?

Endel Tulving (1987, 2005) proposed that information in long-term memory can be represented in one of two general ways: declarative memory and nondeclarative memory. **Declarative memory** refers to facts and events and comes in two types: episodic memory and semantic memory. **Episodic memory**—literally, memory for episodes, such as what you had for breakfast this morning, the gist of a conversation you had with your mother last night, and the Christmas visit to your grandparents when you were 5 years old—can be consciously retrieved. Such memory is sometimes called **explicit memory**, which refers to the fact that it is available to conscious awareness and can be directly (explicitly) assessed by tests of recall or recognition memory.

**Semantic memory** refers to our knowledge of language, rules, and concepts. So, for instance, the meaning of the term *democracy* or the rules for multiplication are examples of semantic memory. For instance, the definition for the word *perfunctory* is part of my (KC) semantic memory, but my recollections of the events surrounding my learning the word (preparing for comprehensive exams in graduate school) are part of my episodic memory.

The second general type of memory has been termed **nondeclarative memory** (or procedural memory). Nondeclarative memory refers to knowledge of procedures that are unconscious. For example, some have argued that the learning and memory observed in classical and operant conditioning are unconscious, as are many familiar routines once they have become well practiced (tying one’s shoe, for example). Such memory is sometimes called **implicit memory**, which refers to the fact it is unavailable to conscious awareness (“memory without awareness”) and can be assessed only indirectly (that is, you just can’t ask someone to remember something he or she knows only implicitly).

Consider the classic case of amnesia, where a person walks into a police station and announces to the desk sergeant that he has no idea who he is or how he got there—the perfect beginning of a mystery novel. Now consider a person who knows very well who she is and can carry on a conversation just fine, but 5 minutes after meeting you, she has forgotten who you are and anything you talked about. Yet were you to meet with her every day and teach her how to tie a complicated knot, after a week of practice she would be able to tie the knot expertly without having any awareness of doing it before. These are both forms of amnesia (*retrograde amnesia* in the first case and *anterograde amnesia* in the second), but different memory systems are involved. In the first case, the person has lost his personal history. He remembers nothing about “the self.” In the second case, the person’s sense of self and personal history is intact. However, she can learn no new information other than some procedures (tying knots), and she will have no recollection of having ever learned them. In both cases, people keep their knowledge of their language, multiplication tables, and basic facts of the world. For example, if they were American citizens, they would likely know the current president and who the first U.S. president was. The example of the person with retrograde amnesia who forgot who he was displays a deficit in a form of **explicit/declarative memory**—specifically, *episodic memory*. The example of the person with anterograde amnesia displays access to past episodic memories but an inability to form new ones (usually because of damage to the hippocampus), although she can form new procedural memories. The existence of these **dissociations**—instances where one form of memory is impaired while others remain intact—provides evidence for independent memory systems that serve specific
functions. Figure 8.1 shows the various components of the explicit and implicit memory systems.

In addition to tapping different types of memories, different areas of the brain are involved in declarative and nondeclarative memories (Schacter, 1992). This supports the argument that memory is not a single phenomenon (that is, domain general) but, rather, is a set of domain-specific mental operations that may show different patterns of developmental function.

**MEMORY DEVELOPMENT IN INFANCY**

Babies obviously remember things. The questions of interest are when and under what conditions infants demonstrate memory and how long these memories last. For example, research

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**FIGURE 8.1 Classification of different types of memory.** The human memory system can be divided into two general types of memory: explicit, or declarative, which is available to consciousness, and implicit, or nondeclarative, which is not available to consciousness, with both types able to be divided further. Age differences are greater in explicit than implicit memory.

- **Explicit (declarative)** With conscious recall
  - Facts–general knowledge (“semantic memory”)
  - Personally experienced events (“episodic memory”)

- **Implicit (nondeclarative/procedural)** Without conscious recall
  - Skills–motor and cognitive
  - Dispositions–classical and operant conditioning effects

Source: © Cengage Learning.

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**Section Review**

- Memory is multifaceted, involves a host of other cognitive operations, and is involved in all complex forms of thinking.
- **Declarative (explicit) memory**, which includes episodic and semantic memory, is proposed to be available to consciousness and is often contrasted with nondeclarative (procedural or implicit) memory, which is unavailable to consciousness.

**Ask Yourself . . .**

1. When you ride a bike, what type of memory are you using?
2. Think about some movies you’ve seen that depict different types of memory loss or amnesia (The Vow, for instance, or Finding Nemo or Memento). What types of amnesia are depicted? What form of memory is impaired, and what remains intact?
examining infants’ search behavior, as reflected by object permanence tasks (see Chapter 4), indicates changes in memory with age during the first year (Diamond, 1985). Recall Adele Diamond’s findings that the amount of delay necessary to yield the A-not-B error increased with each successive month between 7 and 12 months of age. Although Diamond proposed that developmental differences in the ability to inhibit a prepotent response were partly responsible for this effect, she also acknowledged that such results reflect age changes in memory during this 6-month period (Diamond, Cruttenden, & Neiderman, 1994).

Preference for Novelty as an Indication of Memory

The bulk of research assessing infant memory, particularly in the early days of such research, used variants of the habituation/dishabituation paradigm discussed in previous chapters. To review, infants’ attention declines as a result of repeated presentation of a stimulus (habituation) but returns to its previously high levels when a new stimulus is presented (dishabituation). Such a finding not only indicates that infants can discriminate between the two stimuli but also implicates memory, in that the discrimination is being made between one stimulus that is physically present and another that is present only memorally. In a related procedure, infants are familiarized with a stimulus and later shown two stimuli: the original, familiarized stimulus and a novel one. As in the habituation/dishabituation paradigm, preference (or longer looking times) for the novel stimulus is (usually) taken as evidence of memory for the original. Using these preference-for-novelty paradigms, memory for visual stimuli has been found for some newborns. Basic visual memory is an early developing ability—certainly within the capacity of most infants during their first months of life.

Perhaps the most influential work demonstrating memory in infants using the preference-for-novelty paradigm is that of Joseph Fagan (1973, 1974). One study showed that 5- and 6-month-old babies formed visual memories following brief exposures (5 to 10 seconds) and that these memories lasted as long as 2 weeks (Fagan, 1974). Fagan’s procedures have been widely used by researchers, and later work suggested a relationship between individual differences in preference for novelty during infancy and childhood memory and intelligence. This research is examined in Chapter 13.

Subsequent research has shown that even 1-month-old infants demonstrate relatively long-lived memories. For example, in one study, the mothers of 1- and 2-month-old infants read their babies one of two nursery rhymes over the course of 2 weeks. Infants were then brought into the laboratory, and their preferences for the familiar versus a novel nursery rhyme were tested. This was done by permitting infants to choose hearing either the familiar or a novel nursery rhyme by modifying their sucking on a pacifier (for example, increase sucking rate to hear one rhyme, decrease sucking rate to hear the other). After a 3-day delay between the time infants last heard their mothers read the familiar nursery rhyme and being tested in the lab, even 1-month-old babies showed a preference for the familiar rhyme, indicating memory for the auditory event (Spence, 1996).

It’s worth noting here that infants’ preference in Melanie Spence’s (1996) study was for the familiar stimulus, not for the novel one. To demonstrate memory, all that is required is that infants show a decided bias for one stimulus over the other. As we noted in earlier chapters, infants’ preferences for novel
versus familiar objects/events varies as a function of their age and stage of learning in a task, among other factors (Bogartz & Shinskey, 1998). For example, Mary Courage and Mark Howe (2001) showed 3.5-month-old infants a stimulus for 30 seconds and then tested their preference for the old (familiar) versus a new (novel) stimulus after delays of 1 minute, 1 day, and 1 month. The researchers reported a bias for the novel stimulus after the 1-minute delay, no bias after the 1-day delay, and a bias for the familiar stimulus after the 1-month delay (see Figure 8.2). Following the theorizing of Lorraine Bahrick and Jeffrey Pickens (1995), Courage and Howe (2001) interpreted these findings as indicating that infants’ attention to novel versus familiar stimuli varies as a function of the strength of the familiar information in long-term memory at the time of testing. Infants will attend more to novel stimuli when memory traces are strong (after the 1-day delay) and attend more to familiar stimuli when the memory traces are weak (after the 1-month delay). Null effects (that is, neither a preference for the novel nor a preference for the familiar stimuli) reflect a transition phase in which both stimuli compete equally for attention. Richard Aslin and colleagues have since characterized this phenomenon as the Goldilocks effect, which we introduced in Chapter 4 (and see Kidd et al., 2012). According to their interpretation, infants are implicitly motivated to maintain intermediate rates of stimulation and encoding. In this way, they avoid wasting cognitive resources on overly simple or overly complex events. When the stimulus is still familiar, they will attend to the relatively novel stimulus, but after some time and forgetting, they will return their attention to the familiar stimulus, strengthening the fading memory trace as a result.

**FIGURE 8.2** Mean proportion of total looking time infants directed to the novel stimulus during the 1-minute, 1-day, and 1-month delays. Chance is 0.5. Mean looking time significantly greater than chance reflects a preference for novelty. Mean looking time significantly less than expected by chance reflects a preference for familiarity.

<table>
<thead>
<tr>
<th>Retention Interval</th>
<th>Proportion of Total Looking Time to Novel Stimulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Minute</td>
<td>0.6</td>
</tr>
<tr>
<td>1 Day</td>
<td>0.5</td>
</tr>
<tr>
<td>1 Month</td>
<td>0.4</td>
</tr>
</tbody>
</table>


**Kicking Up Their Heels**

Other research by Carolyn Rovee-Collier and her colleagues has used conditioning techniques, demonstrating retention over relatively long periods for very young infants (see Rovee-Collier & Cuevas, 2009, for a review). In their conjugate-reinforcement procedure, a ribbon is tied to an infant’s ankle and connected to a mobile that is suspended over the crib (see Photo 8.1). Infants quickly learn that the mobile moves when they kick their feet, and they soon make repeated kicks, controlling the movement of the mobile overhead. In a typical
experiment, for the first 3 minutes the ribbon is not connected to the mobile, so kicks do not cause it to move (baseline nonreinforcement period). This is followed by a 9-minute reinforcement period in which the ribbon and mobile are connected, and infants quickly learn to kick to make the mobile move. What will happen when the infants are hooked up to the apparatus hours or days later? Will they resume kicking (even when the ribbon is not connected to the mobile), or will their level of kicks be comparable to that observed during the 3-minute baseline? If the kicking rate is high on these delayed trials, it reflects memory; if it is low, it reflects forgetting.

Rovee-Collier and her colleagues have used this procedure successfully with infants as young as 2 months of age. For example, Margaret Sullivan, Carolyn Rovee-Collier, and Derek Tynes (1979) varied the delayed memory test between 48 and 336 hours (2 weeks) with 3-month-old infants. The researchers reported no forgetting by these young infants for as much as 8 days, and some babies displayed memory for the full 2-week interval. In related work, infants as young as 8 weeks demonstrated retention of conditioned responses during a 2-week period, although evidence of memory was obtained only under optimal conditions (distributing training over several sessions) (Vander Linde, Morrongiello, & Rovee-Collier, 1985). These results indicate that young infants can remember events over long intervals, although these skills do improve over the first several months of life.

Subsequent research by Rovee-Collier and her colleagues focused on the role of context in infants’ memories. How similar must the learning environment and testing environment be for babies to show retention? This was assessed by a study in which different aspects of the learning environment (in this case, the playpens in which the infants were tested) were changed between the time of learning and the time of testing (Rovee-Collier et al., 1992). Six-month-old infants were tested using the conjugate-reinforcement procedure described earlier, but the testing situation was made very distinctive. Infants sat in an infant seat that was placed in a playpen. The sides of the playpen were draped with a distinctive cloth (for example, yellow liner with green felt squares). Some infants were tested 24 hours later with the same cloth, whereas others were placed in the playpen that

PHOTO 8.1 An infant connected to a mobile in an experiment to assess memory used by Carolyn Rovee-Collier and her colleagues.

Thanks to Carolyn Rovee-Collier
was draped with a blue liner and vertical red felt stripes. The results of this experiment are presented in Figure 8.3 (expressed as kicking rate during testing relative to kicking rate during baseline). As you can see, infants in the no change condition demonstrated significantly better retention of the learned behavior than infants in the context change condition, indicating the important role that context plays in reinstating infants’ memories.

Rovee-Collier et al. (1992) performed six other experiments, varying different aspects of the context. They concluded that infants do not respond to the context as a whole but, rather, seem to process individual components of a context. For instance, changes in visual patterns (for example, stripes versus squares) or reversal of the foreground and background (for example, yellow liner with green squares versus green liner with yellow squares) disrupted memory, but changes in color did not (for other examples, see Bhatt, Rovee-Collier, & Shyi, 1994; Fagen et al., 1997). Rovee-Collier and Gary Shyi (1992) speculated that infants’ reliance on specific aspects of a context prevents them from retrieving memories in “inappropriate” situations. This may be especially important for infants with poor inhibitory abilities, who would be apt to retrieve previously acquired memories (actions) in a wide range of often-inappropriate situations unless there were some potent constraints (such as context specificity) on the memory system. The role of inhibitory factors in infant cognition has been addressed by several researchers, most notably Adele Diamond, and some of this work is discussed in Chapter 2.

Rovee-Collier and her colleagues have also used conjugate-reinforcement procedures to assess age-related changes in long-term memory in infants. For example, in addition to the mobile task, they developed the train task, which uses the same logic as the mobile task but is appropriate to use with older babies. In the train task, infants sit in front of a display that includes a miniature train set. They can learn to move the train around the set by pressing a lever in front of them, and retention is tested as it is in the mobile task, with infants sitting in front of the display after a delay and the rate with which they press the lever (when it is now not connected to the train) being measured. With these two comparable tasks, it is now possible to ask how long memories last for infants of different ages. Figure 8.4 presents the maximum number of weeks that infants from 2 to 18 months of age demonstrated retention on the mobile and train tasks. As can be seen, the duration of infants’ memories showed gradual but steady increases with age, reflecting a continuously developing memory system.

**FIGURE 8.3** Mean baseline ratios for 6-month-old infants in a no-change (control) condition and a context-change condition. The higher ratio for infants in the no-change condition reflects greater retention of the behaviors that were learned 24 hours earlier.


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Deferred Imitation as a Measure of Memory

Another task that has been used to assess infants’ long-term memory is deferred imitation, which refers to imitating a model after a significant delay. In most deferred-imitation experiments, infants watch as an experimenter demonstrates some novel behavior with an unfamiliar object. At some later time, they are given the object. If they display the novel behavior more than a control group of infants who had not previously been shown the object, it implies that the study group formed a long-term memory for the action. The results of this research are quite striking, showing that infants form long-term memories for these novel actions that can last as long as 1 year (see P. J. Bauer, 2002, 2007). These results suggest that preverbal infants and toddlers do represent events in their long-term memories and, under the right conditions, can access those memories months later.

At what age do infants display deferred imitation? Although results vary with the specific task used, infants as young as 9 months old will imitate simple actions up to 5 weeks later, and 6-month-olds have been shown to imitate simple behaviors after a 24-hour delay and remember events for up to 8 weeks (see Rovee-Collier & Giles, 2010, for a review).

Once infants observe an action, how long do those memories last? The answer depends primarily on the age of the infant, with older infants being able to remember more complicated sets of behaviors over longer periods of time. For example, Patricia Bauer and her colleagues (P. J. Bauer, 2002, 2007; P. J. Bauer et al., 2000, 2001) showed infants a series of three-step sequences. For example, the researcher placed a bar across two posts, hung a plate from the bar, and then struck the plate with a mallet (see Photo 8.2). After delays ranging from 1 to 12 months, the babies were given the objects, and their imitation was measured. About half of the 9-month-olds imitated the simpler two-sequence actions after a 1-month delay, but these infants required at least three exposures to the events to achieve this level of performance. Rate of deferred imitation increased substantially for 13-, 16-, and 20-month-old infants, with older infants demonstrating higher levels of deferred imitation during each delay interval than younger infants did (P. J. Bauer et al., 2000). Figure 8.5 shows results of long-term retention as a function of age of infant.
PHOTO 8.2 Bauer’s three-step sequence as shown by the gong task. Infants watched as a model performed a three-step sequence: placing the bar across two posts, hanging a plate on the bar, and striking the plate with a mallet. Infants were later given the opportunity to reproduce the sequence, demonstrating evidence of deferred imitation, and thus memory.

Thanks to Patricia Bauer.

and length of delay from this study. These findings are similar in form to those Rovee-Collier and colleagues reported using the conjugate-reinforcement procedures. They illustrate that infants are able to form long-term memories early in life and that the ability to retain these memories increases gradually during the first 2 years.

Is deferred imitation a type of explicit, declarative, memory? Recall from earlier in this chapter that explicit memory is contrasted with implicit memory. The former represents a deliberate attempt to remember and is potentially available to conscious awareness, whereas the latter is often referred to as memory without awareness. Most researchers who have investigated
deferred imitation in older infants believe it to be a form of nonverbal explicit memory (P. J. Bauer, Larkina, & Deocampo, 2011; Hayne, 2007). If so, it would be using the same type of representational system as that used by older children on verbal memory tasks.

How can one tell the difference between explicit and implicit memory in preverbal children? Perhaps one can’t definitively, but support for this distinction comes from a study of adults with anterograde amnesia, like the woman we described earlier who learned to tie complicated knots but had no recollection of doing so. People with anterograde amnesia are unable to acquire new declarative memories (memory with awareness) but perform well on implicit memory tasks (memory without awareness). So how do they perform on deferred-imitation tasks? Just like they do on declarative memory tasks—they fail them (McDonough et al., 1995). These findings suggest that deferred-imitation tasks tap the same memory system as do declarative tasks used with older children and adults (for example, “Tell me what you had for breakfast this morning”) and “that the neurological systems underlying long-term recall are present, in at least rudimentary form, by the beginning of the second year of life” (Schneider & Bjorklund, 1998, p. 474).

**Neurological Basis of Infant Memory**

The pattern of deferred imitation shown by infants ages 9 months to approximately 2 years is consistent with what is known about brain
development during this time (see Bachevalier, 2014; P. J. Bauer, 2009). Long-term memory requires the integration of brain activity from multiple sites, including the hippocampus and the prefrontal cortex and structures within the temporal lobe. Most parts of the hippocampus develop early and are adultlike before birth, although the dentate gyrus (part of the hippocampus), which plays an important role in episodic memory, continues to develop after birth and into adulthood (Aimone & Gage, 2011; Richmond & Nelson, 2007). In fact, one layer of the dentate gyrus includes at birth only about 70% of the number of cells that it will have in adulthood (Seress, 2001), meaning that about 30% of the neurons in this layer will be generated after birth. As we saw in Chapter 2, it was once believed that no new neurons were generated after birth. However, we now know that neurogenesis continues throughout life in the hippocampus, particularly in the dentate gyrus. Once neurons are generated, synapses between neurons need to be formed, and this reaches its peak in the dentate gyrus during the fourth or fifth month after birth. Synapses are then pruned to adult levels by about 10 months.

The early developing hippocampus presumably underlies the deferred imitation of simple actions by 6-month-olds (Collie & Hayne, 1999), but other brain areas must mature before infants can retain more complicated information for longer periods.

The frontal cortex is important in the encoding and retrieval of declarative memories, and this develops more slowly than the hippocampus (Monk, Webb, & Nelson, 2001). For instance, synaptic density reaches its peak in the frontal cortex between 15 and 24 months after birth, and significant pruning takes place during childhood (P. Huttenlocher, 1979). Not until the second year of life do these and other systems (hippocampus, prefrontal lobe, temporal lobe) begin to coalesce, with development continuing well into the third year. The relatively gradual development of these brain structures correlates with the relatively gradual improvement in long-term retention of infants during this same period (P. J. Bauer et al., 2000; Liston & Kagan, 2002).

The neuromaturational model of memory development, as we’ve discussed so far, is sometimes interpreted as a transition from implicit to explicit memory, controlled by two different neuroanatomical memory systems that mature at different rates. An alternative ecological model holds that the basic memory process does not change ontogenetically (but is emergent, and quite continuous, as depicted in Figure 8.4). Rather, what immature infants versus adults select to encode for learning does. Rovee-Collier and Giles (2010) has argued that the lack of long-term, declarative memory in infancy is not a memory deficit or indicator of immaturity but represents “rapid forgetting . . . an evolutionarily selected survival-related strategy that facilitates young infants’ adaptation to their rapidly changing niche and enables them to shed the excessive number of recent, rapidly formed associations that are potentially useless, irrelevant, or inappropriate” (p. 203). She describes the first 9 months of life as a period of “exuberant learning,” when synaptic pruning occurs, marking a developmental change in what young infants need to learn and remember around 10 months, as they transition to a period of perceptual tuning (a phenomenon we discussed in Chapter 4). At this point, infants have acquired more stable associations between stimuli in the world. As these associations begin to crystallize, infants have a firmer knowledge base onto which they can attach new information, aiding in the retention of long-term, declarative memory. Although the question remains open, the findings we’ve described so
far make it apparent that the memory systems that support implicit and explicit memory are both present from early in infancy.

Understanding the nature of infants’ long-term memory is important for our appreciation of the effects of early experience (P. H. Miller, 2014). For instance, some evidence of the relation between brain and memory development in infancy comes from studies of premature infants. For example, Michelle de Haan and her colleagues (2000) administered deferred-imitation tasks to three groups of 19-month-old children. One group of babies was born full term. Another group of infants had been born premature, after 35 to 37 weeks of gestation, but were physiologically healthy. A third group had been born premature after 27 to 34 weeks and were physiologically immature. The three groups of infants showed comparable levels of immediate imitation; however, they differed on deferred-imitation tasks, with the preterm infants, especially those who were physiologically immature, having significantly lower levels of memory. These results suggest that the declarative memory system of these preterm infants was adversely affected by depriving them of the last several weeks of their prenatal environment.

Other research indicates that the memory abilities (and their underlying brain structures; see Kolb et al., 2012) of infants are impaired as a result of living in deprived environments. For example, the deferred-imitation abilities of 20-month-old infants, some of whom had been adopted about 8 months earlier from a Romanian orphanage, where they had experienced extreme deprivation, were impaired relative to typically developing children (Kroupina et al., 2010). Toddlers who had spent their first year or so in conditions of extreme deprivation showed immediate imitation similar to that of home-reared children but displayed significantly poorer levels of deferred imitation. As we noted in Chapter 2, postnatal experience plays a critical role in getting the brain “hooked up” properly, and when infants receive less-than-optimal experiences during their first year of life, their brains and memories suffer.

Indeed, Rovee-Collier has made the argument that even though younger infants forget more rapidly, how long they can retain information is determined by their experience, not their level of maturation. She views long-term memory as an emergent process, whereby infants’ retention is affected by the number and strength of associations between the target memory and other events, as well as the frequency and rate at which the infant is repeatedly exposed to the target information. Rovee-Collier and Cuevas (2009) have argued that younger infants forget more rapidly, not because they are neurologically less mature but because they have less experience and thus fewer associations to which the memory can be linked.

### Section Review

- Infants display memory in habituation/dishabituation and preference-for-novelty paradigms shortly after birth. Conditioning techniques, particularly conjugate reinforcement procedures, have been used to demonstrate memory in infants as young as 3 months for periods as long as 2 weeks, with infants’ memories in these situations being greatly influenced by context effects.
- Deferred-imitation tasks have shown that older infants can retain information over
Infantile amnesia—the seeming inability of adults to recall specific events or episodes from early childhood—is bothersome not only to researchers but also to some parents. For example, my wife and I (DB) used to write a column for a parenting magazine and would occasionally get letters from concerned parents. One letter came from a woman who was worried because her 10-year-old son could remember very little from his preschool days. She said that she and her husband had always tried to be good parents but thought her son’s inability to remember things from early childhood was an indication that either they hadn’t done a very good job after all or, worse yet, they had done a truly terrible job and her son was repressing this painful period of his life. We wrote back to the woman, assuring her that her son’s inability to remember events much before his fourth birthday is quite normal and that just because her child can’t remember his experiences from this age doesn’t mean that they didn’t have an impact on him.

It is not just memories from infancy that escape us. For the most part, we are unable to remember much of anything before the age of 3.5 or 4 years (P. J. Bauer, 2014). Most of us have a few memories for events that happened between the ages of about 3 and 6 years, but these memories are very few in comparison with what we can remember from after this time (Pillemer & White, 1989). What we lack specifically are autobiographical memories, which refer to personal and long-lasting memories and are the basis for one’s personal life history (K. Nelson, 1996). If children younger than 2 can form explicit memories, why are they unable to retain those memories as autobiographical episodes that they can recall later in life?

JoNell Usher and Ulric Neisser (1993) studied this lack of memory for the early years by questioning college students about experiences they had had early in life—experiences such as the birth of a younger sibling, a stay in the hospital, a family move, or the death of a family member. To assess recall, a series of questions was asked about each event the person had experienced (Who told you your mother was going to the hospital to give birth? What were you doing when she left? Where were you when you first saw the new baby?). The percentage of questions college students could answer increased substantially the older the person was when he or she had experienced the event. Usher and Neisser concluded that the earliest age of any meaningful recall was about 2 years for the birth of a sibling or a hospitalization and 3 years for the death of a family member or a family move.

Ask Yourself . . .

3. How do researchers use infants’ preference for novelty to assess newborns’ memory?
4. What role does context play in infants’ memories? How have researchers assessed this?
5. What is a deferred-imitation task? How do we know it is a measure of explicit memory?
A more recent series of longitudinal studies conducted by Carol Peterson and colleagues involved asking children 4 to 13 years old about their earliest three memories (Peterson, Grant, & Boland, 2005). Two years later, researchers followed up with these children (Peterson, Warren, & Short, 2011). They found that, as children aged, so did their earliest childhood memory. That is, older children had later ages of first memory than did younger ones, and there was an overall shift of about 1 year for the earliest provided memories from the time of the first interview to the second. There was also some inconsistency in children’s earliest memories from one time to the next, particularly in the youngest age groups (former 4- to 7-year-olds). However, in the oldest group, almost one quarter of children recalled at least two of the same three memories during both interviews. Thus, children’s recollection of early childhood memories seems to become more stable with age.

These findings are consistent with others (for example, Scarf et al., 2013; Tustin & Hayne, 2010) showing that young children form episodic memories but fail to recall them over long delays. Thus, it seems that we should not overlook the role that forgetting plays in childhood amnesia. Of course, many people do claim to have memories from infancy or even from birth (or before). But are these memories to be trusted? The story that opened this chapter (a sick baby looking out the bars of his crib) is an example of how a vivid memory from infancy can be a reconstruction of an event and not the recollection of an event that actually happened to the “rememberer.” Are all early memories like this? And, perhaps more to the point, does the inability to retrieve memories from infancy contradict the new research findings of long-term retention in early infancy?

**Why Can’t We Remember Events From Infancy and Early Childhood?**

Sigmund Freud (1963) was the first to speculate on the reason for infantile amnesia, proposing that the events of infancy and early childhood are...
rife with sexual overtones toward one's mother and are just generally so traumatic that they are actively repressed. We protect our adult egos, claimed Freud, by preventing these disturbing memories from rising to consciousness.

Few scientists today agree with Freud’s interpretation. To the contrary, research shows that we are more likely to remember events from early childhood that are enhanced by emotion, as well as those more chronologically, thematically, and contextually coherent (Peterson et al., 2014). Other more cognitively based interpretations propose the possibility that (a) information is not stored for long-term retention before about 2 years of age, and (b) information is encoded differently by infants and toddlers than by older children and adults (see P. J. Bauer, 2007; Howe, Courage, & Rooksby, 2009; Rovee-Collier & Giles, 2010). The first possibility seems unlikely; as we’ve seen, research using the deferred-imitation procedure (P. J. Bauer, 2007; Meltzoff, 1995), discussed earlier in this chapter, has shown that infants from 6 to 16 months of age can encode and retain a simple experience for as long as 1 year.

The second alternative, that information is encoded differently during the early and later years of life, is consistent with observations made by Jean Piaget and others that the nature of representation changes from infancy to early childhood and then again (although less drastically) somewhere from age 5 to age 7. The minds that resided in our heads when we were infants are no longer there, replaced by minds that process symbols, especially verbal ones. We reconstruct memories through adult schemes and representations, which are not suitable for events encoded in infancy and early childhood. For example, the memories tested in infancy all involve recall of action patterns, whereas the recall assessed in childhood and adulthood involves verbal recall, using language. Perhaps the inability to convert motor memories into verbal ones prevents children from recalling events from infancy.

Evidence for this latter interpretation has been accumulating over the past 2 decades or so (Hayne & Simcock, 2009; Simcock & Hayne, 2002). For example, Gabrielle Simcock and Harlene Hayne (2002) showed children ranging in age from 27 to 39 months sequences of actions and then interviewed them 6 and 12 months later for their verbal and nonverbal memory of the events. Despite having the verbal ability to describe their previous experience, none of the children did so spontaneously. To the extent that children did talk about these prior events, they did so only if they had the vocabulary to describe the event at the time of the experience. That is, children who were more verbally sophisticated at the time of initial testing tended to verbally recall some aspects of the event, but children were seemingly not able to translate earlier preverbal experiences into language. According to Simcock and Hayne (2002), “Children’s verbal reports were frozen in time, reflecting their verbal skill at the time of encoding, rather than at the time of test” (p. 229; see also a review by Reese, 2014).

Such an interpretation can account for our inability to retrieve memories from infancy, but 3- and 4-year-old children are clearly verbal and would presumably represent information in a symbolic form similar to the way adults do. The fact that 3- and 4-year-old children can recount verbally events that happened many months or even years ago suggests that this interpretation cannot be the entire answer (Fivush & Hamond, 1990).

A number of alternative explanations for infantile amnesia have been proposed. For example, several authors have suggested that for autobiographical memories to be laid down and
later retrieved, there needs to be a sense of self (the *auto* in autobiographical) (Fivush, 2011; Howe, 2014). Research has shown that the sense of self develops gradually during the preschool years (see discussion of the development of self-concept in Chapter 10) and that, although young children have memories, the experiences of early childhood occurred when the sense of self was poorly developed, thus providing no anchor for such events. Unless events can be related to the self, they cannot be retrieved later.

Another alternative is that infantile amnesia is merely a consequence of the child’s developing information-processing system (Leichtman & Ceci, 1993). Following the tenets of fuzzy-trace theory (Brainerd & Reyna, 2014; see discussion in Chapter 5), Michelle Leichtman and Stephen Ceci (1993) proposed a developmental shift in how events are represented, with young children encoding events primarily in terms of verbatim (precise) memory traces and older children relying more on gist (less precise) traces. Verbatim traces are more susceptible to forgetting than gist traces are. Thus, the heavy reliance on the highly forgettable verbatim traces makes memories from infancy and early childhood unavailable. Gist traces become increasingly available by the early school years, about the time when more memories can be retrieved.

Recent neurocognitive research also points to changes in hippocampal neurogenesis as important (Akers et al., 2014). Recall that rates of hippocampal neurogenesis are high early in life and decline with age, as we described earlier. These high rates of neurogenesis and subsequent pruning may result in our inability to access hippocampus-dependent episodic memories later in life. In fact, when neurogenesis was experimentally reduced in mice at an early developmental stage, their hippocampus-dependent memories persisted. But when neurogenesis was increased at a later stage of development, mice demonstrated an increase in forgetting. These results are interesting, but they do not account for the large and somewhat exclusive loss of autobiographical memories, yet not other forms of declarative memory, as we transition from infancy to childhood. Thus, shifts in encoding, representation of the self, and language, as we describe next, provide additional explanation for infantile amnesia.

Other theorists have proposed changes in language and how language is used as explanations for the phenomenon of infantile amnesia (Fivush & Hamond, 1990; K. Nelson, 1993, 1996). This was illustrated in Simcock and Hayne’s (2002) research, which showed that 2- and 3-year-old children were not able to translate a preverbal memory into language 6 months later. But language is not fully developed by 3 years of age, and other language-related changes may further influence children’s ability to remember events from their past. Young children, in trying to understand and predict their world, are attentive to routines and embed novel events in terms of these routines (for example, what happens at breakfast, what happens on a trip to the grocery store). Such memories, ensconced as they are in routines, are not very distinctive and, thus, are not easily retrieved later on. Even when events are distinctive, however, young children do not necessarily know how to organize them in a memorable form. As we’ll discuss in more detail later in this chapter, children “learn” to remember through interactions with adults. Adults provide the cues and structure for children to form narratives—stories for embedding events and, later, for remembering them. Only after being guided by adults can children learn to code memories and realize that language can be used to share memories with others.
Katherine Nelson (1993) makes this point especially clear:

The claim here is that the initial functional significance of autobiographical memory is that of sharing memory with other people, a function that language makes possible. Memories become valued in their own right—not because they predict the future and guide present action, but because they are shareable with others and thus serve a social solidarity function. I suggest that this is a universal human function, although one with variable, culturally specific rules. In this respect, it is analogous to human language itself, uniquely and universally human but culturally—and individually—variable. (p. 12)

Research examining the earliest memories of people from different cultures lends some support for Nelson’s ideas. For instance, in a series of studies, White North Americans reported earlier memories than Asians, in most cases by about half a year (Peterson, Wang, & Hou, 2009; Q. Wang, 2006, 2014). In addition, American adults’ earliest memories were more likely to include emotions and less likely to involve family activities than were the childhood memories of Chinese adults (Q. Wang, 2001). These patterns are correlated with cultural differences in parent-child interaction. For example, compared to Korean mothers, American mothers talk about past events more with their 3-year-old children (Mullen & Yi, 1995) and also have earlier memories than Korean adults (Mullen, 1994). (Gender also seems to have an effect, with women tending to have memories from earlier in life than men; see Fivush & Zaman, 2014.)

K. Nelson’s (1993) claim suggests that infantile amnesia might not be so significant in its own right, as Freud believed, but, instead, reflects an important transition in human cognition. This transition is based on everyday adult-child interaction and the developing language system, and it transforms the child into an individual who has a personal past that can be shared with others. This does not preclude the possibility that changes in the self-system (Howe, 2014) or in the information-processing system (Leichtman & Ceci, 1993) also play an important role. Our guess is that they do. The most recent research suggests that infantile amnesia reflects important changes occurring during early childhood—changes that permit autobiographical memory and that truly separate our species from all others. However, even later-developing skills, such as perspective taking and abstract reasoning, may be important for helping us organize life experiences along a timeline (Habermas & Bluck, 2000). Some research shows that it is not until age 12 that children begin to link single events together (Habermas & de Silveira, 2008), although others have shown that even 8-year-olds can nominate “chapters” or stages of life that describe their history, and the number and complexity of these periods increases with age (Reese et al., 2010).

**Infantile Amnesia and Hypnotic Age Regression**

Are memories from infancy and early childhood really gone, or are they just not retrievable by our conscious minds? What about hypnosis? Don’t psychologists often use hypnosis to help people remember forgotten or repressed memories, and doesn’t that sometimes include remembering events from one’s early childhood? But are memories recalled using hypnosis reliable, and are these memories even real? In general, people under
hypnosis often do recall more details about an event than do people not under hypnosis, but many of these details turn out to be false (Erdelyi, 1994).

In hypnotic age regression, adults are hypnotized and “brought back” to an earlier age. In doing so, will the adults now truly think like they did as children, and will they remember events from their childhood better than nonhypnotized people? Michael Nash (1987) reviewed more than 60 years of this literature, and his answer is a definitive no. For example, in research during which adults are regressed to the preschool years and then given Piagetian tasks such as conservation (see Chapter 5), they act more like adults who are asked to pretend to solve the problem like a 4-year-old would than like an actual 4-year-old child. In one study, adults were regressed to 3 years of age and asked to identify objects such as dolls, blankets, or teddy bears that were of particular importance and comfort to them at that time (Nash et al., 1986). The parents of both hypnotized and control participants were contacted to confirm the subjects’ recollections. The hypnotized people were substantially less accurate in identifying favorite objects from their early childhoods than were the controls. The reports of the hypnotized participants matched those of their parents just 21% of the time, whereas the hit rate for the controls was 70%.

People who experience age regression might have the feeling of recalling a real memory. However, how confident one is in the veracity of a memory, unfortunately, does not always predict the truth of the memory. There is no evidence that hypnotic age regression can succeed in retrieving repressed, or simply forgotten, memories from childhood, despite many people’s claims to the contrary.

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### Section Review

- **Infantile amnesia** refers to the inability to recall information from infancy and early childhood. Current theories about the reason for infantile amnesia focus on the development of self-concept, developmental differences in how information is encoded, and changes in children’s use of language to communicate their memories to others.
- The use of hypnotic age regression is not successful in retrieving memories from infancy.

### Ask Yourself . . .

6. How does the emergence of autobiographical memory correspond to other measures of self-awareness, such as mirror self-recognition and metacognition?

7. What are some explanations for infantile amnesia? What evidence is there to support these theories?

### IMPLICIT MEMORY

The memory infants show in the preference-for-novelty task or in Rovee-Collier’s conditioning experiments does not seem to require conscious awareness. Typically, conscious awareness has been a prerequisite for explicit, or declarative, memory, with the unconscious memories of infants typically being classified as a form of **implicit memory**. (See, however, Howe, 2000, and Rovee-Collier & Giles, 2010, for arguments against this distinction.) Implicit memory is “memory without awareness” (see Schacter, 1992), and it is not limited to preverbal infants and toddlers but occurs also in older children and adults.

The distinction between implicit and explicit memory has more than heuristic value, for the
two types of memories seem to be governed by different brain systems, as revealed by research on people with brain damage (Schacter, 1992; Schacter, Norman, & Koutstaal, 2000). For instance, as we mentioned previously, the hippocampus is involved in transferring new explicit information from the short-term store (the location of immediate awareness) to the long-term store. People with damage to the hippocampus can acquire a new skill as a result of repeated practice, but they will have no awareness of ever learning such skills. For example, Brenda Milner (1964) reported the case of H.M., a patient with hippocampal brain damage. H.M. was given a mirror-drawing task over several days, in which he had to trace figures while watching his hand in a mirror. H.M.’s performance was quite poor initially but improved after several days of practice, despite the fact that he had no recollection of ever performing the task before. The enhancement of performance as a result of practice is a reflection of intact implicit (procedural) memory, whereas H.M.’s failure to recall previously performing the task is a reflection of a lack of explicit memory.

There has been less developmental research on implicit memory compared to explicit memory, but what research has been done presents a consistent picture. Although substantial age differences are found on tests of declarative memorization, few age differences are found when implicit memory is tested (see Finn et al., 2016; Lloyd & Miller, 2014). For instance, Riccardo Russo and colleagues (1995) adapted a perceptual priming task to assess the implicit memory of children. Children first viewed pictures of classmates and were asked to make decisions about the portrayed expressions and gender. After a delay, they were shown another series of pictures, half of which had been presented in the earlier phase and half of which had not. In this second phase, children were tasked with responding whether they knew the person pictured. Regardless of age, 5-, 8-, and 11-year-olds showed implicit priming effects; they were faster to respond that they recognized previously presented faces than those of faces they knew that had not been presented earlier in the experiment. To rule out the influence of explicit, declarative memory, Russo and colleagues excluded from their analysis those responses to pictures that participants could explicitly recall having seen during the first phase of the study, instead focusing only on those responses to pictures that children did not remember seeing earlier (even though they indeed had). These findings provide strong evidence for similar priming effects (implicit memory) across age groups when the influence of explicit memory is controlled for. A similar finding was reproduced in 4-, 5-, and 10-year-olds (Hayes & Hennessy, 1996). In other words, although children exhibited substantial age differences in explicit memory, no developmental differences were found in implicit memory.

Another interesting study of implicit memory again 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 each picture they were shown was that of a former classmate (an explicit recognition memory task); changes in the electrical conductance of their skin were 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, no difference in skin conductance was found 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, implicitly, as many of their former classmates as those children who had performed better. This pattern of data indicates that some children remembered (implicitly) more than they knew (explicitly). A similar pattern of findings was demonstrated in the event-related potentials (ERPs, a measure of brain response as the direct result of exposure to a stimulus) of 6-month-old infants when viewing previously experienced stimuli. The ERPs recorded when they viewed repeated faces showed greater negativity (in other words, a stronger response) than when they viewed new faces, suggesting that infants were sensitive to the previously experienced stimuli (Webb & Nelson, 2001).

These findings suggest that implicit memory is an early developing ability. Performance on implicit memory tasks is associated with the basal ganglia, neocortex (priming), striatum (skill learning), and cerebellum (conditioning; see Toth, 2000, for a review), which develop earlier than areas of the brain associated with declarative memory (see Lukowski & Bauer, 2014). Many believe that nondeclarative, implicit memory is an evolutionarily older memory system in contrast with explicit, declarative memory (see Bjorklund & Sellers, 2014).

Some theorists have speculated that implicit memory is under the control of automatic rather than effortful processes (Jacoby, 1991) and, following the theorizing of Lynn Hasher and Rose Zacks (1979), the evidence suggests that these processes show little development across childhood, supporting the developmental invariance hypothesis (Schneider, 2015). Indeed, Nora Newcombe and colleagues (2000) suggest that we may retain much in the way of implicit memories from infancy that can affect our behavior much later in life.

It is worth noting, as Lloyd and Miller (2014) have, that implicit memory is a broad umbrella term, used by memory researchers to describe a variety of aspects of nondeclarative memory, from operant and classical conditioning, to perceptual and conceptual priming, and procedural memory, to name a few, each of which is linked to different brain areas. As neuroscience advances, it is likely that we will develop more detailed distinctions between the different forms of implicit memory and their development (Lloyd & Miller, 2014).

Section Review

- In contrast to explicit memory, few age differences are observed for implicit memory, when there is no conscious intention to remember something.

Ask Yourself . . .

8. What do we know about the development of implicit memory? How does it differ from the development of explicit memory?

DEVELOPMENT OF EVENT MEMORY

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 did not intend to learn 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 in Chapter 7.) 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 would more deliberate memorization attempts, especially for young children (Istomina, 1975; Piaget & Inhelder, 1973).

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

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 realize is that young children pay attention to different aspects of events than adults do, and they do not necessarily know which 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 batboys, and the second-base umpire. What they remember of the game will thus be very different than what an older child or adult remembers.

It is also worth noting that event memory is constructive in nature. Event memory does not involve the verbatim recall of a list of facts or the memorization of lines, like an actor in a play (although children, and adults, do retain some specific, or verbatim, aspects of events; see Brainerd & Reyna, 2014). Rather, we recall the gist of the message, and in the process, we transform what was actually said or done. That is, we interpret our experiences as a function of what we already know about the world, and our memory for events is colored by previous knowledge (see our discussion of top-down processing in Chapter 7 and Bartlett, 1932). Memory, in general, is not like a tape recorder. True, we sometimes do retain verbatim information and use that information to construct stories. But the tales we tell about our lives are best thought of as constructions, based on our actual experiences, our background knowledge of the things we are trying to remember, our information-processing abilities, and the social context in which the remembering is being done.

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 (Hudson & Mayhew, 2009). 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 (K. Nelson, 1993, 1996; see also Fivush, 2008). For example, a fast-food restaurant script might involve driving to the restaurant, entering the restaurant, standing in line, ordering, paying the cashier, taking the food to the table, eating, and then throwing away the trash before leaving. Children learn what usually happens in a situation, such as what happens during snack time at school, a birthday party, or breakfast, and they remember novel information in the context of these familiar events.

Substantial research demonstrates that even very young children organize information temporally in a scriptlike fashion (see P. J. Bauer, 2007; Fivush, Kuebli, & Clubb, 1992) and that such schematic organization for events doesn’t change appreciably into adulthood (for reviews of this literature, see Fivush & Hudson, 1990; K. Nelson, 1996). Perhaps even more impressive is evidence that even preverbal infants use temporal order to remember events. For example, 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 reenacted 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 seem to result in their tendency not to remember much in the way of specific (that is, nonscript) information. For example, Robyn Fivush and Nina Hamond (1990) asked 2.5-year-old children 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 routine information. Take, for instance, the following conversation reported by Fivush and Hamond (1990) between an adult and a child about a camping trip. The child first recalled sleeping outside, 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, 2005) has taken such a functional view, arguing 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 are others (single events). According to K. 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 unrepeatable events—and to integrate new information about variations in recurrent events into a general knowledge system. (p. 174)

K. Nelson’s ideas are related to theory-theory concepts discussed in Chapters 4 and 5, specifically the Goldilocks effect, Bayesian statistical learning, and causal representation. Nelson makes the point that memory for routine events allows infants to anticipate events and to take a part in (and, possibly, control of) these events. There is no such payoff for a novel event; thus, it makes sense to forget it.

Children do, however, 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 for extended periods (Hamond & Fivush, 1991; Howe, 2000). Hamond and Fivush (1991) presented research that demonstrates how long memories for specific events can last for young children. They interviewed 3- and 4-year-old children 6 or 18 months after they had gone to 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, and children who talked more about the trip with their parents recalled more information about the trip. Nevertheless, recall for this single, special event was quite good, even though it did not fall nicely into a familiar routine.

Role of Parents in “Teaching” Children to Remember

Children begin to talk about past events not long after they acquire their first words, and their recollection skills develop rapidly from 2 to 4 years of age (K. Nelson, 2014). Parents play an important role in this development, as Hamond and Fivush’s research demonstrated. In effect, parents “teach” children how to remember (Fivush, 2014). As it turns out, parents, especially mothers (but also sometimes fathers), and their children spend a good deal of time reminiscing about the past, and individual differences in how this is done are related to how well children remember past events. This suggests that parents can play an important role in children’s early remembering, a point that has been made by several theorists (Fivush, 2014; Haden & Ornstein, 2009) and that is consistent with the theorizing of Lev Vygotsky (1978) and the sociocultural perspective discussed in Chapter 3 (see the discussion of shared remembering; Gauvain, 2001). For example, Judith Hudson (1990) 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 proposed, 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?,” and “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 so that they can be easily retrieved when needed. Parents also often discuss future events with children (for example, an upcoming trip to Disney World), and when they do, particularly when they include photographs of what they may see, children later remember more about the event (Salmon et al., 2008).

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 when remembering an event, but they can remember much more when specific cues are presented. 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 (DB) 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!

Hilary Ratner (1984) illustrated the importance of these parent-child conversations. 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 (Fivush, Haden, & Reese, 2006; McDonnell et al., 2016). 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 are. Other research has even shown that preschool children whose mothers used more elaborative language in talking with them about past events had earlier memories as adolescents than did children with less elaborative mothers (Jack et al., 2009).

In other research, mothers and their young children engaged in three novel events, one when children were 30 months, a second at 36 months, and a third at 42 months (Haden et al., 2001; Hedrick et al., 2009). For example, in one study (Haden et al., 2001), children were tested for their memory of each event at 1 day and at 3 weeks following each episode. The events were carried out in children’s homes and involved the investigator setting up props and asking the mother and child to carry out an elaborate make-believe activity. For example, for the camping event, the mother and child first loaded supplies in a backpack, hiked to a fishing pond, caught a fish with a fishing rod and net, and then moved to their campsite, where they found sleeping bags, pots, pans, and utensils, which they used to cook and eat their food. The frequency with which mothers and children jointly carried out these activities, and the degree to which language was involved during the execution of the task, were observed and related to children’s subsequent memory performance. First, and not surprisingly, children’s overall memory performance increased with age and was greater for the 1-day delay than the 3-week delay. Most pertinent for our discussion here was the relation between mother-child activities during the event and children’s later recollections. Features of the events (for example, putting food in the backpack) that were jointly handled and talked about by the mother and child were better remembered than were features that were handled and talked about only by the mother or that were jointly handled by the mother and child but not discussed. This result clearly points out the important role of joint activity guided by the mother, including the use of language, in fostering young children’s event memory.

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; Fivush, 2014). 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 children to share their experiences with others. This is a practice that may vary somewhat, however, between cultures (Schröder et al., 2013). For example, Mary Mullen and Soonhyung Yi (1995) examined how frequently Korean and American mothers talked to their 3-year-old children about past events and reported that the American mothers talked about the past with their young children nearly 3 times as often as the Korean mothers did. This is consistent with reports that American children talk about past events more than Korean children do (Han, Leichtman, & Wang, 1998) and that American adults report earlier childhood memories than Korean adults (Mullen, 1994). This suggests that early language experience contributes to the onset of autobiographical memory, consistent with the argument made by Katherine Nelson (1996, 2005).

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 do (Reese, Haden, & Fivush, 1996), but not always (see K. D. Lewis, 1999). For example, in a study by Elaine Reese, Catherine Haden, and Robin Fivush (1996), children ages 40 to 70 months participated in several sessions during 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 did. These gender differences were related to ways in which parents conversed with their sons and daughters about the past. Both mothers and fathers tended to be more elaborative with daughters than sons when engaged in parent-child reminiscing, and 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 result, in part, 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, Dorothy Flannagan, Lynne Baker-Ward, and Loranel 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 in what they are asked to remember, both of which seemingly affect what and how well children remember.

It’s hard to minimize the significance of autobiographical memory and to think that there may have been a time in our lives when it didn’t exist. Our recollections about what we’ve experienced in the past define for us who we are and how we interact with others. But autobiographical memory develops over the course of infancy and early childhood. In fact, Alison Gopnik (2009) proposed that although 2- and 3-year-old children can remember specific events, a reflection of episodic memory, they lack true autobiographical memory. According to Gopnik, “They do not experience their lives as a single timeline stretching back into the past and forward into the future. They don’t send themselves backward and forward along this timeline as adults do. . . . Instead, the memories, images, and thoughts pop in and out of consciousness as they are cued by present events, or by other memories, images, and thoughts” (pp. 153–154).

### Section Review

- Young children’s event memory is based on **scripts**, a form of schematic organization with real-world events organized by their causal and temporal characteristics.
- Children’s early memories are for general routines and not for specific autobiographical experiences.
- Parents “teach” children how to remember by interacting with them and providing the structure for putting their experiences into narratives.

### Ask Yourself . . .

9. What do we mean when we say that event memory is constructive in nature?
10. What evidence is there for the social-cultural perspective of event memory?
11. How do children remember and organize events in memory?
CHILDREN AS EYEWITNESSES

One topic in event memory that has attracted substantial research attention concerns the reliability of children as eyewitnesses. How reliable is children’s testimony? How much do they remember, and for how long? How suggestible are children? Can a persuasive interviewer make children report things that didn’t really happen, and can faulty interviewing techniques actually result in children believing they were victims of (or witnesses to) a crime when they were not? These are questions not only for the justice system but also for psychologists because they deal with the nature of children’s developing memory systems and the construction of a particular kind of event memory.

In the following sections, we review research and theory into children as eyewitnesses and the degree to which their testimonies and their memories are subject to change. In the first section, we review age differences in children’s eyewitness reports when no one is trying to change their minds. That is, what do children remember, and what factors influence their memory, when they are asked to report what they witnessed or experienced? In the second section, we examine the large literature on age differences in suggestibility. How susceptible are children to suggestion, and to what extent will they change their answers or their memory representations as a result of suggestive questioning?

First, however, let us provide a general framework for making sense of this research literature. Children’s eyewitness testimony and suggestibility, like event memory in general, are influenced by a host of interacting factors. Which factors are most important? Can we specify how the various factors will interact to predict performance? And can we be confident enough in our conclusions to inform the legal system? Marc Lindberg (1991; Lindberg, Keiffer, & Thomas, 2000) has suggested three major categories of factors that we should consider in evaluating studies of children’s eyewitness memory and suggestibility (see Figure 8.6). The first category in Lindberg’s scheme is memory processes, and these concern the different memory operations of encoding, storage, and retrieval. Encoding refers to children’s representation of an event and how children respond to information they receive before the event. For example, how are children influenced by being told that someone they are about to meet is a “bad boy” or prone to breaking things? Storage refers to information provided to participants after witnessing an event. This may be in the form of suggestive questions (for example, “He spilled chocolate milk over the book, didn’t he?”) or postevent information, which includes any experiences that intervene between witnessing an event and recollecting it. Retrieval refers to manipulations at the time of testing. For instance, how is memory tested? With open-ended, free-recall questions (for example, “Tell me everything you can remember about what happened at the park last week”), cued-recall questions (such as “Tell me what color was the boy’s T-shirt”), or recognition (for instance, “Look at these pictures. Was one of these the boy who took the bike?”)? How are these questions posed?

Lindberg refers to the second category of his taxonomy as focus of the study, by which he means the type of information that is being assessed. For example, is the interviewer concerned with psychologically and legally central (or focal) information (who did what to whom, which is critical in determining innocence or guilt in court), or is peripheral (incidental) information (for example, “What color pants was the man wearing?” or “How tall was the girl?”) also important? Similarly, is the memory for gist information or for details, or verbatim information (as
in fuzzy-trace theory’s description of memory traces; see Brainerd & Reyna, 2014).

And, finally, one must consider participant factors. Here, developmental level and the associated social, emotional, and cognitive skills of children are important. Also of potential importance are personality characteristics of the participants, their level of stress at the time of the event (or at the time of retrieval), their past experiences with a situation, and their more general knowledge of the things they witness. No single study will include all relevant factors from this taxonomy, but it is worthwhile to keep these categories in mind if for no other reason than to remember that understanding children’s eyewitness memory is not child’s play.

**Age Differences in Children’s Eyewitness Memories**

Although there is much variability in methods 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. Later, 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, 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 (such as “Did the man play nicely with the teddy bear?”) and sometimes leading to an “incorrect” answer (such as “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 Brainerd & Reyna, 2014; Bruck, Ceci, & Principe, 2006).

**How Much Do Children Remember, and How Accurate Are They?**

First, how much do children of different ages remember shortly after witnessing an event? When examining immediate (that is, within the same experimental session) free recall, substantial age differences are found (Ornstein, Gordon, & Larus, 1992; Poole & White, 1995). How much is remembered differs from study to study, but preschool children typically recall only a small proportion of information from an event in answer to free-recall questions. Although young children remember very little information, what they do recall is highly accurate and central to the event—if there are no suggestions or coaching (G. S. Goodman, Aman, & Hirschman, 1987; Poole & White, 1995). For example, in a video involving a boy and a girl in a park, with the boy stealing a bike, young children typically recall the bike theft but are much less apt than older children or adults to mention in their free recall descriptions of the participants, characteristics of the bicycle, or things about the setting (Cassel & Bjorklund, 1995; Cassel, Roebers, & Bjorklund, 1996). Thus, young children’s free recall is typically low, accurate, and about central aspects of an event.

When children are provided general cues (for example, “Tell me what the girl looked like”), they recall more information, as you would expect. However, in addition to remembering more correct facts, they also tend to remember some incorrect “facts” as well, reducing the overall accuracy of their recall (Bjorklund et al., 1998; Lindberg et al., 2000).

When children do falsely remember information to cues, does this actually change their memory representations? Will these children, when interviewed later, remember this misinformation again? The answer seems to depend on several factors, including the amount of time between the initial and later interviews. With delays of only several weeks or less, children seem not to recall their earlier false memories (Cassel & Bjorklund, 1995). But when delays are longer (Poole, 1995) or when children are merely asked to recognize rather than to recall information (Brainerd & Reyna, 1996), these false memories...
not only tend to persist, they might even be more resistant to forgetting than true memories (Brainerd & Mojardin, 1999).

These counterintuitive findings have been interpreted in terms of fuzzy-trace theory (Brainerd & Reyna, 2014; see also Chapter 5). According to fuzzy-trace theory, correct recognition is based on literal, or verbatim, memory traces, which are more susceptible to forgetting than are less-exact fuzzy, or gist, traces. In contrast, false recognition must be based on gist traces because there are no verbatim traces for false memories. Gist traces are more resistant to forgetting than verbatim traces are, so the gist-based false memories become more likely to be remembered over long delays than the more easily forgettable, verbatim-based true memories.

**How Long Do Memories Last?**

Although most studies have not assessed the long-term recollections of children, several have investigated children’s memories of specific events for periods ranging from several weeks to 2 years (Flin et al., 1992; Salmon & Pipe, 1997). This is important for the legal system, given that children are sometimes asked in forensic interviews to remember events they witnessed weeks, months, or even years earlier (Paz-Alonso et al., 2009; Pipe & Salmon, 2009). Although the results of these studies are not always consistent, a picture emerges of greater age differences in the accuracy of recall with increasing delays. Accuracy, as used here, does not refer to how much was remembered but, rather, to the ratio of incorrect-to-correct information remembered. Children who recall very little, for example, but correctly recall what they do remember, have perfect accuracy. In contrast, a child who recalls a substantial amount of both correct (accurate) and incorrect (inaccurate) information might demonstrate more recall but less accuracy.

First, with delays of about 1 month or less, children of all ages and adults remember about the same proportion of accurate and inaccurate information as they did originally (Baker-Ward et al., 1993; Cassel & Bjorklund, 1995). Age differences in recall accuracy are found with longer delays, however. For example, Rhona Flin and her colleagues (1992) reported that both 6-year-olds and adults recalled as much correct information after a 5-month delay as they had originally but that recall by the 6-year-olds was less accurate than recall by the adults. Thus, the ratio of incorrect-to-correct recall became higher for the children than for the adults during the 5-month period. The conclusion from this and similar studies is that age differences in accuracy are found, but only when memory is assessed after extended delays. Fuzzy-trace theory (Brainerd & Reyna, 2014; see also Chapter 5) explains these findings by the greater rate of decay of verbatim (exact) traces relative to gist traces. Verbatim traces, favored by younger children, deteriorate more rapidly than the gist, or fuzzy, traces favored by older children, resulting in greater loss of information over delays and corresponding increases in erroneous recall. These are the same arguments that have been used to explain the phenomenon of infantile amnesia (see earlier discussion). The verbatim traces favored by infants and young children are especially susceptible to deterioration, making it highly unlikely that these memories would be available years after their original encoding (Leichtman & Ceci, 1993).

**Factors Influencing Children’s Eyewitness Memory**

A host of factors other than age and length of delay have been found to influence the amount and accuracy of children’s eyewitness memories. For instance, children with high IQs show higher
levels of eyewitness recall than do their peers with lower IQs (Roebers & Schneider, 2001); children given incentives to be accurate in their recall are, indeed, more accurate than children not given incentives (Roebers, Moga, & Schneider, 2001); intermediate levels of stress (when experiencing the event) seem to facilitate recall of an event relative to overly high or low levels of stress (Bahrick et al., 1998); children having emotionally supportive mothers who discuss upcoming medical procedures with them recall less inaccurate information about the procedure than children having less sympathetic or talkative mothers (G. S. Goodman et al., 1994; 1997); and children whose parents score as more avoidant are less accurate after experiencing higher distress levels during a medical procedure, whereas children’s parents who are less avoidant are more accurate after experiencing higher distress (Chae et al., 2014). Two sets of factors that have substantial influences on children’s eyewitness reports are children’s background knowledge for the event (Ornstein et al., 2006) and the characteristics of the interview (Ceci, Bruck, & Battin, 2000), each of which we discuss in greater detail next.

Role of knowledge. We saw in Chapter 7 that knowledge has a potent role in children’s working memory and strategic memory, so we should not be surprised that it also plays an important role in eyewitness memory (Elischberger, 2005; Ornstein & Greenhoot, 2000). Indeed, some researchers (see Howe, Wimmer, Gagnon, & Plumpton, 2009) have proposed an alternative approach to fuzzy-trace theory in explaining children’s false memories, the associative activation theory, arguing that age differences in knowledge base and automatic processing are the most important factor underlying false-memory production. For example, children’s recollections of stressful and invasive medical procedures are related to their knowledge of the procedures; children who know more about the procedure remember more accurate information (Clubb et al., 1993; Ornstein et al., 2006) and recall less inaccurate information (G. S. Goodman et al., 1994). Yet although knowing a lot about an event (that is, how actions in an event are supposed to go) is usually associated with increased memory accuracy, knowledge can be a double-edged sword. For example, in a study of 4- and 6-year-old children’s recall of a mock physical examination, Peter Ornstein and his colleagues (1998) included some typical, script-consistent features in the exam (for example, the doctor listened to the children’s hearts with a stethoscope and looked into their ears), but they also included some atypical, unexpected features (for example, the doctor measured children’s head circumference and used alcohol to wipe their belly buttons). In addition, some expected features were omitted from the exams (for example, measuring blood pressure and looking in children’s mouths). Children were interviewed about the exam both immediately and after a 12-week delay. They were first asked open-ended questions (for example, “Tell me what happened during your checkup” and “Tell me what the doctor did to check you”), followed by increasingly specific questions (for instance, “Did the doctor check any parts of your face?” and “Did the doctor check your eyes?”). In addition to questions about what really did happen during the exam, children were also asked specific questions about things that did not happen. For example, children for whom the doctor did not check their ears would be asked, “Did the doctor look into your ears?” Some of the questions referred to events that are likely to occur in an exam, such as looking into children’s ears, whereas others were for events that were unlikely to occur (for example, “Did the doctor give you some stitches?”).
How did the children do? The results for the 12-week assessment of this study are shown in Figures 8.7 and 8.8. The first figure reports the percentage of correct responses for the 4- and 6-year-old children for the present-typical and present-atypical features (that is, aspects of the exam that children actually experienced) for the open-ended questions and for the specific questions. As can be seen, children of both ages recalled more typical features correctly than atypical features, for both types of questions. This reflects the positive effects of knowledge base. This was not the first medical exam for any of the children, and they presumably had a script for what usually happens in such an exam. As a result, features that are typically found in medical exams, based on children’s past experiences, were more likely to be remembered than atypical features. But there was a negative side to knowledge, and this is reflected in the results displayed in Figure 8.8. Correct denials (the dark portion of the bars in Figure 8.8) refer to children correctly stating that an event did not happen (“Did the doctor give you stitches?” “No.”). As can be seen, children were more likely to correctly reject these non-events for the atypical features. False alarms (the light portion of the bars

*FIGURE 8.7* Percentage of present-typical and present-atypical features recalled correctly in response to open-ended and specific questions for 4- and 6-year-old children, 12-week assessment.

[![Graph](image-url)](image-url)


*FIGURE 8.8* Percentage of absent-typical and absent-atypical features to which children responded with correct denials and false alarms for 4- and 6-year-old children, 12-week assessment.

[![Graph](image-url)](image-url)

in Figure 8.8) refer to children *incorrectly* agreeing that an event happened when it did not (“Did the doctor look into your ears?” “Yes.”). Here, both the 4- and 6-year-old children were more likely to erroneously say that these events did, indeed, happen when they were typical rather than atypical features of a physical exam. Knowing what usually happens caused children to falsely remember what did happen, at least when their memory was tested 12 weeks after the event.

A similar finding was produced by Henry Otgaar and colleagues (2010) with slightly older children, 7 to 11 years old. Regardless of age, children developed more false memories after listening to false narratives describing events about which they had a lot of knowledge (for example, getting their fingers caught in a mousetrap) versus little knowledge (for example, receiving a rectal enema). These studies provide convincing evidence that script knowledge boosts children’s false memories.

**Characteristics of the interview.** Not surprisingly, how children are interviewed can greatly affect what they remember and the accuracy of their recollections (D. A. Brown & Lamb, 2015; Bruck et al., 2006). The type of questions asked, for example, influences what children remember. Young children tend to recall relatively little to open-ended, free-recall questions (“Tell me everything that happened when the man came into your classroom”), but what they do recall tends to be highly accurate. Children recall more when given neutral cues, but the accuracy of their recall declines (that is, they also recall more false information).

Interviewer characteristics, such as whether the interviewer is warm and supportive or high status (for example, a police officer), influences the accuracy of children’s memory, as does the use of any special recall-facilitating technique or props. For example, many forensic interviews make use of anatomically correct dolls when questioning children who are suspected of being victims of sexual abuse. Does the use of such dolls increase the accuracy of children’s reports? Maggie Bruck and her colleagues (1995) interviewed 3-year-old children following a routine medical exam (these children were *not* suspected child-abuse victims). Half of the children received a genital exam by the doctor, and half did not. Immediately after the examination, children were shown an anatomically correct doll and were asked, with the interviewer pointing to the genital area of the doll, “Did the doctor touch you here?” Only about half of the children who did receive the genital exam answered correctly, whereas about half of those who did not receive a genital exam also said yes. When simply asked to “show on the doll” how the doctor had touched their genitals or buttocks, only 25% of the children who had received the genital exam responded correctly, and 50% of the children who were not given such an exam falsely showed anal or genital touching. Similar results have been reported by other researchers (see Poole & Bruck, 2012). Other research indicates that interviewers who use dolls and other objects to aid recall ask fewer open-ended questions and are less likely to stay on topic than interviewers who do not use such objects (Melinder et al., 2010). Findings such as these call into question the use of anatomically correct dolls, at least with young children, indicating that the dolls themselves may cause children to “make accusations” of abuse when no abuse occurred.

How warm or supportive an interviewer is can also influence the accuracy of children’s recollections. For instance, children remember more correct information, and less incorrect information, when they are questioned by a warm and supportive interviewer (Bush et al., 2014; Quas, Bauer, & Boyce, 2004). In one study, 4- to 6-year-old children who had high levels of stress...
showed increased levels of recall accuracy when they were questioned by an emotionally supportive interviewer but reduced levels of accuracy when questioned by a nonsupportive interviewer (Quas et al., 2004).

Age Differences in Suggestibility

Perhaps the single most investigated area of eyewitness testimony in both the adult and child literatures concerns suggestibility (for a review, see Ceci, Hritz, & Royer, 2016). To what extent are children susceptible to suggestion? Research has shown that people of all ages report more inaccurate information when misleading questions are posed (that is, questions suggesting incorrect “facts”). The questions for developmentalists, and for the legal profession, include are children more suggestible than adults, what factors influence their suggestibility, and how can we maximize memory accuracy and minimize suggestibility?

The general consensus regarding the question of whether children are more suggestible than adults seems to be yes. In an extensive review of the early literature, Stephen Ceci and Maggie Bruck (1993) concluded, “There do appear to be significant age differences in suggestibility, with preschool children being disproportionately more vulnerable to suggestion than either school-age children or adults” (p. 431). Most investigators looking for age differences in suggestibility have found it, although in varying degrees and sometimes only under certain circumstances (Ackil & Zaragoza, 1995; Bruck et al., 1995).

How Do Children Respond to Misleading Questions?

Let us provide an example from research that asked children different types of suggestive (leading) questions. William Cassel and I (DB) (1995) showed groups of 6- and 8-year-old children and college adults a brief video of a boy and a girl in a park, with the boy eventually taking the girl’s bike without permission. Participants were interviewed 15 minutes after viewing the video and then again 1 week and 1 month later. During these later interviews, participants were given either sets of misleading questions, suggesting things that did not happen (for example, “The girl said it was okay for the boy to take her bike, didn’t she?”), or positive-leading questions, suggesting things that did, indeed, happen (for example, “The girl told the boy not to take the bike, didn’t she?”). Figures 8.9 and 8.10 present some of the results for the 1-week interview. As can be seen, the 6- and 8-year-olds tended to follow the lead of the interviewer, agreeing both with the misleading questions (see Figure 8.9), thus getting
more wrong than the adults did, and with the positive-leading questions (see Figure 8.10), thus getting more right than the adults did. In fact, as can be seen in Figure 8.9, both the 6- and 8-year-olds had more incorrect than correct responses to the misleading questions, whereas the reverse was true for the adults.

In the 1-month interview, participants were first asked sets of leading questions by one examiner suggesting one interpretation (either misleading or positive leading) and then immediately thereafter were asked a second set of questions by a second examiner, asking for the opposite interpretation (misleading if positive leading had been asked first, and vice versa). How would children respond to the same question they had just been asked, but with an opposite spin? The answer is that children often changed their answers. For example, when asked about the color of the bike, 71% of the 6-year-olds who had agreed with the suggestion of the first interviewer later changed their answers to comply with the suggestion of the second interviewer. The corresponding percentages for the 8-year-old children and adults were 53% and 35%, respectively. For the more critical central question—that is, whether the girl had given the boy permission to take her bike—42% of the 6-year-old children changed their answers in response to the second interviewer, whereas only 7% of 8-year-olds and 12% of adults did so. These results make it clear that younger children are highly susceptible to the suggestion of an adult interviewer, modifying their answers, it seems, to suit the desires of whomever is interviewing them.

Yet despite the ease with which young children can be led to give answers consistent with the suggestion of any adult, are their memories actually changed as well? Research that has asked children misleading questions over repeated interviews indicates that such repetition will, indeed, cause some children to report the incorrect information in later tests of free recall and recognition, particularly information that is peripheral, or incidental, to the event. Such findings indicate that suggestive questioning changes not only children’s answers but also their memories. However, in many other cases, children who follow the lead of an interviewer fail to incorporate that misinformation, especially information that is central to the event, in their subsequent free recall of the event, suggesting that it is far easier to change children’s answers with such questions than it is to change their minds (see Bjorklund, Brown, & Bjorklund, 2002).

In an early investigation, Gail Goodman and Allison Clarke-Stewart (1991) illustrated the extent to which young children’s reports of a witnessed event can be swayed and the extent to which they will stick to their interpretation.
Preschool children watched a man, posing as a janitor, who either cleaned and arranged some toys, including a doll, or played with the toys in a somewhat rough and inappropriately suggestive manner. About an hour later, the janitor’s “boss” interviewed the children about what they had seen. Of primary concern here is the situation in which children watched the janitor merely cleaning the toys, although it was suggested to them that he had actually been playing with the toys improperly instead of doing his job. If a child in this situation initially did not agree with the interviewer’s suggestion, subsequent leading questions were asked, with each question becoming increasingly stronger in its suggestion (that is, more explicitly suggesting misbehavior). Two thirds of these children eventually followed the interviewers’ suggestions, even though the suggestions did not correspond to what they had seen. Moreover, when the children were questioned by their parents at the end of the session, all stuck with the story that they had given the interviewer. In sum, when suggestions and accusations were strong and persistent, young children were easily led and did not alter their newfound interpretations when later questioned by their parents.

In other research, Leichtman and Ceci (1995) assessed the effects of negative stereotyping and suggestion on preschool children’s recollections of an event that happened at their school. An unfamiliar person, Sam Stone, came into children’s classrooms, talked to the teacher, sat with the children during the reading of a story, made a comment about the story (“I know that story; it’s one of my favorites!”), walked around the classroom, and finally left the room, waving good-bye to the children. Children in the stereotype condition were given information about Sam Stone before his visit that depicted him as accident prone and irresponsible (“That Sam Stone is always getting into accidents and breaking things!”). Children in the suggestion condition were interviewed several times after Sam Stone’s visit and given misinformation about the visit (“Sam ripped a book and soiled a teddy bear when he visited”). Children in the stereotype-plus-suggestion condition received both the negative stereotype before Sam Stone’s visit and the misinformation afterward, and children in the control condition received neither the stereotyped information nor the misinformation about Sam.

Ten weeks after the visit, the children were given an open-ended interview about what happened the day Sam Stone visited the classroom. Leichtman and Ceci (1995) reported that, relative to children in the control condition, children who had been given the stereotypes made a modest number of false statements about Sam in the interview and that children in the suggestion condition made a substantial number of false reports. The highest levels of false reports about Sam’s visit, however, came from children who had received both the stereotyped information before and the misinformation after the visit: 46% of 3- and 4-year-old children and 30% of 5-and 6-year-old children said that Sam had either ripped a book, soiled a teddy bear, or both. The percentage of erroneous responses increased to 72% and 44% for the younger and older preschoolers, respectively, when children were asked specific follow-up questions concerning whether Sam had ripped a book or soiled a teddy bear.

Why are younger children often more susceptible to the effects of misinformation and suggestion than older children are? One explanation comes from fuzzy-trace theory, as discussed earlier (Brainerd & Reyna, 2014). Because verbatim traces deteriorate rapidly, they may not be available when postevent information is provided or when suggestive questions are asked.
Thus, the erroneous information has an excellent chance of being incorporated with “real” memories and becoming indistinguishable from them. Similarly, it would seem that young children’s elevated rates of erroneous information to unbiased cues (that is, questions that ask for more information but do not attempt to bias a child’s answer one way or the other) might be the result of their greater reliance on verbatim traces.

Many factors influence suggestibility in children. For example, social factors, such as a desire to comply with adult requests, surely play a role in children’s greater suggestibility (Bjorklund et al., 1998). Children are more likely to comply with the suggestion of a high-status versus a low-status person (Ceci, Ross, & Toglia 1987). Children’s background knowledge for the witnessed event also influences their performance (Ornstein et al., 2006), as does the number of times an event is experienced (Powell et al., 1999). Much research has investigated how other aspects of children’s cognitive development influence suggestibility. For example, developmental and individual differences in working memory and inhibitory control are related to suggestibility in children (Ruffman et al., 2001). Preschool children who perform better on theory-of-mind tasks tend to be less suggestible than are children with poorer theory-of-mind abilities (Welch, 1999), and children and adults with better metacognitive skills are more accurate in suggestive interviews than are their less-metacognitively sophisticated peers (Roebers, 2002).

One topic that has received considerable attention is that of source monitoring, which refers to being aware of the source of information one knows or remembers. For example, did a particular experience happen to them, to a friend, or did they see it on TV? This can be particularly important in cases of eyewitness testimony. Was the information that the boy stole the bike something I saw or something someone told me? Research has shown that preschool and early school-age children often have difficulty monitoring the source of their memories (see discussion in Chapter 5). For example, children sometimes have difficulty determining whether they actually performed an act or just imagined it (Foley, Santini, & Sopasakis, 1989), and they often incorrectly remember that an action carried out by another person during a joint activity was actually performed by them (Ackil & Zaragoza, 1995; Foley, Ratner, & Gentes, 2010). When young children make errors in such situations, they are much more likely to attribute an action to themselves that someone else actually did than vice versa. Findings such as these have caused some researchers to propose that young children’s increased susceptibility to suggestion might be caused largely by their difficulty in monitoring the source of what they know (Ceci & Bruck, 1995). Some research supports these speculations, showing that 6-year-olds who are poor at source monitoring are more prone to the effects of suggestion (Mazzoni, 1998). Moreover, children who are given some source-monitoring training (for example, training in distinguishing between events they experienced directly versus events they heard about in a previous interview) make fewer false statements to misleading questions (Thierry & Spence, 2002), although some researchers have found this effect only for older (7- and 8-year-old) children and not for preschoolers (Poole & Lindsay, 2002).

Another reason contributing to young children’s suggestibility might be their beliefs that their memory is invulnerable to suggestion, or poor metamemory. For example, Julia O’Sullivan, Mark Howe, and Tammy Marche (1996) interviewed preschool, first-grade, and third-grade children about factors that might influence their memories. Although children of
all ages believed that central aspects of a story would be more likely to be remembered than peripheral details, only the third-grade children believed that their memories would be susceptible to suggestion. The preschool and first-grade children were confident that suggestion from a parent or sibling would not affect their recollection of an event.

**False-Memory Creation**

How easy is it to create a false memory in a person? Asking children misleading questions about an event they have seen can cause children to confuse the source of the information, thinking that the misinformation was actually something they experienced and not just something they heard someone else say (Ackil & Zaragoza, 1995). But how easy is it to actually get children, or adults, to believe an event happened to them that never really did?

Elizabeth Loftus and her colleagues first investigated this with adults (Loftus & Pickrell, 1995). College students were interviewed about four events that had supposedly happened to them in childhood (based on reports of parents and older siblings). One event, being lost in a mall at age 5, never actually occurred. The students were asked to write as much about each event as they could remember. They remembered, on average, 68% of the true events; they also “remembered” 25% of the false events, sometimes vividly.

It seems that preschool children are even more susceptible to creating false memories than are adults. Ceci and his colleagues (1994) used a similar technique to that used by Loftus and Pickrell (1995) and interviewed children throughout an 11-week period about events that might have happened to them. For example, children were asked if they remember ever getting their finger caught in a mousetrap. The percentage of false reports (that is, recalling something about the event) for the 3- and 4-year-old children and for the 5- and 6-year-old children in this study over the 11-week period is shown in Figure 8.11. Although few children admitted to experiencing these false events in the initial interviews, by the conclusion of the study more than 50% of the 3- and 4-year-old children and about 40% of 5- to 6-year-olds assented that these events did, indeed, happen—and often provided substantial detail about the events. Moreover, many children continued to believe that these events actually happened even after being told by the interviewers and their parents that the events were just made up. It seems that false memories

of plausible but extraordinary events are relatively easy to put into young children’s minds. Other research has examined how rumors may influence children’s memory of events. For example, in research by Gabrielle Principe and her colleagues (Principe et al., 2006, 2010, 2012), preschool children witnessed a magic show by Magic Mumfrey, during which, toward the end of the show, Mumfrey tried to pull a rabbit out of his hat but failed. After the show, some children heard an unfamiliar adult tell their teacher that she knew why the trick failed: The rabbit had escaped and was in the classroom eating carrots. Other children didn’t hear the rumor from an adult but were classmates of the children who did, and they heard the rumor as they interacted with children in their classroom. Finally, some children saw the show but were not exposed to any rumor. One week later, children were interviewed about the show. A majority of children in both rumor conditions reported that the rabbit had gotten loose in the classroom, and many of these children actually professed seeing the runaway bunny. Five- and six-year-old children who were warned that there was a false rumor going around about what had happened in the school made fewer such claims when they heard the rumor from their classmates, although such a warning did not affect 3- to 4-year-old children’s reports. Moreover, children who said they saw the rabbit in the classroom provided more vivid descriptions of the (non)event than children who did not, suggesting that the implanted rumor produced a true false memory, complete with perceptual details, and was not simply the result of children wanting to conform with what other children had witnessed (Principe et al., 2010).

Henry Otgaar and colleagues (Otgaar et al., 2012) were further interested in the question of whether children’s implanted memories represent real memory traces or just compliance. They presented 8-year-olds with a narrative about a true (first day at school) and false event (hot air balloon ride). Across two interviews, the majority of children developed at least a partial false memory of the balloon ride. To analyze whether the false memories were guided by children’s compliance with the experimenter or actual memory traces, the researchers examined how quickly children responded yes or no to statements that were either consistent or inconsistent with the true and false events. On some trials, children were instructed to tell the truth, and on other trials they were instructed to lie. So, for example, when instructed to tell the truth, a yes response to a statement consistent with the real narrative would be correct. When instructed to lie, a no response would be correct. The manipulation becomes a bit more complicated when we look at the false event. For children who correctly rejected the false narrative as never occurring, a yes response would be the correct response for the statement, “I have been on a hot air balloon ride” when instructed to lie. However, for children who indicate they have a false memory of the balloon ride, the expected response when instructed to lie would be no.

The researchers first looked at response times to the true events (school-related trials) and found that children took longer to respond when they had to lie versus when they had to tell the truth. Next, they compared these response times to those of children with false memories who were responding to statements about the false event (hot air balloon ride). The rationale was that if children’s false memories were caused by faulty memory traces, then denying that the false event took place would actually feel like a lie. These trials should then demonstrate elevated response times and error rates relative to trials in which they have to confirm that the event took
place. However, if implanted false memories are based on compliance (in other words, they never believed the ride took place, but they said it did to please the experimenter), then the pattern should be the opposite: Denying that the false event occurred would be a truthful response, and response times should be relatively quick. The pattern of results confirmed that false memories were indeed treated like true memories, with children taking longer when they had to “lie” about these events, suggesting they were based in actual faulty memory traces, not just a desire to conform.

Final Thoughts on Children as Eyewitnesses

Children do not have perfect memories, making them less than ideal witnesses. Of course, adults’ memories are also fallible, so how different are children from adults when it comes to providing reliable testimony? As we’ve seen, young children’s spontaneous recall is typically sparse, but it also tends to be accurate and about psychologically and legally central aspects of an event. They are also more prone to suggestion than adults, at least in most contexts (but see Brainerd & Reyna, 2012, for important exceptions). Since the 1980s, when issues about the accuracy of children’s testimony became of increasing interest to the legal community (Ceci & Bruck, 1995), developmental psychologists have investigated children’s event memories for forensically relevant information and have discovered important things about the emotional, social, and cognitive factors that influence children’s reports and memories.

However, most of the investigations described in this section were laboratory studies. Because children’s testimony may have significant legal consequences, it is important to do research in the real world, developing paradigms where researchers have some control over the situation but where children remember “real” events that may have legal implications, which some researchers have done. For example, researchers have assessed children’s recollections of events surrounding natural disasters (Ackil, Van Abbema, & Bauer, 2003; Bahrick et al., 1998). Other real-life research paradigms involve assessing children’s recollections of invasive medical procedures—some traumatic (such as trips to the emergency room) and others not (such as well-child pediatric exams). In general, older children remember more than younger children, and prior knowledge of the exam procedure is positively related to amount of initial (but not delayed) recall of the events (see Peterson, 2012).

Other studies attempt to construct forensic interviews similar to those that abused children would experience (D. A. Brown & Lamb, 2015; Pipe & Salmon, 2009). Such studies afford control of variables that are difficult, if not impossible, to control in real life. However, there is always the question of the ecological validity of the studies. How do we know that children who experience child abuse behave in the same way? This is where field studies, interviewing children who are suspected victims of child abuse, become important (D. A. Brown & Lamb, 2015). Of course, field studies lack control of important factors, and one does not know for certain what children actually experienced. But the combination of laboratory and field studies can provide greater insight into the reliability and accuracy of children as witnesses.

This research has made significant contributions to the legal system, affecting how children are interviewed by police officers, social workers, and lawyers (Bruck et al., 2006; Howe, 2013) and the development of a number of protocols to help those in the legal profession get the most accurate information possible when interviewing children. For example, the National
Institute of Child Health and Human Development (NICHD) protocol incorporates research findings from both laboratory and field settings (Lamb, Sternberg, & Esplin, 1998), and an outline of the protocol is presented in Table 8.1.

We may never know with 100% certainty the veracity of a child’s recollections (or that of an adult, for that matter), but developmental science has made great leaps in understanding children’s memory and factors that affect its accuracy.

### TABLE 8.1 Sequence of phases recommended by the NICHD guidelines.

1. Introduction of parties and their roles
2. The “truth and lie ceremony” (warning the child of the necessity to tell the truth)
3. Rapport building
4. Description of a recent salient event
5. First narrative account of the allegation
6. Narrative accounts of the last incident (if the child reports multiple incidents)
7. Cue question (for example, “You said something about a barn. Tell me about that”)
8. Paired direct-open questions about the last incident
9. Narrative account of first incident
10. Cue questions
11. Paired direct-open questions about the first incident
12. Narrative accounts of another incident that the child remembers
13. Cue questions
14. Paired direct-open questions about this incident
15. If necessary, leading questions about forensically important details not mentioned by the child
16. Invitation for any other information the child wants to mention


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**Section Review**

- Age differences are found in the amount of information children remember, but what young children do recall tends to be accurate and for central components of an event.

- The accuracy of children’s event memory is influenced by a host of factors, including their knowledge for the event they experienced and the characteristics of the interview, such as the use of an anatomically correct doll.
- Young children are generally more susceptible to misleading questions (suggestions) and misinformation than are older children and can easily be caused to form false memories.
- Many factors influence children’s suggestibility, including deficits in source monitoring, with children confusing the source of information they know or remember.

**Ask Yourself . . .**

12. What are the major age differences found in children’s eyewitness testimony?
13. How suggestible are children? What factors affect the accuracy of their memories?
REMEMBERING TO REMEMBER

To this point, our discussion of memory has focused on what is called **retrospective memory**, or remembering something that happened in the past. But another type of memory, one that we engage in every day, is **prospective memory**, or remembering to do something in the future (Einstein & McDaniel, 2005). For example, if you need to pick up a bottle of wine tonight on your way home from school or work for that special dinner and remember to do so, you are demonstrating good prospective memory. If you neglect to do so, you are displaying a failure of prospective memory (and, perhaps, a less successful evening than you had hoped for). Prospective memory involves what some people refer to as **mental time travel**—anticipating the future and planning for it (Suddendorf & Corballis, 2007; Tulving, 2005). This requires a sophisticated cognition/memory system.

Researchers have paid less attention to the development of prospective memory relative to retrospective memory, but this is gradually changing (see Mahy, Moses, & Kliegel, 2014, for a review). One of the first studies to examine prospective memory in young children was performed by Susan Somerville and her colleagues (1983), who asked the parents of 2-, 3-, and 4-year-old children to remind them to perform some task in the future, some of which were of low interest to the children (for example, “Remind me to buy milk when we go to the store tomorrow”) and others of which were of high interest (for instance, buying candy at the store). Figure 8.12 shows the performance of the children for the high- and low-interest tasks for short (5 minutes or less) and longer (for example, from morning to afternoon) delays.

As you can see, even the 2-year-olds were very good at reminding their parents when the task was one of high interest and over short delays. Performance for all children dropped sharply, however, for the low-interest and long-delay tasks. In fact, none of the 2-year-olds spontaneously remembered to remind their parents about a low-interest task over a long delay. Children improved when given a clue (“Was there something you were supposed to remind me to do?”), increasing their performance by about a third, on average. These results suggest that motivation plays an important role in when children display prospective memory, as does the length of time they have to wait.

More recent research using controlled laboratory experiments has shown that 2-year-olds...
rarely perform as well as Somerville’s youngsters did (Kliegel & Jager, 2007) and that prospective memory continues to improve over the preschool (Quon & Atance, 2010) and school years (R. E. Smith, Bayen, & Martin, 2010; Yang, Chan, & Shum, 2011).

Many factors influence age differences in prospective memory performance, including the type of task. Somerville’s tasks involved event-based prospective memory, a type that researchers distinguish from time-based prospective memory. Whereas event-based tasks require us to remember to do something after some specific circumstances occur (for instance, being at the store), time-based tasks require that we act at a particular point in time or after the passage of a specific duration (for instance, attending a meeting at 2:00). Children’s performance on these tasks varies as a function of age, with children remembering event-based tasks at a younger age than time-based tasks, but the general trend is improvement across development. For instance, in one study, 7- to 12-year-old children played a computer game called CyberCruiser, a time-based task, in which they used a joystick to maneuver around obstacles. They also had to occasionally check the fuel gauge to make sure they did not run out of gas and to fill up when they had less than a quarter of a tank. Perhaps not surprisingly, younger children ran out of gas more often than older children (Kerns, 2000).

Like performance on some retrospective memory tasks (Lehmann & Hasselhorn, 2007), children’s performance on prospective memory tasks is influenced by individual differences in executive function (Causey, 2010; Causey & Bjorklund, 2014; Mahy & Moses, 2011). For example, in the study by Kimberly Kerns (2000) described in the previous paragraph, the author reported a moderate but significant negative correlation ($r = –0.29$) between executive-function measures and the number of times children ran out of gas. Subsequent research reported significant relations between measures of strategic time monitoring (checking a clock to indicate the passage of every 5 minutes while watching a film), prospective memory success (Voigt et al., 2015), and metacognition (Causey, 2010). Other research has shown that executive function predicts 3-year-olds’ performance on a low-interest event-based prospective memory task (“Remind me to remove the sign on the door when we leave”) but not for high-interest tasks (“Remind me to get you a prize when we finish”) (Causey & Bjorklund, 2014). These patterns of findings suggest that the relation between executive function and prospective memory is complex and highly task dependent.

Prospective memory involves a host of cognitive skills, among them a symbolic system that can represent the self in the future, which is the essence of episodic memory, and executive function (Causey & Bjorklund, 2014; Ford et al., 2012). In fact, some people have referred to this type of memory as episodic future thought (Atance, 2015; Nigro et al., 2014). Relatedly, self-awareness in the form of metacognition seems important in ensuring children implement relevant strategies (like clock checking) to succeed in prospective memory tasks (Causey, 2010; Mahy & Moses, 2011). Apparently, under some limited conditions with delays of 5 minutes or less, this is something that 2-year-old children can do. However, the tendency to travel through time and to remember to do something in the future develops with age, as children’s representational abilities, memories, and executive functions improve.
Section Review

- Developmental differences are found in prospective memory, which refers to remembering to do something in the future.
- Researchers distinguish between event-based and time-based prospective memory.
- Age differences in performance on these tasks are influenced by many extrinsic and intrinsic factors, including task type, motivation, executive function, representational ability, and metacognition.

Ask Yourself . . .

14. How are time-based tasks different from event-based tasks? How might children’s strategies differ across each type?

15. How is the development of prospective memory influenced by executive function? What about representational ability? Metacognition?

KEY TERMS AND CONCEPTS

autobiographical memories
conjugate-reinforcement procedure
declarative memory
deferrred imitation
dentate gyrus
episodic memory

event memory
explicit memory
implicit memory
infantile amnesia
nondeclarative memory
preference-for-novelty paradigms

procedural memory
prospective memory
scripts
semantic memory
source monitoring

SUGGESTED READINGS

Scholarly Works:


Cham, Switzerland: Springer International. This book, by one of the leading researchers in children’s memory, provides an up-to-date review of research and theory on memory development.

Reading for Personal Interest

Lamb, M. E., Hershkowitz, I., Orbach, Y., & Esplin, P. W. (2008). *Tell me what happened: Structured investigative interviews of children victims and witnesses*. West Sussex, UK: Wiley. Child forensic science is one of the fields in which cognitive development research has had a great practical impact. This book, written by leading researchers in the field, provides a recent summary of how professionals (for example, psychologists, police officers, social workers) should approach children suspected of abuse and child witnesses to obtain reliable accounts of what happened.