2.37 The Development of Skilled Remembering in Children

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2.37.1 The Development of Skilled Remembering in Children

A number of the intellectual giants of the nineteenth and early twentieth centuries thought seriously about the mnemonic abilities of young children. Initial considerations of children's remembering can be seen in Darwin's (1877) and Preyer's (1882/1889) diary case studies of their own children's memory skills, in Binet's (e.g., Binet and Henri, 1894a, Binet and Henri, 1894b) early experiments on children's memory for words and ideas, and in Freud's (1901) initial psychoanalytic writings about infantile amnesia. Sustained interest in children's memory was reflected in Hunter's (1913) basic studies of memory capacity and retention and in Stern and Stern's (1909) applied investigations of memory, suggestibility, and eyewitness testimony. Moreover, assessments of memory figured prominently in initial measures of intellectual capacity (e.g., Terman, 1916; Terman and...
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In addition to this important distinction between memory development and the development of memory, the stage for this chapter is set by two pervasive themes in the now-voluminous research literature on children’s remembering. First, a substantial corpus of work now documents the remarkable mnemonic competence of infants (e.g., Meltzoff, 1995; Rovee-Collier, 1995; Bauer et al., 2000; Bauer, 2006; See Chapter 2.36) and preschoolers (Baker-Ward et al., 1984; Goodman et al., 1990). Second, an equally impressive literature confirms the presence of substantial age differences in aspects of memory performance that include the degree of detail reflected in children’s reports (e.g., Fivush and Hamond, 1990; Roelers and Schneider, 2001), the amount of forgetting observed (Brainerd et al., 1990; Howe and Courage, 1997), and the deployment and effectiveness of deliberate strategies for remembering (Ornstein et al., 1988; Bjorklund, 1990; Schlagmüller and Schneider, 2002). These two themes—the surprising competence of young children’s memory on the one hand and clear age-related differences in performance on the other hand—represent a distillation of evidence stemming from research paradigms that range from elicited and deferred imitation (Meltzoff, 1995; Bauer et al., 2000, Bauer, 2006) and conditioning (Rovee-Collier and Shyi, 1992; Rovee-Collier, 1997) to those involving the production of narrative accounts of previous experiences (Fivush, 1991; McCabe and Peterson, 1991; Reese et al., 1993) and verbal measures of both strategy use and remembering (Baker-Ward et al., 1993; Fivush et al., 1990; Schlagmüller and Schneider, 2002).

The aim of this chapter is to provide an overview of children’s memory, focusing on age-related differences in the underlying processes of encoding, storage, retrieval, and reporting. With respect to the flow of information within the developing memory system, the emphasis is on early mnemonic competence and age-related changes in a range of memory skills, characterizing children’s abilities at different points in time and exploring factors that serve to bring about change. However, reflecting the relative dearth of information in the literature on the development of memory, the bulk of the work reviewed here deals with memory development. To some extent, this state of affairs reflects the predominance of cross-sectional research designs, in which the performance of children of different ages is contrasted, and the infrequent use of longitudinal designs in which the same children are tracked over time. There are, of course, many reasons why cross-sectional designs have been favored, but...
longitudinal research is certainly necessary for an account of developmental change within individuals, especially given the evidence to date that cross-sectional findings are not always replicated within a longitudinal framework. For example, although the cross-sectional literature would suggest a smooth age-related progression in the skill with which an organizational strategy is deployed, inspection of individual developmental trajectories available from the Munich Longitudinal Study reveals a markedly different pattern: Children’s strategic deployment seems to be characterized by inconsistency and abrupt change across measurement points (Sodian and Schneider, 1999). As such, longitudinal designs are essential if the aim is to address issues concerning the development of memory, but these designs must be chosen so as to provide information concerning factors—within the child and within the environment—that may serve as mediators of the developmental change that is observed.

The bulk of the chapter is devoted to characterizing age differences in various aspects of children’s memory performance, making extensive use of the cross-sectional literature. To the degree possible, longitudinal data are utilized to supplement this characterization of children’s abilities in an attempt to move the discussion to (1) a description of the course of developmental change and (2) a treatment of potential mediators of this change. However, because longitudinal research designs are inherently correlational in nature, the treatment of longitudinal studies is combined, where possible, with parallel experimental investigations in which hypothesized mediators of change (e.g., mother–child communicative interactions) are brought under experimental control. These experimental interventions (e.g., Carr et al., 1989; Boland et al., 2003) are necessary if the aim is to make causal statements about factors that serve to bring about developmental change. In addition, the findings of these cross-sectional, longitudinal, and intervention studies are supplemented by a discussion of the few extant microgenetic studies of children’s memory. In microgenetic studies (see Siegler and Crowley, 1991; Siegler, 2006), frequent observations are made of children’s performance during periods in which their skills are thought to undergo rapid change and development (e.g., Schlagmüller and Schneider, 2002).

The sections that follow are devoted to a discussion of two basic literatures that are not often treated together: Children’s memory for specific events that are typically experienced without intent to remember, as well as their deliberate memory for materials that are encoded with the expectation of a subsequent memory assessment. These different aspects of mnemonic competence are discussed together because the underlying processes of encoding, storage, retrieval, and reporting seem to operate in a similar manner in each of these domains (Baker-Ward et al., 1997; Ornstein et al., 2006b). Moreover, it seems likely that elemental skills in talking about past experiences set the stage for later accomplishments within the domain of deliberate remembering (Haden et al., 2001). After a consideration of research on the nonverbal memory skills of infants and young toddlers, the discussion turns to children’s verbally based memory for events and autobiographical experiences, and then to a treatment of their strategic efforts in tasks that require deliberate remembering.

### 2.37.2 Nonverbal Memory

Given its developmental focus, the emphasis in this chapter is on the emergence and growth of children’s verbal mnemonic skills. Nonetheless, it is important to appreciate the fact that the verbal skills that are described here are built upon a nonverbal foundation and that considerable attention has focused on characterizing this foundation (see, e.g., Barr and Hayne, 2000; Rovee-Collier et al., 2001; Bauer, 2006; Oakes and Bauer, 2007; Courage and Cowan, in press), with researchers using a wide variety of behavioral measures to piece together a picture of what infants can remember over varying delay intervals. Two caveats are in order, however, as we begin this brief treatment of early memory. First, the conclusions that one can reach about young children’s memory seem to vary as a function of the measures used to assess remembering, and little is known about the extent to which the different measures converge to characterize children’s skill at any one point in development. Second, little is also known about the ways in which children’s nonverbal memory performance leads to (or predicts) subsequent performance on tasks that require verbal reports.

#### 2.37.2.1 Estimates of Long-Term Retention

It is clear that infants evidence remarkable skills in being able to retain information over delays that increase dramatically over the first year and a half.
of life. Early retention has been demonstrated in paradigms ranging from visual paired comparison and habituation to conditioning and imitation, with estimates of retention in neonates that range from a few minutes to weeks on visual habituation tasks (e.g., Slater et al., 1984; Pascalis et al., 1998), to months by the end of the first year on elicited imitation tasks (e.g., Carver and Bauer, 2001). But what can be said about the age-related changes in the nature and complexity of the information that is being retained?

To illustrate current understanding related to this important question concerning early memory, we focus on studies of children's performance in the context of two tasks: operant conditioning (See Chapter 2.36) and elicited/deferred imitation procedures. (Meltzoff, 1985, 1995; Bauer, 2007). Systematic research with these behavioral tasks has enabled researchers to document infants' quite dramatic mnemonic skills and has also sparked a lively debate concerning the nature of early memory (e.g., Nelson, 1995; Bauer, 1996; Rovee-Collier, 1997).

2.37.2.1.1 Conjugate reinforcement paradigms

In the conjugate reinforcement paradigm, an infant—typically between 3 and 6 months of age—is placed on her back with a mobile overhead. After an operant period in which the infant's base level of kicking is measured, her leg is connected via a ribbon to the mobile. With this arrangement, each kick is followed by the reinforcement of observing the mobile move, and stable responding in its presence can easily be established. With the operant response acquired, remembering after varying intervals can readily be assessed under conditions of extinction in which the ribbon is disconnected from the mobile, so that no contingencies are in effect. Memory is then inferred if the rate of kicking observed in these test periods is greater than that seen in the baseline period, and under these conditions two fundamental patterns of age differences in performance in the first 6 months of life have been reported: Both speed of learning and length of retention increase with age. Thus, older infants acquire the kicking response more rapidly than younger children, and when trained to the same criterion of performance, they retain it longer than their younger peers (e.g., Hill et al., 1988).

Programmatic research with the mobile conjugate reinforcement task has also revealed two other important features of early memory. First, under some conditions, memories that would seem to be forgotten can be cued and recovered. Indeed, by using reinstatement, partial reminders of a previous experience (Campbell and Jaynes, 1966), and reactivation (Spear and Parsons, 1976) procedures in which a component of the original event is presented at the end of the delay interval, retention of the kicking response can be extended considerably (e.g., Sweeney and Rovee-Collier, 2001). Typically, exposure to the mobile or the context (e.g., the crib lining) can serve to maintain memory over an extended delay, but the timing of the reminder is of critical importance, with maximal facilitation occurring if it is administered shortly before the assessment of long-term memory, as long as the response has not yet been forgotten (Sullivan, 1982; Rovee-Collier et al., 1987; Rovee-Collier and Hayne, 1987). Second, Rovee-Collier and her colleagues have shown that the kicking response can be remarkably sensitive to changes in aspects of the mobile and/or the context, with maintenance of responding being dependent upon a complete overlap in the cues present during learning and subsequent testing. Even a change in a single element of the mobile or the decoration on the crib liner can lead to dramatic disruptions in performance (Hayne et al., 1986; Borovsky and Rovee-Collier, 1990; Rovee-Collier et al., 1992). These findings provide useful information about the precision of early memory and the specificity of the underlying representations in memory that have been established (See Chapter 2.36).

2.37.2.1.2 Imitation-based paradigms

In the elicited and deferred imitation paradigms, memory is demonstrated when an infant is able to use props to reproduce an action sequence that had previously been modeled by an examiner. Consider, for example, the acts involved in constructing a gong: putting a crossbar atop two posts, hanging a metal plate on the crossbar, and then hitting the plate with a plastic mallet. After a baseline period in which a young child interacts freely with these materials, an experimenter demonstrates the sequence that will lead to the construction of the gong one or two times while, under some conditions, providing simple labels for each of the actions. Typically, in the elicited but not the deferred imitation procedure, the modeling of these actions is accompanied by a verbal description of the target actions and the goal of the event sequence. Moreover, in the elicited imitation paradigm, an immediate assessment of memory is typically obtained, with the child being invited to
imitate the modeled sequence of actions; for example, “Now you show me how to make a gong.” Memory is usually also assessed after a delay, with and without the verbal cue. In contrast, in the deferred paradigm, imitation is assessed, but without much verbal prompting, and only following a delay. As such, in the deferred imitation procedure, there is no immediate indication of remembering – and hence of initial encoding, or even of whether the child has the motor ability to reproduce the sequence – although control groups have been used to approximate children’s ability to imitate the sequences following presentation (see Meltzoff, 1985; Barr et al., 1996). In tests of elicited imitation, children act as their own controls, such that memory is indexed by their better performance with previously modeled versus novel event sequences. It is worth noting that the procedural differences between the deferred imitation and elicited imitation tasks can make a difference in memory performance (e.g., Hayne et al., 2003), with exposure to language cues and the opportunity to imitate the action sequences immediately after modeling facilitating long-term retention.

As previously mentioned, converging evidence from the elicited and deferred imitation paradigms shows that the age-related changes that begin in infancy, to the extent to which information can be held in memory, continue during toddlerhood. For example, 6-month-olds are able to produce parts of a three-step sequence 1 day – but not 2 days – after it is modeled (Barr et al., 1996). Importantly, two features of this demonstration of early recall provide a foundation from which improvement in mnemonic skill can be observed across the first 2 years of life. First, recall at 24 h is dependent upon the amount of experience that the infants have with the modeled action sequence: Approximately two-thirds of the children who had seen the three-step sequence six times produced at least one of the actions 1 day later, whereas the children who had observed the sequence only three times did not differ from control participants who had not witnessed the modeling. Second, there is essentially no evidence that the children can produce the components of the sequence in order, either immediately or after the 24-h delay. In contrast, by 9 months of age, infants are able to recall individual components of novel two-step sequences after 5 weeks (Carver and Bauer, 2001). Approximately half of the 9-month-olds are able to produce the sequences in correct temporal order after a delay of 5 weeks (e.g., Bauer et al., 2003) but not after 3 months. To be sure, this is a period in which skills for remembering change in a dramatic fashion, as illustrated by the fact that by 10 months, children evidence ordered recall at delays of both 1 and 3 months (Carver and Bauer, 2001).

Although this improvement in performance is certainly impressive, it should nonetheless be emphasized that the temporally ordered recall of 9- and 10-month-olds is still rather limited. First, the children’s recall is dependent upon multiple exposures to each modeled event sequence. Indeed, as Bauer (2006) indicates, ordered recall at these ages is observed if the infants observe the target sequence on two (and sometimes three) occasions before the onset of the delay. Under these conditions, approximately 45% of the infants evidence ordered recall after 1 month; however, if children view a to-be-remembered sequence at only one session, then these figures drop considerably, with only 7% providing ordered recall (Bauer et al., 2001; Bauer, 2006). Second, the size of the event sequences that are to be remembered is rather small, with 9- and 10-month-olds typically being able to remember two-step events, and third, the length of time over which information can be remembered is quite short.

Each of these limitations is overcome to a considerable extent over the course of the second year of life. For example, by 13 months of age, children no longer need multiple exposures to an event in order to remember it over a delay of several months (Bauer et al., 1995), and yet remembering is clearly enhanced by the opportunity to experience an event sequence several times. In addition, with increases in age, children are better able to remember longer sequences for greater periods of time. To illustrate, in contrast to the two-step events that are remembered by 9- and 10-month-olds, children at 24 months of age can produce sequences of five steps in length (Bauer and Travis, 1993). Finally, the length of time across which ordered recall can be observed increases dramatically during this time period; indeed, 100% of children at 20 months of age are able to recall in an ordered fashion after 1 month, with more than half evidencing memory for portions of the to-be-remembered sequences after delays as long as 1 year (Bauer et al., 2000). For additional information concerning imitation-based approaches to the exploration of young children’s memory, see Bauer’s recent reviews (2006, 2007).
Research on young children's memory with the conjugate reinforcement and imitation-type paradigms provides information about age-related differences in the conditions under which representations in memory can be established and maintained over time. But what can children's behavior in these two types of situations tell us about the structure and contents of these representations? The conjugate reinforcement procedure is a recognition (as opposed to recall)-based assessment, in which the index of remembering is based on kicking in the presence of a previously experienced stimulus. The specificity of children's responding in these studies – with the response rate dropping off markedly as a function of changes in the mobile or crib context – would suggest that the representation is both detailed and specific. However, even though variation in kicking patterns provides a sensitive indicator of whether or not elements of the mobile or context have changed, the procedure is not informative about the ways in which component features may be organized sequentially in the underlying representation. Yet this type of information is available in the imitation paradigms because responding involves recall, albeit action-based – not verbally based – recall, as opposed to recognition. Admittedly, infants cannot generate long strings of actions, but those that they do produce include the elements of events that are being remembered. Moreover, with increases in age, children's productions become more and more sequentially organized, thus reflecting the structure of the events and the underlying organization of the representation (Bauer et al., 2000). Finally, 1- to 2-year-olds readily apply their prior knowledge to the task of remembering action sequences, as can be seen in their enhanced recall of enabling as opposed to arbitrary sequences (Bauer et al., 2000). With enabling sequences, each action must be performed in a temporally invariant pattern in order to reach the end state (e.g., making a rattle with a ball and a nesting cup by first placing the ball in one-half of the cup and then covering it with the other half before it is shaken); in contrast, in arbitrarily ordered sequences, there are no inherent constraints on the temporal position of the actions (e.g., in making a party hat, it does not matter if a pompon is put on top before a sticker is placed on the front).

Researchers using conjugate reinforcement and imitation-based tasks have provided alternative perspectives on the mnemonic skills of infants, but it is nonetheless clear that these views are complementary and indicate that an impressive memory system is in place before language is available for the encoding and reporting of information. Given these demonstrations of a mnemonic foundation, what can be said about linkages between early nonverbal memory and later verbally based skills for remembering information? At one level, statements about the extent to which young children's early (and rapidly changing) abilities are related to their later verbally based mnemonic skills are quite limited. These statements must be based on longitudinal studies in which children are assessed initially on nonverbal memory tasks and then later on verbally based procedures, and the necessary data have not yet been reported in the literature. At another level, however, questions about linkages between early nonverbal and later verbal memory can be addressed in terms of the types of memory systems that are in place at the two points in time, and from this systems perspective, there may indeed be evidence for developmental continuity. More specifically, a strong claim can be made that the imitation-based tasks tap explicit (as opposed to implicit) memory, and thus line up well with the explicit memory tasks that are employed in assessments of children's abilities to talk about past experiences and prepare for deliberate assessments of memory (Bauer, 1996, 2006).

In order to evaluate this claim, it is necessary to review the distinction between explicit and implicit memory. There certainly are many ways of characterizing memory, but a distinction between explicit (or declarative) and implicit (or nondeclarative) memory is widely accepted (Schacter, 1987; Squire, 1987; Moscovitch, 2000). These two types of memory are thought to differ on many dimensions. For example, in the type of information that is being remembered, in the speed with which it is acquired and lost over time, and in the degree to which remembering involves conscious recollection. To illustrate (and greatly simplify), consider the way in which an experience of visiting a friend may be processed by the explicit memory system. The features of this visit (e.g., names, facts, locations) are rapidly encoded, but specific information can also
be lost over time (and/or replaced in a constructive manner with related information). Yet, in any event, the telling of the tale certainly involves conscious recollection. Now, by way of contrast, consider the way in which a perceptual motor skill – such as driving a car or riding a bicycle – is acquired and represented in implicit memory. These skills require a great deal of practice and are literally honed over longer periods of time; but once mastered, there is little forgetting, and production does not entail conscious recollection. In addition, recent research suggests that in the latter half of the first year, it is possible to differentiate explicit and implicit memory systems structurally, with explicit memory relying on the hippocampus (in particular, the dentate gyrus and other supportive cortical structures), and implicit memory depending on the neostriatum and cerebellum (Eichenbaum, 2003).

From this vantage point, the types of memory that are the focus of this chapter – e.g., a child’s report of a recently experienced event or recall of a list of words – would certainly be seen as involving the explicit memory system, but what can be said of the demonstrations of children’s nonverbal memory prowess discussed above? To the extent to which any one of the nonverbal tasks used to assess memory in infancy can be viewed as tapping into the explicit memory system, there would be continuity across the nonverbal/verbal divide in terms of memory systems that are in place. In this regard, Bauer (2006, 2007) has argued convincingly that the imitation-based techniques capture the essence of explicit memory. She points out that the infants who are assessed with imitation-based procedures rapidly encode and learn the modeled event sequences, without extensive practice, but also that their memories are fallible, with considerable forgetting over time being observed. Moreover, the memory that is assessed with imitation procedures is clearly rather flexible in that it is preserved (or generalized) across variations in materials contexts. Admittedly, these tasks do not involve verbal reports, and it is impossible to know whether the infants whose performance is assessed experience a sense of conscious recollection, but one other source of evidence is relevant to the argument: Adult humans with amnesia that impairs their performance on explicit memory tasks have been shown to have deficits on the elicited imitation task (McDonough et al., 1995).

In contrast to these procedures, conjugate reinforcement has typically been viewed as reflecting implicit memory (Mandler, 1990, 1998; Schneider and Bjorklund, 1998; but see Rovee-Collier, 1997, and Chapter 2.36, for a contrasting perspective). As indicated in Section 2.37.1.1, these tasks are based on operant conditioning procedures, and both operant and classical conditioning have been taken – along with perceptual-motor skills and priming – to be indicators of implicit, as opposed to explicit, memory. Moreover, the contrast between conjugate mobile and imitation tasks can be seen in the basic features of performance: Learning in the conjugate reinforcement task takes a considerable amount of practice before stable levels of kicking are reached, and once the response is acquired, the memory seems to exhibit very high levels of specificity. Indeed, as suggested earlier, even minor changes in the mobile or the context are sufficient to disrupt performance considerably.

Given this view that deferred and elicited imitation tasks involve the same explicit memory system that is activated in verbally based tasks, we would expect that longitudinal analyses would reveal linkages between children’s performance on the different procedures. Another reason for this expectation is that the imitation tasks seem to have greater face validity than does conjugate reinforcement, especially in terms of potential links both to language and to event memory as is reflected in assessments of older children’s mnemonic skills. For example, although the evidence is admittedly mixed (Bauer et al., 2000; Bauer, 2006), under some conditions young children’s elicited imitation is influenced positively by their language skills, and it is known that verbal ability plays a significant role in later events and autobiographical memory (Bauer and Wewerka, 1995; Welch-Ross, 1997; Boland et al., 2003). In addition, the task demands of the elicited imitation procedure seem similar in certain critical respects to those of tasks that are used to explore 2- and 3-year-olds’ reports of their previous experiences. More specifically, the conversations between young children and their parents about recently experienced events that will be discussed below involve remembering and subsequently reporting the details of these experiences. As such, both elicited imitation and mother–child reminiscing procedures involve event recall, even though remembering is expressed motorically in one procedure and verbally in the other. Moreover, given that both procedures yield information about children’s recollections about the component details of previously experienced events, they, in principle, provide insight into the underlying memory representations.

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Given this discussion of conceptual linkages between the elicited imitation and verbally based assessments of children’s memory, we turn now to a treatment of children’s verbal reports of personally experienced events. In the section that follows, we provide an overview of children’s memory for routine and unique experiences and discuss factors that impact developmental changes in remembering.

2.37.3 Learning to Remember

2.37.3.1 Remembering Previously Experienced Events

Starting with the work of Nelson and her colleagues (e.g., Nelson and Gruendel, 1979; see Nelson, 1986, for an overview) on children’s memories for familiar and recurring events, the corpus of research on preschool-aged children’s abilities to remember their personal experiences has expanded in an impressive fashion. Indeed, in addition to what we now know about children’s abilities to produce scripts or generalized event representations for routine experiences such as going grocery shopping or dining at a restaurant, there is now a voluminous literature concerning their abilities to recall the details of specific, distinctive events that they have experienced. In providing a selective treatment of this work, we first discuss research on children’s scripts, then review evidence concerning their memory for salient target events, and finally move to a description of studies that have emphasized event memories expressed in parent–child conversations about the past. We do so with a focus on the establishment, maintenance, and modification of event memories, emphasizing the role that knowledge plays in affecting the flow of information through the developing memory system.

2.37.3.1.1 Children’s scripts

In their initial studies, Nelson and Gruendel (1981) conducted semistructured interviews with children as young as 3 years of age about what happens during familiar and routine events, such as eating at McDonald’s, making cookies, and attending a birthday party. The results of these and later studies (Nelson, 1978; Nelson and Gruendel, 1979; Nelson et al., 1983; Fivush, 1984; Fivush and Slackman, 1986) demonstrate that preschoolers are able to give both veridical and consistent reports of what typically occurs during such events, although certainly older children’s scripts are more detailed than those of younger children. Moreover, these script reports reflect the ways in which the events being described are structured in the world, just as the elicited imitation performance of infants studied by Bauer reflected the organization of the action sequences being remembered. To illustrate, in both settings some events are ordered in an enabling fashion, such that each component activity sets the stage for the next activity, whereas other components are arbitrary and variable in their temporal order. For example, in going to McDonald’s, one must order food before one can eat it, whereas during a birthday celebration, one must open presents, but this does not have to happen at any particular time during the event. Children as young as 3 years of age are sensitive to these distinctions, recounting activities connected by enabling relations in their experienced order, whereas arbitrary activities are recalled in variable order (see, e.g., Fivush et al., 1992). Equally intriguing, children recount more information about events that are linked by enabling relations than those that are arbitrarily ordered, with some suggestion that this may be true even after the very first experience with the events (Slackman and Nelson, 1984; Ratner et al., 1990; Fivush et al., 1992; Murachver et al., 1996). The linkages between Bauer’s elicited imitation studies and this research on verbal scripts lead to the basic conclusion that as early as 12 months of age, children are sensitive to the structure of events in the world, and that their memory reports of those events reflect this structure.

2.37.3.1.2 Memory for salient events

Supplementing research on children’s generic representations of recurring events is a considerable body of work on young children’s memory for unique personally experienced events. In some studies, children have been exposed to a range of specially crafted stimulus events, such as visiting a pirate (Murachver et al., 1996) or a pretend zoo (McGuigan and Salmon, 2004), whereas in others, the focus has been on naturally occurring routine visits to the doctor and other less familiar and more stressful medical experiences (Merritt et al., 1994; Peterson and Bell, 1996; Goodman et al., 1997; Ornstein et al., 1997a; Burgwyn-Bailes et al., 2001). This literature indicates the presence of substantial age differences in various aspects of memory performance. To illustrate, with increases in age, children demonstrate higher levels of overall recall of these experiences, recount more information in response to
open-ended questions, and thus show less dependence on yes/no questions to elicit memory (e.g., Fivush and Hammond, 1990; Baker-Ward et al., 1993; Ornstein et al., 1997). Moreover, older children evidence less forgetting over time (Brainerd et al., 1985, 1990; Ornstein, 1995) and are less susceptible to suggestive questions (Ceci and Bruck, 1995; Ornstein et al., 1997). Existing evidence also indicates that with age and increased experience in talking about the past, children’s reports become more richly detailed and complex and less dependent on information being provided by adult conversational partners (e.g., Fivush et al., 1995; Haden et al., 1997).

In one illustration of this work, Baker-Ward et al. (1993) assessed 3-, 5-, and 7-year-olds’ memory for details of a routine pediatric examination. Most children were interviewed two times, first immediately after the check-up and then after a delay of 1, 3, or 6 weeks. The interviews were structured in such a way that they began with open-ended questions (e.g., “Tell me about what happened during your check-up.”), followed by more specific questions (e.g., “Did the doctor check any parts of your face?”), and, finally, yes/no probes (e.g., “Did she (he) check your eyes?”). The children were asked yes/no questions both about features that had not been volunteered in response to the open-ended probes as well as regarding activities that had not been included in the check-ups. As illustrated in the top panel (A) in Figure 1, even the 3-year-olds were able to report most (approximately 75%) of the features of the event. However, as illustrated in the lower panel (C) in Figure 1, there were clear age-related improvements in performance, such that the 7-year-olds reported the greatest number of features (approximately 90%). Moreover, even though the performance of the 3-year-olds was impressive, they nonetheless produced less information than the older children in response to open-ended probes — as shown in the black portion of the bars in the figure — and thus required more specific questions to provide information about the experience. A comparison of the bars across the three panels at each delay reveals that the younger children evidenced more forgetting than the older children over the 6 weeks of the study.

### 2.37.3.2 The Role of Knowledge

The event memory literature has both challenged earlier views of young children’s recall as being quite limited (e.g., Myers and Perlmutter, 1978) and raised important questions about how we are to understand the dramatic age-related changes in remembering in terms of the factors that contribute to the encoding, storage, retrieval, and reporting of information. Children’s understanding of the events being experienced is one such factor, as age differences in knowledge can seriously affect the processing and retention of information in memory.
2.37.3.2.1 Prior knowledge
It is well known that prior knowledge enables people to create initial expectations that serve to focus their attention and make inferences that facilitate comprehension, so as to influence what gets into memory (Bjorklund, 1985; Chi and Ceci, 1987; Ornstein et al., 1997). In general, events about which children have significant prior knowledge are more readily encoded and subsequently retrieved than are those about which they have less knowledge. For example, studies that focus on the development of expertise in specific domains (e.g., chess, soccer) have demonstrated repeatedly that the highly organized and accessible knowledge of experts enables them to encode and remember domain-relevant information more effectively than novices (e.g., Chi, 1978; Schneider et al., 1989). In a similar manner, children's scripts (Nelson, 1986) that reflect their understanding of frequently occurring events can markedly affect their later memory of specific instances of these experiences (e.g., Farrar and Goodman, 1990).

An illustration of the impact of prior knowledge on memory can be seen in a reanalysis of the 5-year-olds’ recall data from the Baker-Ward et al. (1993) study that was discussed in section 2.37.3.1.2. Clubb et al. (1993) rescored the protocols from the Baker-Ward et al. study to create memory scores representing the proportion of children who recalled each component of the check-up (e.g., blood pressure, eye check, urine specimen) in response to open-ended questions. These memory scores for each component of the office visit at each recall assessment were compared to knowledge scores that were constructed on the basis of interviews with a separate sample of 5-year-olds who responded to questions about what generally happens when they go to the doctor (e.g., “What does the doctor (nurse) do to check you?”). The knowledge scores were therefore based on the proportion of children in the Clubb et al. (1993) sample who nominated each component of the check-up in response to the interviewers’ general knowledge probes. Given comparable memory and knowledge scores for individual features of the pediatric check-up, it was possible to determine the degree to which the recall of the 5-year-olds in the Baker-Ward et al. (1993) study could be predicted on the basis of Clubb et al.'s (1993) normative knowledge data.

Inspection of the data plotted in Figure 2 indicates that there was considerable variability in the memorability of the components of the physical

![Figure 2](image-url)
examination. There was also variability in the children’s knowledge of the individual features, but most interestingly, the knowledge and memory scores were highly correlated, indicating that increases in knowledge were associated with corresponding increases in remembering; indeed, the correlations were 0.68, 0.63, 0.64, and 0.74 for the initial, 1-, 3-, and 6-week (shown in Figure 2) interviews. These data (see also Ornstein et al., 1997b) and other findings with the subject as opposed to the feature as the unit of analysis (Ornstein et al., 2006a) strongly suggest that what a child knows about an event can seriously affect the extent to which information about the experience is coded and placed in memory.

Although prior knowledge certainly impacts children’s memory performance positively, it is important to note that it also can have negative effects. To illustrate, in an effort to explore the extent to which an individual’s general knowledge can, over time, lead to alterations in memory for a specific event, Ornstein et al. (1998) studied 4- and 6-year-olds’ long-term memory for the details of a specifically constructed physical examination that was both consistent and inconsistent with knowledge-driven expectations. In this experiment, the stimulus event was a mock physical examination carried out by a licensed pediatrician that included some typical medical features (e.g., listening to the heart with a stethoscope) but omitted others that, on the basis of prior knowledge, would have been expected to occur (e.g., checking the mouth). These omitted features, moreover, were replaced by unexpected and quite atypical medical procedures (e.g., measuring head circumference). The findings indicated that prior knowledge had both positive and negative effects on performance. Expected features of the procedures were better remembered than atypical features at all assessments. Most interestingly, 12 weeks after their check-ups, the children made spontaneous errors of commission (i.e., they claimed that they experienced certain medical procedures that had not been administered) and evidenced high rates of false alarms to yes/no questions about medical features that had not been included in their check-ups. The spontaneous intrusions of omitted-but-expected features and the low rates of correct denials to explicit questions about these features that were observed by Ornstein and his colleagues are consistent with the view that the representations of the children’s check-ups changed over the 12-week delay interval. More specifically, it would seem that as the children’s memory for the check-ups faded over the course of the interval, aspects of their generic event representations for visits to the doctor were incorporated into their specific event representations.

2.37.3.2.2 Knowledge that is acquired during an event

When previously acquired knowledge is lacking, as in a situation in which a child experiences a novel event, facilitative effects can be observed when knowledge is gained while the experience is taking place. For example, Principe et al. (1996) used data from a study of 3- to 7-year-olds’ memory for an invasive and novel radiological procedure (a voiding cystourethrogram, or VCUG; Merritt et al. 1994), to look at how the provision of information to children during the event about the stressful and unfamiliar medical procedure affected their subsequent remembering of the experience. Interestingly, the radiological technicians involved in the procedure naturally varied in the extent to which they provided medically relevant information to the children about the experience as it was ongoing. Therefore, whereas some children were provided with a verbal description of the catheter and its insertion, some mention of the contrast fluid going through the catheter, and information about the filling of the child’s bladder with this fluid, other children did not receive this procedural narrative. Underscoring the dramatic impact of new knowledge on comprehension and memory, children in the procedural narrative group remembered more details immediately after the exam, as well as 6 weeks later, than children who were not given such a description. These differences could not be attributed to differences among the children in their age or their levels of stress during the procedure and suggest that information that is gained during an unfamiliar and stressful event enhances remembering.

2.37.3.2.3 Changes in knowledge

Once in the memory system, the status of information about an experience can be substantially altered during the period between the event and the later report of it. Indeed, a number of variables can contribute to changes in the representation, including the passage of time (Ornstein et al., 2006a) and intervening experiences (Principe et al., 2000), and these influences may vary as a function of age. Moreover, because knowledge does not remain constant over
time, it is important to ask what happens when knowledge itself changes. Ross (1989) has argued cogently that as memory for the details of an experience fades over time, one tends to ‘fill in’ on the basis of current understanding and knowledge. One demonstration of the ways in which changes in knowledge over time can lead to alterations in remembering was reported by Greenhoot (2000), who used a series of stories as stimulus material to lead children to develop certain assumptions about the protagonists. Over the course of several sessions, the 5- and 6-year-olds who participated in her study built up a knowledge base about the main story characters and their relationships, and hence the underlying motivation for certain acts that were depicted in the stories. Then, at later sessions, the children were given additional information that prompted some of them to reassess the relationships among the characters (and the motivation for various behaviors) that had been operative. Importantly, Greenhoot showed that the children’s memory for prior episodes was distorted in the direction of the new information.

2.37.3.2.4 Recall in conversations about past events

Although much has been learned about children’s memory for salient events, a great deal needs to be done to understand how a variety of factors come to together to influence the establishment, maintenance, and modification of representations in memory. In this regard, it is clear that adults have a great role to play in facilitating children’s understanding and remembering. Indeed, social–communicative interactions between parents and children provide opportunities for focusing children’s attention on salient aspects of an event and thus increasing their understanding and memory, as well as facilitating the acquisition of generalized skills for remembering.

2.37.3.2.5 Parental reminiscing styles

Children begin to talk about past events almost as soon as they produce their first words, and the skills for recalling past experiences in parent–child conversations develop rapidly between 2 and 4 years of age. Nevertheless, as illustrated in this example of a mother and her 18-month-old, when children first begin to reminisce, it is the adult partner who provides most of the content and structure.

| Mother: What else happened [at Taylor's house]? |
| Child: (no response) |
| Mother: We had dinner. What did you eat? |
| Child: (goes off task). |
| Mother: What did you do with Taylor? |
| Child: Barney. |
| Mother: Yeah, you watched a Barney video. What else did you do with Taylor? Did you guys fight about something? |
| Child: (shakes head no). |
| Mother: No? When you were watching Barney? |
| Child: (nods head yes). |
| Mother: Yeah. You guys got hungry and tired. Then what happened? |
| Child: Uh oh. |
| Mother: Yeah. What happened? Did you bite Taylor’s finger? |

A central focus in the literature on parent–child reminiscing has been on the marked individual differences in the reminiscing styles parents use to structure conversations about the past with their young children (see Fivush et al., 2006, for a review). In contrast to parents who use a low elaborative style, those who employ a high elaborative style – such as the mother in the example above – ask many questions, follow-in on their children’s efforts to contribute to the conversation, and continue to add new information even when children do not. It is clear that these reminiscing styles generalize across different types of past event discussions (e.g., excursions and holidays, zoo or museum trips, entertainment outings) and tend to be consistent over several years with the same children (Reese et al., 1993) and across different-aged children in the same family (Haden, 1998). Most important, longitudinal data indicate that differences in maternal reminiscing styles are associated with later differences in children’s abilities to recall personally experienced events. For example, as illustrated by the lagged correlations in Figure 3, Reese et al. (1993) demonstrated that mothers’ elaborations during conversations with their 40-month-old children are associated positively with children’s contributions of memory information in conversations with their mothers at 58 and 70 months of age. Moreover, the direction of the effect was more from mother to child over time than from child to mother. Although children did influence their mothers to a limited extent, as illustrated in the lower portion of the figure, the correlations for memory responses across age indicate that the children’s own earlier skills for verbally recalling events were not directly related to their later abilities.
The finding that the more mothers engaged in highly elaborative talk about the past, the better their children’s event memory skills even years later, has been widely replicated both in the United States and cross-nationally (e.g., Hudson, 1990; Flannagan et al., 1995; Welch-Ross, 1997; Haden, 1998; Harley and Reese, 1999; Peterson et al., 1999; Farrant and Reese, 2000; Leichtman et al., 2000; Low and Durkin, 2001; Welch-Ross, 2001; Fivush and Vasudeva, 2002; Bauer and Burch, 2004), such that it seems clear that mothers who are highly elaborative early in development facilitate their children’s abilities to report on their past experiences in a detailed manner. Moreover, Peterson et al. (1999) were successful in manipulating mothers’ conversational style when talking with their children about previously experienced events, finding that children of mothers who received their intervention produced longer memory reports that contained more details about past events than children of mothers who had not received reminiscing training.

Findings concerning the impact of maternal reminiscing styles on remembering have led to speculation about how early conversations about the past may change the way children organize and represent experiences (Fivush and Haden, 1997; Fivush et al., 2006). Interestingly, it has been suggested that children of mothers who use a highly elaborative reminiscing style may actually come to encode experiences in more richly detailed ways than children of less elaborate mothers, although presently no study has addressed this particular issue.

Nevertheless, just as memories may be maintained, elaborated, or even modified through subsequent reminiscing, a growing body of evidence supports the idea that language-based interactions during events can be of critical importance in guiding initial encoding and the establishment of a representation in memory (Tessler and Nelson, 1994; Haden et al., 2001; Boland et al., 2003; McGuigan and Salmon, 2004; Ornstein et al., 2004; Hedrick, 2006). It is to this work that we now turn.

### 2.37.3.2.6 Conversation during events

The few studies to date that have examined mother-child talk during an event suggest that preschoolers produce longer and more detailed reports of these experiences if their mothers use elaborative Wh-questions and follow-in on and positively evaluate their children’s verbal and nonverbal behaviors as events unfold (Haden et al., 2001; Boland et al., 2003; McGuigan and Salmon, 2004; Ornstein et al., 2004). Moreover, joint linguistic interactions between parents and children during events are more strongly related to children’s later memory than are interactions characterized as primarily involving mother-only talk, child-only talk, or no-talk (Tessler and Nelson, 1994; Haden et al., 2001). To illustrate, Haden et al. (2001) conducted a longitudinal investigation in which young children took part in three specially constructed activities with their mothers: At 30 months, a camping trip; at 36 months, a bird-watching adventure; at 42 months, the opening of an ice-cream shop. Within the confines of each family’s living room, mother–child
interactions during the events were videotaped, providing a precise record of how each dyad interacted—both nonverbally and verbally—with each component feature of the event (e.g., in the camping event, hot dogs, marshmallows, backpack, sleeping bag) as it unfolded.

Given that the majority of features that were interacted with during the events were jointly handled (and thus jointly attended to), Haden et al. (2001) asked whether recall of these components varied as a function of the type of talk (e.g., joint verbal, mother-only verbal, child-only verbal, no verbal) that had been directed toward them during the activities. The children’s recall of these experiences after delays of 1 day (upper panel) and 3 weeks (lower panel) is summarized in Figure 4. Inspection of the figure indicates the striking effect of joint talk as the events unfolded on the information the children provided in response to the open-ended questions of the interviewers. As can be seen, at both interviews and for each of the activities, the features that were handled and discussed by both the mother and the child jointly (solid bars) were better recalled than those that were jointly handled but talked about only by the mother (gray bars), which, in turn, were better recalled than those not discussed (white bars). Additional analyses indicated further that the features of the event (e.g., a spatula in the camping event) about which questions had been asked by the mothers during the activity that had been responded to by the children (e.g., the mother asks, “What is the spatula used for?” and the child responds “For flipping.”) were better recalled than features about which mothers’ questions did not result in the children’s response (Ornstein et al., 2004). Thus, findings from this longitudinal study—as well as the work by Tessler and Nelson (1994) involving a sample of 4-year-olds—suggest that the nature of mother–child interaction as an event unfolds influences encoding and subsequent remembering.

Experimental work also supports this conclusion. For example, Boland et al. (2003) trained some mothers to use four specific conversational techniques to enhance their children’s understanding of unfolding events: (1) Wh- questions to elicit their child’s linguistic participation in the activity, (2) associations to relate that which was being experienced to what their child already knew, (3) follow-ins that

![Figure 4](image-url)
encouraged discussion of aspects of the event in which the child was showing interest, and (4) positive evaluations to praise their child’s verbal and nonverbal contributions to the interaction. After this instruction, when observed engaging with their 4-year-old children in the context of the camping event, trained mothers produced significantly more of all four of the targeted conversational techniques than did untrained mothers. Moreover, the effects of the training did not vary as a function of the children’s language skills and did not impact the mothers’ use of untrained techniques (i.e., repetitions, yes-no questions, and statements). Of even greater interest, the children’s recall of information about the camping event was affected by the training that their mothers received. For example, the children of trained mothers exceeded those whose mothers had not received training in the production of details of the event.

Given these demonstrations of the importance of adult–child talk for children’s memory performance, interesting questions concerning the potentially additive effects of conversations about the present and the past on remembering are currently being explored (McGuigan and Salmon, 2004, 2005; Conroy, 2006; Hedrick, 2006). Moreover, relatively few studies have considered how talk prior to an event may set the stage for the development of children’s representations (Hudson, 2002) and the linkages between children’s performance in these event memory tasks and their subsequent use of deliberate techniques for remembering (Haden et al. 2001; Lange and Carroll, 2003). We turn now to a treatment of children’s developing skill in the use of these mnemonic strategies.

### 2.37.4 Learning to Be Strategic

As young children develop expertise in talking about their past experiences, they also evidence increasing skill in the use of strategies for remembering information. To a considerable extent, their growing competency in discussing the past reflects age-related improvements in the incidental encoding of information—which in turn stems from children’s greater understanding of the situations that they encounter—as well as improvements in retrieving and reporting information from memory. In contrast, however, the deployment of a specific strategy for remembering—such as naming or grouping—represents intentional preparation in the service of an expected assessment of memory (Ornstein et al., 1988; Wellman, 1988; Folds et al., 1990). Given this distinction between incidental and deliberate remembering, it is interesting that even young preschoolers can demonstrate “strategic” behavior under certain circumstances. For example, when asked to remember the location of a familiar stuffed animal that was hidden in a room, 18-month-olds utilized a number of rudimentary strategies (pointing, peeking, and naming) so that the toy could be retrieved after a delay (DeLoache et al., 1985). Although the deployment of these strategic behaviors was not unambiguously related to the memory performance, these responses to a memory request do indeed suggest that children enter the preschool years with a basic understanding that remembering requires action of some sort. Nonetheless, interpretation of this finding is complicated by the fact that similar behaviors are also exhibited—but to a lesser extent—in a variation of the hide-and-seek game in which remembering is not required (DeLoache et al., 1985, Experiment 3). Consistent with Wellman’s (1988) treatment of intentionality, these early mnemonic skills can be viewed as protostrategies that emerge during enjoyable activities in highly salient and meaningful situations and may not necessarily be related to later strategy acquisition (see also Ornstein et al., 1988; Folds et al., 1990).

Older preschoolers may have a firmer understanding of the need to do something in order to prepare for an assessment of memory, but the effectiveness of their efforts is analogous to that of the 18-month-olds studied by DeLoache et al. (1985). Consider, for example, a study by Baker-Ward et al. (1984) in which 4-, 5-, and 6-year-olds made use of a set of similar techniques in a memorization task with common objects. These children were directed to interact with a set of objects and toys for a 2-min period and were placed in one of three conditions: Target Remember, Target Play, and Free Play. The children in the Target Remember condition were told that they could play with all of the objects but that they should try especially to remember a subset of the items (i.e., the target objects). In contrast, the participants in the Target Play group were given instructions that did not mention remembering but rather stressed playing with a subset of the target objects, whereas those in the Free Play condition were given general play instructions.

The use of an observational coding scheme during the activity period revealed that even at age 4, the children who were told to remember behaved
differently from those in the play conditions. For example, as can be seen in Figure 5, spontaneous labeling or naming occurred almost exclusively among the children in the target remember condition who were instructed to remember a subset of the objects, and it was found that these children also played less than the children in the free play and target play conditions. Moreover, as can be seen in Figure 6, the children who received instructions to remember also engaged in more visual inspection and evidenced more unfilled time than the children in the two play conditions. Unfilled time was coded when a child was not paying direct attention to the items but nonetheless did not seem to be off-task; informally, it seemed to involve reflection and self-testing. The memory instructions thus engendered a studious approach to the task among the 4-, 5-, and 6-year-olds alike, but it is important to note that only among the 6-year-olds were the strategic behaviors associated with higher levels of recall.

The literature now contains many demonstrations of what Miller (1990; see also Bjorklund and Coyle, 1995; Bjorklund et al., 1997) has termed utilization deficiencies in young children who are just beginning

![Figure 5](image1.png)

**Figure 5** Mean number of 5-s blocks of the activity period in which each naming and play occurred for the 4-year-olds (panel A), 5-year-olds (panel B), and 6-year-olds (panel C) in each instructional condition. Adapted from Baker-Ward L, Ornstein PA, and Holden DJ (1984) The expression of memorization in early childhood. *J. Exp. Child Psychol.* 37: 555–575. Copyright © 1984, Elsevier.

![Figure 6](image2.png)

**Figure 6** Mean number of 10-s blocks of the activity period characterized by unfilled time and visual examination for the 4-year-olds (panel A), 5-year-olds (panel B), and 6-year-olds (panel C) in each instructional condition. Adapted from Baker-Ward L, Ornstein PA, and Holden DJ (1984) The expression of memorization in early childhood. *J. Exp. Child Psychol.* 37: 555–575. Copyright © 1984, Elsevier.
to generate strategies in response to memory goals. As in the Baker-Ward et al. (1984) study, strategies are produced spontaneously, but they do not seem to initially correspond to improvements in the amount recalled. Why should this be the case? If Baker-Ward et al.’s 4-, 5-, and 6-year-olds were engaging in the same strategic behaviors, why did only the efforts of the 6-year-olds have a positive effect on their recall? Moreover, why should similar strategic activities differ in their mnemonic effectiveness? Of course, it is possible that even though the observable behaviors (e.g., naming, visual inspection) of the 4-, 5-, and 6-year-olds were similar, they may have been the external manifestation of quite different underlying strategies. As such, the similarity across age in strategic efforts may be illusory, with, for example, the children of different ages combining the observable behaviors into qualitatively different strategies. That this may have been the case is suggested by Baker-Ward et al.’s observation that the younger children seemed to combine verbal naming or labeling and manipulation, whereas the older children put naming together with visual examination. It thus seems worthwhile to develop higher-order coding schemes to capture these age-related changes adequately in the coordination of different mnemonic behaviors. Efforts of this kind may well result in more precise definitions of effective mnemonic techniques, but it is also possible that such fine-grained analyses will still leave open questions about the conditions under which the application of strategies may and may not impact remembering. As discussed here, there may be other factors – for example, age-related changes in underlying knowledge (Bjorklund, 1985), speed of processing (Kail, 1991), and the effort requirements of strategy usage (Gutten tag, 1984; Case, 1985) – that may influence whether or not a given strategy influences remembering.

At the very least, this brief treatment of early strategies that do not work serves to highlight the fact that intentionality is only one aspect of strategic behavior and that two others – consistency and effectiveness – must be considered in any account of the development of memory. This is especially the case when it is recognized that the developmental course of children’s mastery of mnemonic skills extends through the end of the elementary school years. In terms of consistency, skilled strategy users have command over a broad repertoire of mnemonic techniques (e.g., rehearsal, organization, elaboration) and are able to apply them skillfully across a broad set of situations that call for remembering (Brown et al., 1983; Ornstein et al., 1988; Pressley et al., 1989). In contrast, novice strategy users not only have a limited set of techniques at their disposal, but the very application of any given procedure is often quite context-specific and not consistent across settings. Indeed, when young children are able to demonstrate sophisticated strategy use, it typically is only in highly supportive and salient settings (Ornstein et al., 1988; Ornstein and Myers, 1996). Moreover, in terms of effectiveness, work on utilization deficiencies, discussed above, indicates that the strategic efforts of young children often do not facilitate remembering. In addition, however, even when the application of strategies does influence recall, younger children may derive less benefit than do older children (Ornstein et al., 1988; Wellman, 1988; Folds et al., 1990).

Given these complexities, longitudinal data are necessary to track on a within-individual basis developmental progress in the acquisition and deployment of strategies for remembering. Ideally, young children’s increasing sophistication in the use of these techniques would be charted over time with multiple indicators of strategic competence, under conditions that vary in terms of their effort and attentional demands. Data from microgenetic research designs (Siegler and Crowley, 1991; Slaghmuller and Schneider, 2002) in which children are followed intensively for limited periods of time are also very useful for developmental analyses of mnemonic skill. Unfortunately, longitudinal and microgenetic research designs are still quite rare in the area of memory development, and our understanding of age-related changes in strategy usage stems largely from the (admittedly rich) cross-sectional literature. To illustrate strategy development, we focus here on cross-sectional studies in which an age-related progression from passive to active memorization styles has been demonstrated (Ornstein and Naus, 1985; Ornstein et al., 1988).

2.37.4.1 Rehearsal and Organizational Strategies in the Elementary School Years

A comparison of children’s performance on tasks that assess memory for personally experienced events and those that require deliberate remembering reveals substantial differences in the levels of demonstrated sophistication. Indeed, by 8 or 9 years of age, children are very adept at providing rich reports about their experiences, but at the same time their skills appear to be quite limited in situations that call for the deployment of complex deliberate mnemonic strategies.
To illustrate the relatively late emergence of these deliberate memory skills, consider the substantially different ways in which 9- and 14-year-olds behave when given a list of words to remember and are prompted to talk aloud as the items are presented. In this type of overt rehearsal task, 9-year-olds tend to rehearse each to-be-remembered item alone as it is displayed, whereas older children (and adults) rehearse each one with several previously presented stimuli (Ornstein et al., 1975; Ornstein and Naus, 1978). To illustrate, if the first three items on a to-be-remembered list are table, car, and flower, a typical third grader would rehearse table, table, table, when the first word is shown; car, car, car, when car is presented; and flower, flower, flower, when the third word is shown. In contrast, the average 14-year-old is likely to rehearse table, table, table, when table is presented; table, car, table, car, when car is presented; and table, car, flower, when flower is displayed. These children thus differ considerably in the extent to which rehearsal is limited (or passive) versus more cumulative (or active), and these differences in rehearsal style are related to substantial differences in recall. Indeed, with increases in age, not only does rehearsal become more active – with several different items being intermixed – but recall improves dramatically, especially that of the early list items. That is, children’s increasingly active rehearsal styles are associated with improved recall of the primary section of the serial position curve (Ornstein et al., 1975).

These changes in the use of rehearsal are paralleled by comparable developments in the deployment of organizational strategies for remembering. Consider, for example, the performance of third and fourth graders on a sort-recall task in which they are given a set of low-associated words (or pictures) and asked to “form groups that will help you remember.” Under these conditions, in which the items are sorted prior to each recall trial, children as old as 9 years of age tend not to form groups on the basis of semantic relations among the to-be-remembered materials but, rather, establish what seem to be randomly arranged groupings that vary considerably over trials (Liberty and Ornstein, 1973; Bjorklund et al., 1977). In dramatic contrast, children aged 12 and older routinely establish groups that are semantically constrained, even though the memory instructions do not prompt sorting on the basis of meaning. These older individuals seem to have the metacognitive understanding that sorting on the basis of meaning will facilitate recall, readily translating a remembering instruction into one that involves a search for a meaning-based organization (Ornstein et al., 1974). Moreover, consistent with the rehearsal literature, these age differences in the extent to which sorting is driven by the semantic organization of the materials are associated with corresponding differences in recall. However, it should be emphasized that younger children’s failure to use a meaning-based grouping strategy does not imply that they lack understanding of the semantic linkages among the items, as they can readily sort even low-associated items on the basis of meaning when instructed to do so (Bjorklund et al., 1977; Corsale and Ornstein, 1980). As such, the age differences in performance would seem to reflect age differences in understanding how underlying knowledge can be applied strategically in the service of a memory goal.

2.37.4.2 Context Specificity in Strategy Development

These age-related differences in rehearsal and sorting represent a sampling from a now-extensive literature on children’s developing skills in the use of a variety of strategies for remembering (Schneider and Pressley, 1997; Schneider and Bjorklund, 1998; Bjorklund et al., in press). Although the bulk of this literature is composed of cross-sectional studies, it is nonetheless clear that with increases in age there are corresponding increases in rehearsal, organization, elaboration, and other techniques that influence the encoding, storage, retrieval, and reporting of information. Further, demonstrations of the ways in which older and young children differ in the deployment of mnemonic strategies have been supplemented by training studies so as to document causal linkages between strategy use and remembering. To illustrate, the provision of minimal instructions to rehearse several items together is sufficient to increase the recall of younger children, and prompts to rehearse each item on a list alone or in relative isolation can reduce the recall of older children (Ornstein et al. 1977; Ornstein and Naus, 1978). Similarly, when young children are required by a yoking procedure to follow the more semantically constrained sorting pattern of older children or adults, their recall is facilitated, and when adults are yoked to these sorts of young children, their recall is reduced (Liberty and Ornstein, 1973; Bjorklund et al., 1977). Children’s sorting of low-associated materials can also be manipulated – with corresponding effects on their remembering – by simply instructing them to sort on the basis of
meaning (Bjorklund et al., 1977; Corsale and Ornstein, 1980) or by exposing them to materials that are highly organized (Best and Ornstein, 1986).

It is thus clear that there are causal linkages between children's strategic efforts and their recall performance. However, it is also the case that there are limits to the success of these experimental interventions that shed light on other factors that contribute to effective strategy production. For example, although third graders can follow instructions to rehearse several items together, their use of such an active rehearsal strategy does not increase their recall to the level of sixth graders (Ornstein et al., 1977). This failure to eliminate age differences in remembering most likely stems from the fact that the use of an active rehearsal strategy requires that young children expend more of their attentional resources than is necessary for older children (Guttentag, 1984). Consistent with Guttentag's observation that the attentional demands of an active rehearsal strategy may vary at different points in development, it certainly is easier for young children to rehearse several items together when the effort demands are fewer. Thus, for example, when children are exposed to materials in which children have continued visual access to each to-be-remembered item after its initial presentation, striking improvements in memory performance and subsequent recall are noted (Ornstein et al., 1985). Although effort demands are also important in the context of organizational strategies (see Bjorklund and Harnishfeger, 1987), when children of different ages have comparable understanding of the to-be-remembered items and are led by instructions to use this knowledge as a basis for their sorting, recall differences are generally eliminated (Corsale and Ornstein, 1980).

Although context can certainly affect the outcome of training manipulations, it can also influence the degree to which children will engage spontaneously in strategic activities, as well as the sophistication of their efforts. To illustrate, the manipulation mentioned above to reduce the effort demands of an instructed active rehearsal strategy – permitting children to view all previously presented items – has been shown to increase the likelihood of spontaneously making use of a cumulative rehearsal strategy. Indeed, Guttentag et al. (1987) observed that third graders who typically rehearsed passively when the to-be-remembered items were presented in the typical fashion changed to a multi-item rehearsal strategy without prompting when given an opportunity to continue to see all items. In addition, consistent with the finding discussed above that prior knowledge can impact children's reports of previously experienced events, knowledge and understanding of the materials can dramatically influence children's use of mnemonic strategies when acting in the service of a memory goal (Bjorklund, 1985; Ornstein and Naus, 1985). Indeed, increases with age in the contents of the knowledge base and the ease with which stored information may be accessed have serious implications for the deployment of strategies. What a child knows about the items to be remembered can certainly determine just what can – and cannot – be done strategically with those materials. At one extreme, a child may not be able to execute a grouping strategy at all if he or she does not know the category structure of the to-be-remembered materials, but even when children are familiar with the meaning of the materials, they may nonetheless appear to be strategic when given some items to remember and nonstrategic with others (Ornstein and Naus, 1985; Ornstein et al., 1988).

These demonstrations of the impact of the materials on remembering have led to the suggestion that the children's first expressions of deliberate memorization will be observed when they are presented with highly meaningful materials in very salient contexts (Ornstein et al., 1988). This was illustrated above in the discussion of Baker-Ward et al.'s (1984) study in which 4-, 5-, and 6-year-olds could interact with a set of toys and objects under remember- or play-based instructions. With these very salient materials, the 4-year-olds engaged in strategic behaviors when told to remember, even though their efforts did not facilitate remembering. In addition, although it is known that third graders do not sort low-associated items in terms of their underlying meaning when told to “form groups that will help you remember” (Bjorklund et al., 1977), as discussed earlier, when given more salient, categorically related items, they will readily group on the basis of meaning when given the typical memory-based instruction (Corsale, 1978). It seems likely that the saliency of the category structure is so powerful that it is difficult not to sort in an organized manner. Similar effects of the dependence of memory strategies on the stimulus properties of to-be-remembered materials can be seen in Tarkin's (1981; see also Ornstein et al., 1988) exploration of third graders' use of rehearsal strategies. Further, it is likely that the increasing articulation of the knowledge system with age and experience may facilitate information retrieval and thus reduce the amount of
attentional effort required to implement various sub-components of memory strategies (Ornstein et al., 1988).

### 2.37.4.3 The Development of Effective Strategy Use

With increases in age, the context specificity that characterizes early strategy use is reduced, as children extend the range of settings in which they behave in a strategic fashion (Ornstein et al., 1988). In parallel with this generalization of strategy use, their strategic efforts become increasingly effective in facilitating remembering. Two features of this change in the efficacy of children's strategic efforts are discussed briefly, followed by a treatment of some of the factors that may underlie these age-related changes.

First, as already indicated, there are substantial age-related changes in what children actually do when confronted with a memory goal. Younger children, for example, are more likely than older children to select strategies that are inappropriate for a task, as, for example, when preschoolers implement deliberate strategies that do not facilitate performance in any way (see Wellman, 1988, for a treatment of faulty strategies). Moreover, when children of elementary school age are asked to remember verbal materials, there is a general progression from more passive, rote-type mnemonic techniques to more active strategies that seem to involve deliberate efforts at integrating the material being remembered with existing knowledge. Further, with increases in age, children have increased numbers of strategies at their disposal and are better able to make flexible use of this mnemonic repertoire (Folds et al., 1990; Schneider and Bjorklund, 1998). Second, even when the same strategy appears to be employed by children of different ages, the technique typically has a more facilitative effect on the memory of older as opposed to younger children. As indicated above, Baker-Ward et al. (1984) showed that 4-, 5-, and 6-year-olds all utilized strategies when trying to remember a set of objects, but these techniques only facilitated the memory performance of the oldest group of children. These data – and other demonstrations of utilization deficiencies (Miller 1990; Bjorklund and Coyle 1995) – again show that even very young children may be aware of the importance of implementing a strategy in the service of remembering, but that the strategies that they nominate may be largely ineffective.

### 2.37.4.4 Factors Underlying Developmental Changes in Strategic Memory

In an effort to understand changes in strategy deployment and effectiveness, we turn now to a brief treatment of several factors that may impact children’s use of strategies and serve as mediators of the observed age-related progression: (1) Changes in the underlying knowledge base in memory, (2) reductions in the effort requirements of strategy implementation, (3) increases in metamnemonic understanding, and (4) experiences in formal schooling.

#### 2.37.4.4.1 Prior knowledge

As discussed earlier in our treatment of knowledge and event memory, changes with age in both the content and structure of children’s underlying knowledge in permanent memory can influence dramatically the flow of information within the memory system and thus affect overall performance (Chi, 1978; Bjorklund, 1985; Ornstein and Naus, 1985). Moreover, in recent years there has been a consensus among memory researchers that both knowledge and strategy use contribute in important ways to the development of children’s deliberate memory skills (Ornstein et al., 1988; Muir-Broadus and Bjorklund, 1990) and recognition that under some conditions, the impact of the knowledge base may be mediated by its effects on strategy implementation (Ornstein and Naus, 1985; Rabinowitz and McAuley, 1990). This emerging perspective emphasizes the impact that the current state of a child’s knowledge system may have on both strategy selection and execution (Ornstein et al., 1988; Folds et al., 1990). Indeed, as illustrated previously in our treatment of context specificity, young children may appear to be quite strategic in supportive settings when presented with highly salient and meaningful sets of materials, but they may seem to be much more tentative, and even a-strategic, when presented with less structured items.

How should these demonstrations of context specificity in strategy use be interpreted? As mentioned previously, one explanation for the sometimes dramatic differences in the performance of young children under contrasting task demands is that they may not have sufficient knowledge about the materials to carry out appropriate strategies. Indeed, knowing the meaning and categorical structure of a set of words is a necessary, albeit not sufficient, prerequisite for implementing a semantically based clustering strategy. A second explanation focuses on the beneficial effects of knowledge on the efficiency
of mnemonic processing. With increases in age and experience, the knowledge system becomes increasingly articulated, with rich interconnections among items, thereby contributing to the ease of access that is needed for the skillful execution of strategies such as active rehearsal and meaning-based sorting (Bjorklund, 1987; Ornstein et al., 1988; Bjorklund et al., 1990). Interestingly, these developments in the underlying knowledge base – with the increased likelihood of the automatic activation of strong associative links – may thus make young children’s strategic efforts not entirely deliberate (Lange, 1978; Bjorklund, 1985). At the same time, however, these associative links may increase the efficiency and effectiveness of the strategy use of older children. Finally, these developments in the knowledge system may contribute to age-related increases in the likelihood that children will spontaneously use their underlying knowledge strategically when confronted with memory goals (Corsale and Ornstein, 1980).

2.37.4.4.2 Effort requirements of strategy use

Age-related changes in the effectiveness of children’s strategies may also reflect corresponding differences in the attentional resources that are needed for the execution of mnemonic techniques. If one assumes a type of tradeoff between the processing and storage operations that are involved in carrying out any given cognitive task (Case, 1985), then in the early stages of acquiring a skill such as cumulative rehearsal, strategy execution may so tax the limited capacity system that little remains to be allocated to encoding and storage processes (Bjorklund and Harnishfeger, 1987). Consistent with this perspective, a child may be able to deploy a given memory strategy under some conditions, but the effort required to do so may be so great that the strategy does not actually facilitate performance. Indeed, as indicated earlier, Guttentag (1984) demonstrated that second graders may be capable of producing an active rehearsal strategy when so instructed, but that their deployment of this technique is more demanding of their limited capacity than is the case for older children or adults (see also Bjorklund and Harnishfeger, 1987; Kee and Davies, 1988). As suggested above, evidence consistent with this finding was reported by Guttentag et al. (1987), who found that some children who typically rehearsed passively were able to change to active rehearsal when the resource demands of this more complex strategy were reduced.

If we assume that young children may expend more of their cognitive resources on the processing component of strategy execution than older children, what factors underlie improvements with age in processing efficiency? Three possibilities can be mentioned. First, speed of information processing (e.g., Kail, 1991) increases markedly across the elementary school years, a change that is largely the result of maturation. Second, as indicated earlier, the development of the knowledge base – in terms of the greater coherence of the semantic network and increased ease of accessibility – may also contribute to increases in efficiency of strategy execution (Bjorklund, 1987). Third, the functional capacity of the system may increase with age because specific aspects of a task may come to require fewer resources, reflecting the increased automatization of skill that is associated with experience and practice (Case, 1985; Ornstein et al., 1988; Siegler, 1996).

2.37.4.4.3 Metamemory

It is well documented that with increases in age, there also are changes in children’s metamemory, that is, in their understanding of the demands of various memory tasks and of the operation of the memory system (Flavell and Wellman, 1977; Cavanaugh and Perlmutter, 1982; Schneider, 1985). It must be indicated, however, that even though metamemory figures prominently in accounts of mnemonic growth (e.g., Cavanaugh and Borkowski, 1980; Schneider, 1985), the results of correlational studies in which both memory and metamemory have been assessed have been quite mixed. Examples of some of the difficulties encountered in providing evidence for the proposed linkage between metamnemonic understanding and strategic deployment and effectiveness include cases in which children can articulate awareness of a memory strategy but nonetheless fail to actually use it in practice (Sodian et al., 1986), and in contrast, situations in which children use what might be viewed as a deliberate strategy but are unable to demonstrate any corresponding metamnemonic knowledge (Bjorklund and Zeman, 1982). On the other hand, both early training studies in which strategy instruction was supplemented by the provision of metamnemonic information (e.g., Paris et al., 1982), and more recent studies involving improved methods of assessing young children’s understanding (e.g., Schneider et al., 1998; Schlagmüller and Schneider, 2002), provide convincing empirical evidence for the linkage between metamemory and memory development. For example, in a short-term
longitudinal study, Schlagmüller and Schneider (2002) reported that children who acquired an organizational strategy over the course of the project actually showed increases in declarative metamemory well ahead of actually exhibiting the strategy.

2.37.4.4.4 Schooling

A number of lines of evidence lead to the inference that formal schooling may contribute to the development of children's increasing skill in the use of memory strategies. Consider, for example, comparative-cultural investigations in which the performance of children who were matched in chronological age but who differed in terms of whether they had or had not participated in Western-style schooling have been contrasted. In studies carried out in Liberia (e.g., Scribner and Cole, 1978), Mexico (e.g., Rogoff, 1981), and Morocco (e.g., Wagner, 1978), children who attended school demonstrated superiority in the types of mnemonic skills that have typically been studied by Western psychologists and anthropologists. To illustrate, Rogoff (1981) reported that nonschooled children generally do not make use of organizational techniques for remembering unrelated items and that school seemed necessary for the acquisition of these skills. These findings, of course, do not in any way imply that schooled children outperform their unschooled peers on everyday memory tasks that are embedded in activities central to their culture. Nonetheless, they do suggest that something in the formal school context most likely is related to the emergence of skills that are important for success on tasks that involve deliberate memorization.

With comparative-cultural research indicating that something about formal schooling encourages the development of strategic behavior, the next question might be, When during a child’s experience in school does this growth occur? First grade seems to be a strong possibility, as Morrison et al. (1995) showed that this grade is very important in terms of the development of memory skills. Morrison and his colleagues studied children who just made the mandated date for entry into first grade (a young first-grade group) and those who just missed the date (an old kindergarten group). As such, the children were basically matched in terms of age but nonetheless differed in their school experience, thus allowing for a comparison between a first-grade school experience and a kindergarten experience. To assess memory, Morrison et al. (1995) used a task (adapted from Baker-Ward, 1985) in which the children were asked to study a set of pictures of common objects. Taking performance at the start of the school year as a baseline, the young first graders evidenced substantial improvement in their memory skills. In contrast, the performance of the older kindergartners did not change over the year, although improvement was noted the next year, following their experience in the first grade. These findings imply that there is something in the first-grade context that is supportive of the development of children's memory skills. The potential importance of the first-grade experience is also suggested by Baker-Ward et al.’s (1984) finding, discussed above, that the strategic efforts of 4-, 5-, and 6-year-olds only facilitated the memory performance of the older children.

Given that the evidence points to formal schooling as a mediator of children’s strategy development, Ornstein et al. (in press) have carried out a series of studies to characterize memory-relevant behaviors that teachers use that may support children's deliberate memory skills. Some of their findings are consistent with Moely et al.’s (1992) important report that it is quite rare to find explicit instruction in mnemonic techniques by teachers throughout the elementary school grades. However, even though mnemonic strategies are not generally taught by teachers in an explicit fashion, Ornstein and his colleagues find that first-grade teachers engage in a variety of memory-relevant behaviors in the course of whole-class instruction, including indirect requests for deliberate remembering, strategy suggestion, and metacognitive questioning. Moreover, children in first-grade classes taught by teachers who use more of this sort of memory-related language show a greater ability to take advantage of strategy training (meaning-based sorting and clustering in recall according to semantic categories) than those children with low-mnemonically oriented teachers (Coffman et al., 2003; see Moely et al., 1992, for similar results). In addition, teachers’ mnemonic style in the first grade is linked to the organized sorting patterns on a sort-recall task with low-associated items that was administered to the children 3 years later, such that fourth graders who had been taught by high-mnemonic first-grade teachers sorted more semantically than did their peers who had been taught by low-mnemonic first-grade teachers. As such, this work suggests that just as ‘parent talk’ about events can impact preschoolers’ developing abilities to remember (e.g., McCabe and Peterson, 1991; Reese et al., 1993; Haden et al., 2001; Boland et al., 2003), ‘teacher talk’ may also be relevant for the emergence and refinement of mnemonic skills.
2.37.4.5 Determinants of Performance and Development

The research on children’s strategy development reviewed here suggests that knowledge, effort, metacognition, and schooling can be viewed as mediators of the performance of children at any given age. These determinants of memory performance may also underlie developmental changes in strategic deployment and effectiveness. Changes with age in children’s knowledge of the materials being remembered, the cognitive effort they need to execute tasks that involve remembering, and their understanding of the operation of the memory system all can contribute to age-related increases in strategic effectiveness. However, we attach special status to schooling as a potential mediator of change because the available evidence suggests that school represents a critical context for the emergence and consolidation of children’s mnemonic efforts. Further, as suggested in our discussion of schooling, it seems likely that teacher–child conversation in the classroom is of great relevance for the development of a repertoire of strategies.

2.37.5 Exploring the Development of Memory

The research literature reviewed here provides a picture of the quite remarkable mnemonic competence of young children, as well as clear age-related differences in many aspects of memory performance. Much is thus known about memory development, that is, the memory skills of children of different ages, but much less is known about the development of memory in the sense of understanding the ways in which early instantiations of skill give way to later competencies, and the factors that serve to explain these changes. It also must be admitted that even understanding of memory development, while substantial, is nonetheless limited and that much remains to be learned about children’s skills at various ages.

Why are there substantial gaps in what we know about memory and its development? To a considerable extent, the problem stems from the methodological choices typically made by researchers. Consider first the paradigm-driven nature of work on children’s memory. Most studies of memory deal with remembering in the context of one or another task (many of which have been discussed here), and as a result, relatively little is known about linkages across tasks that vary in terms of their processing demands and other important characteristics. Yet this is exactly the type of information that is necessary to characterize adequately children’s skills at any given age and to identify just what is changing with age and experience. For example, just as Bauer (2006) compared infants’ abilities to imitate enabling versus arbitrary action sequences, thus providing useful diagnostic information, within-subjects contrasts in strategy use under different conditions could yield valuable insights into the memory skills of elementary school children and their development. As an example, Guttentag et al.’s (1987) description of children’s rehearsal under typical (i.e., each item removed after being presented) and scaffolded (i.e., each item remained visible after being presented) conditions provides important information about skills that are in transition.

A second methodological preference of researchers also seriously hinders our understanding of developmental change. As suggested earlier, because the bulk of the literature is based on cross-sectional experiments, little can be said about the course of developmental change within individual children. Cross-sectional studies present useful accounts of the average level of competence on specified tasks at particular age levels, and the impression one derives is that of a smooth developmental pattern. However, there is nothing in a cross-sectional study that enables inferences about the course of development of an individual child or contrasting patterns of change for different groups of children. Moreover, putting both methodological concerns together, the rich cross-sectional literature can say nothing about how early skill in, say, elicited imitation relates to later ability in talking about the past, and still later competence in settings in which deliberate memorization is required. For information of this sort, it is necessary to make use of longitudinal research designs in which the development of skill is traced over time, with children being assessed on a range of contrasting tasks. Microgenetic studies (Siegler, 2006) in which children are tested repeatedly over relatively restricted periods of time during which skills are undergoing change can also be invaluable in informing our understanding of development.

The challenge, then, is for a commitment to research designs that truly can facilitate our understanding of the development of memory. Such a commitment requires a willingness to move across the sometimes cherished conceptual boundaries of different subgroups of researchers, for example, those of the information...
processing and the social constructivist traditions. It may be useful to think about the encoding, storage, and retrieval of information in information processing terms, and it may be equally productive to think about the forces that propel development from the perspective of social constructivism. This is especially the case when, as suggested above, children's developing memory skills may be fostered by social interaction with parents and teachers. By integrating these methods — and by including multiple assessments of children on tasks that are selected because of their contrasting information processing demands — it is possible to provide more precise cognitive diagnoses of children's changing skills as well as some insight into the social forces that drive development.

To illustrate the importance of longitudinal research for an understanding of development, consider first two longitudinal studies, one dealing with children's event recall in the context of the mother–child reminiscing work discussed above (Reese et al., 1993), and the other concerned with the development of active rehearsal strategies in deliberate memory tasks, also mentioned earlier (Guttentag et al., 1987). Admittedly, each of these studies is somewhat limited by a focus on only a single indicator of mnemonic competence and by the age range examined, but they nonetheless can serve to illustrate some of the benefits of this research strategy. For example, Reese et al. reported that the children of high–elaborative mothers showed higher levels of recall of the events under discussion (as assessed by their production of memory elaborations) than the children of low–elaborative mothers. However, what is unique about this study is the finding that, in the context of these mother–child interactions, the children acquired some generalized skills for remembering that had implications for their performance several years later. Thus, for example, levels of maternal elaboration early in development (at 40 months of age) are positively correlated with the children's skills in making independent contributions to these conversations at later points in time (e.g., at 58 and 70 months).

Guttentag et al.'s (1987) exploration of changes in verbal rehearsal from the third to the fourth grade complements Reese et al.'s (1993) event memory study. As suggested above, Guttentag and his colleagues were concerned with the effort requirements of active, cumulative rehearsal and reported that the rehearsal style of some third graders varied as a function of mode of presentation. In particular, some of the children who rehearsed in a passive fashion under the typical mode of presentation changed to a more active rehearsal pattern spontaneously when they were permitted visual access to the previously presented items. Turning this study into a short-term longitudinal investigation, Guttentag et al. assessed the children again after 1 year, when they were in the fourth grade. Interestingly, the researchers reported that the fourth graders' use of an active rehearsal technique under typical item–by–item presentation conditions was better predicted by what they could do as third graders in the scaffolded than the standard version of the task. They suggested that it was possible to view the children who evidenced active rehearsal as third graders when given visual access to the materials as being in a transitional stage of competence.

Other important insights into development are derived from two separate longitudinal studies of children's developing memory strategies that have been carried out by Schneider and his colleagues. In the first investigation (the Munich Longitudinal Study on the Genesis of Individual Competencies; Sodian and Schneider, 1999), children were tracked between 4 and 18 years of age, whereas in the second study (the Würzburg Longitudinal Memory Study; Schneider et al., 2004), a separate sample of children was observed multiple times between 6 and 9 years of age. Although the studies varied in a number of respects, a consistent pattern that emerges is that strategy development is not as gradual as the cross-sectional data discussed here would lead one to believe. In particular, in both investigations, the improvements that children showed in strategy use reflect a picture of dramatic leaps in performance and not gradual increases in sophistication over time.

Related to longitudinal investigations are microgenetic studies that feature frequent and intense observations of the same child across repeated sessions over relatively short intervals. Several unique insights have been gained from these types of investigation that provide new information concerning the emergence and consolidation of children's strategic efforts. First, Siegler's (2006) exploration of a variety of cognitive strategies suggests that children often use less effective techniques in tandem with more sophisticated and efficient strategies that have been recently acquired. In an important treatment of these patterns, Siegler (1996) describes strategy development in terms of an overlapping waves theory with elementary school children having mastery of a mix of strategies at any point in time, and development being viewed in terms of changes in the composition of this strategy mix. Consistent
with this position, in their longitudinal study of developmental changes in rehearsal, Lehman and Hasselhorn (2007) observed that more than half of the children utilized two or more strategies within each measurement point, suggesting that they are making use of multiple strategies (e.g. naming, cumulative rehearsal) for remembering. Second, consistent with the Munich and Würzburg investigations, the results of microgenetic analyses confirm the fact that children do not always transition from rudimentary to complex strategies in a gradual fashion over time (Kuhn, 1995). Consider, for example, Schlagermüller and Schneider’s (2002) microgenetic study of the development of a categorization strategy in the context of a sort–recall task. Fourth- and fifth-grade children, who had been identified as nonstrategy users in the context of the Würzburg longitudinal study of memory development, were given nine sort–recall tasks over the course of an 11-week period. Importantly, those children who adopted the organizational strategy did so in an all-or-none fashion at different times, with some children never categorizing during the task. However, once children came to organize the materials, immediate improvements in recall were observed and were linked to metamnemonic insights immediately prior to strategy acquisition.

2.37.6 Closing Thoughts

It is clear that longitudinal and microgenetic analyses of children’s memory can extend the cross-sectional database in critical ways by providing a truly developmental account of the acquisition of skill. Although cross-sectional studies can generate valuable information about the abilities of children of different ages, thus suggesting age-related trends, statements about development within individuals can only be made when researchers employ designs in which the changing abilities of the same children are tracked over time. However, to be truly informative, longitudinal studies must be designed so as to identify potential mediators – such as adult–child conversations – of developmental change. Nonetheless, these important features of longitudinal investigations notwithstanding, it must be emphasized, as well, that they are not without their limitations. Indeed, most explorations of cognitive development that incorporate repeated assessments of children are correlational in nature, and as such, it is difficult to make statements about causation. It is thus essential to supplement these within-subjects approaches with experimental interventions in which variables of theoretical importance – such as the nature of the conversation to which children are exposed – are brought under experimental control. In fact, in the ideal research world, we envision an integrated methodological approach in which longitudinal studies that enable us to track children’s skills and identify potential determinants of development are paired with training studies in which these mediators are explored experimentally. In this way, it should be possible to study both memory development and the development of memory.

References

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The Development of Skilled Remembering in Children


The Development of Skilled Remembering in Children


