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Children’s Memory Development: Remembering the Past and Preparing for the Future

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Although the first studies of children’s memory were published more than 100 years ago (e.g., Binet & Henri, 1894; Jacobs, 1887) and research on this topic was prominent in the early days of the 20th century (e.g., Hunter, 1913), programmatic work on memory development did not begin in earnest until the middle 1960s. Starting with Flavell’s seminal studies of early strategy use (e.g., Flavell, Beach, & Chinsky, 1966), the corpus of research on age-related changes in children’s mnemonic skills has expanded in an impressive fashion. Two themes now characterize the voluminous literature: (1) the surprising mnemonic competence of infants and young children, at least under some conditions, and (2) the presence of substantial age differences in almost all aspects of memory performance. This assessment of current understanding represents a distillation of evidence that is drawn from research paradigms ranging from elicited imitation (Bauer, Nemer, Dropik & Wewerka, 2000; Meltzoff, 1988) and conditioning (Rovee-Collier, Sullivan, Enright, Lucas, & Page, 1980; Rovee-Collier, Schechter, Shyi, & Shields, 1992) to those involving the production of narrative accounts of previous experiences (Haden, Haine, & Fivush, 1997; McCabe & Peterson, 1991) and verbal measures of both strategy use and remembering (Baker-Ward, Gordon, Ornstein, Larus, & Clubb, 1993; Folds, Footo, Guttenplan, & Ornstein, 1990).

Given that a number of fine overviews of various aspects of children’s memory have appeared in recent years (e.g., Nelson & Fivush, 2000; Rovee-Collier & Hayne, 2000; Schneider & Bjorklund, 1998), in this chapter, we draw quite selectively from the extant literature. Our aim is to integrate two broad areas of mnemonic competence—children’s “event” recall and their skills in using memory strategies—that are not often treated together. We begin with a discussion of children’s abilities to remember and report salient events that they have experienced and then progress to an examination of their use of deliberate strategies for encoding information for future memory assessments. Our integration of these two domains is driven by our commitment to a developmental analysis.
(Ornstein & Haden, 2001) that requires the use of longitudinal data to make statements regarding changes in mnemonic competence within individual children. To be sure, this orientation is not reflected in the largely cross-sectional literature on children's memory. A review of findings from cross-sectional research, nonetheless, provides a useful vantage point for thinking about children's changing memory skills, even when most statements about development must be inferred on the basis of across-group comparisons.

We take this tack for two reasons. First, although the necessary longitudinal data are not yet available to support the claim, we suspect that skills in talking about the past and in deploying strategies for remembering may lie at different points on a developmental continuum. As we see it, just as early expressions of nonverbal memory give way to later uses of language to make reference to past experiences, it seems likely that growing sophistication in talking about the past may precede later competencies in deliberate planning for future assessments of remembering. Second, we believe that both types of memory performance can be understood in terms of the same underlying processes of encoding, storage, and retrieval. In our view, the encoding of information is driven by the activities in which a child is engaged as an event is experienced or a set of materials is being studied for a subsequent test of memory. Attentional focus—whether achieved by visual examination, physical manipulation, or linguistic means—serves to highlight some of the features of the event/materails being remembered and, accordingly, to facilitate encoding and the establishment of representations in memory. Information from these representations, moreover, must be retrieved and reported when remembering is requested, and these operations are governed by both the deployment of effective search routines and the knowledge of appropriate narrative conventions.

From this perspective, we are particularly interested in factors that govern developmental changes in the encoding, storage, retrieval, and reporting of information. In terms of young children's encoding, we focus on both child and maternal behaviors that regulate understanding of ongoing activities and interaction with to-be-remembered materials, and hence can be expected to influence the establishment of coherent representations. Further, we expect a developmental progression in children's understanding of both events and materials such that, with increases in age, they may be able to attend to salient features more on their own, with less maternal involvement (Baker-Ward, Ornstein, & Principe, 1997; Haden, Ornstein, Eckerman, & Didow, 2001). Similarly, we see mother-child conversations about events and activities that are to be remembered as potential opportunities for children to gain experience in retrieving information from memory and in using language for reporting the past (Fivush & Haden, 1997). Moreover, over the course of the preschool years, frequent discussions of past events provide a basis for the acquisition of some general principles regarding retrieval and reporting (Fivush & Haden, 1997; Ornstein, Haden, & Hendrick, 2004).

Given the goal of characterizing the development of children's memory, our primary focus is on changes in performance over time. Nevertheless, our discussion would be incomplete without acknowledging that the considerable changes we observe in many aspects of mnemonic competence are complemented by relative invariance across time in a few areas. For example, age-related differences are usually quite attenuated in recognition tasks (e.g., Perlmuter & Lange, 1978), even though contextual factors, such as the similarity between distractors and targets, clearly affect the magnitude of the differences that are observed (Mvers et al., 2003). In addition, age-related differences are essentially absent when children's memory is assessed without explicit prompts to remember (e.g., Perrig & Perrig, 1993). That is, the performance of children of different ages is comparable on priming and other implicit memory tasks (see, e.g., Schaeter & Buckner, 1998; Zacks & Hasher, Chapter 11, this volume) in which memory for previously presented information affects ongoing information processing in an indirect manner without conscious awareness. The absence of age differences in implicit memory is taken to indicate that the neural substrate underlying performance is maturationally early and different from that presumed to underlie explicit performance (e.g., Rovee-Collier, 1997).

As we present our integration of the event and strategic memory literatures, we will encounter a number of definitional issues concerning intentionality and the operation of deliberate techniques that are under the control of the child (Baker-Ward et al., 1997; Folds et al., 1990; Ornstein, Baker-Ward, & Naus, 1988). From our point of view, event memory can be conceived of as an amalgam of incidental and deliberate
memory, with information encoded without intent to remember but with deliberate forces operating at the level of "telling the tale." Similarly, we see strategic memory as being primarily deliberate, but with "automatic" contributions to remembering also reflecting strong inter-term associations in permanent memory. It is noteworthy that this perspective implies an emphasis on matters of "control." Therefore, within our assessment of children's memory for previously experienced events, we will focus on control in the sense of developing (deliberate) skills for searching memory and using the narrative conventions of the culture to report what has been recovered. Moreover, within our assessment of children's planful memory (for the future), we will discuss control in the sense of a growing repertoire of deliberate strategies for remembering (e.g., rehearsal, organization).

For each of these types of memory, we will stress the role of dyadic communication (e.g., parent-child; teacher-child) in the development of control processes. As we see it, social-communicative interaction not only serves to facilitate children's understanding and immediate memory but also provides opportunities for the acquisition of generalized skills for remembering. We thus focus on social interaction as a potential mediator of developmental change, although we recognize that there are certain other mechanisms that impact the development of memory, including maturational changes in the neural substrate. For example, relatively protracted changes in the reciprocal connections between the association areas and the hippocampus appear to be linked to children's developing memory for temporal order information and long-term recall of the past (Barr, Thordarson, & Hayne, 1996; Carver & Bauer, 1999; Carver, Bauer, & Nelson, 2000). This prolonged time course for the development of biological mediators of some aspects of children's changing mnemonic skills contrasts markedly with the relative stability of the other features of memory performance. Thus, for example, the skills that underlie short-term recall are supported by medial temporal lobe components that should be evident relatively early in development (Bauer, 2002). A similar state of affairs exists with regard to maturational changes in frontal lobe functioning that have been implicated in the development of inhibitory control, which is believed to enhance working memory by gating out task-irrelevant information. Although not the focus of this chapter, it should be noted that developmental investigators (e.g., Bjorklund & Hamishfeger, 1990, 1995) have begun to explore inhibitory control with children and that researchers interested in the cognitive function of elderly adults (e.g., Zacks, Hasher, & Li, 2000) have devoted a considerable amount of attention to the loss of such control in aging.

**MEMORY FOR EVENTS**

Research using nonverbal measures (e.g., elicited imitation, conditioning) suggests that children evidence memory for the events that they experience quite early and that their recall seems to be influenced by reminding, context, prior knowledge, repeated experience, active participation, and enabling relations in ways similar to that observed with older children (see Bauer, 2002). With these nonverbal skills as a foundation, children's memory abilities change markedly once they are able to use language to express what they remember about previously experienced events. Such changes have been observed in a wide range of situations, some of which involve assessing children's memory for specified events (either naturally occurring or laboratory-based), whereas others examine the nature of mother-child conversations about jointly experienced events. We turn now to a treatment of children's memory for salient "target" events, and then move to a discussion of memory as expressed in conversations about the past.

**Memory for Salient Experiences**

In recent years, a considerable amount has been learned about the abilities of children between 2½ and 8 years of age to provide reports of the details of salient events that they have experienced. In a range of studies, children have been exposed to specially crafted stimuli events such as a staged "visiting the pirate" activity (Murachver, Pipe, Gordon, & Owens, 1996) as well as to naturally occurring (mostly medical) events such as routine pediatric checkups and other less familiar and more stressful procedures (Burgwyn-Bailes, Baker-Ward, Gordon, & Ornstein, 2001; Goodman, Quas, Batternan-Faunce, Riddlesberger, & Kuhn, 1997; Peterson & Bell, 1996; Merritt, Ornstein, & Spicker, 1994; Ornstein, Baker-Ward, Gordon, & Merritt, 1997).
To illustrate this approach, consider Baker-Ward et al.'s (1993) exploration of 3-, 5-, and 7-year-olds' retention of the details of a routine visit to the doctor. At each age level, children were interviewed twice, first immediately after their checkups and then again after a delay of 1, 3, or 6 weeks. The interviews made use of a structured protocol that was designed to assess memory for the various component features of the physical examination. Beginning with open-ended probes (e.g., "Tell me what happened during your check-up."), the examiner continued with more specific questions (e.g., "Did the doctor check any parts of your face?"), and then moved on to yes/no questions about features that had not yet been volunteered (e.g., "Did she [he] check your eyes?"). The children were also asked potentially misleading yes/no questions about activities not included in the checkups.

Overall, Baker-Ward et al.'s (1993) data indicated that young children's reports of salient events can be quite impressive, with recall averaging approximately 83% of the component features of the physical examination. Nonetheless, there were striking age-related changes in various aspects of memory performance. In contrast to the older children, the 3-year-olds showed lower levels of overall recall, greater dependency on yes/no types of questions, more forgetting, and a reduced ability to differentiate between activities that had and had not been included in their medical checkups. These basic findings set the stage for a number of questions about age-related changes in the encoding, storage, and retrieval of information in memory. For example, the "problematic" aspects of the performance of the 3-year-olds would seem not to reflect their lower levels of language competence and incomplete mastery of narrative conventions, as they do not benefit from the introduction of alternative methods of assessment that reduce the demands placed on the child to produce a verbal report (e.g., Greenhoot, Ornstein, Gordon, & Baker-Ward, 1999; Myers et al., 2003). Moreover, children's prior knowledge about the events being remembered can both facilitate initial encoding and retention (Ornstein, Shapiro, Clubb, Pollmer, & Baker-Ward, 1997) and interfere with subsequent recall as the details of an experience fade over time (Ornstein et al., 1998). We also know that the level of stress experienced as an unpleasant event unfolds can influence the deployment of attention, and thus encoding and subsequent storage (Merritt et al., 1994). In a similar sense, stress experienced during an interview can affect the retrievability of information (Ornstein, Larus, & Clubb, 1991).

Establishing an Event Representation

All in all, we now know a substantial amount about young children's memory for salient, personally experienced events and about age-related differences in performance. However, it is also clear that a complete understanding of the skills of children of different ages requires consideration of how factors such as prior knowledge, stress, and coping style act together to influence the establishment of a representation in memory. Knowledge certainly impacts a child's initial interpretation of a situation and, along with coping style, has implications for how stressful experiences are encoded. It is essential to think about the impact of these variables if we are going to understand what transforms an event (such as a medical procedure) that may be similar across participants from the experimenter's vantage point into something that is unique from the perspective of the individual child. To use the language of the verbal learners (e.g., Underwood, 1963), it is necessary to examine those factors that determine how the nominal stimulus that is "presented" by medical personnel is changed into the functional stimulus that is attended to by each participant (see Ornstein & Myers, 1996).

This movement from nominal to functional stimulus can be illustrated in Merritt et al.'s (1994) study of children's retention of the details of a stressful and relatively unfamiliar radiological procedure: a voiding cystourethrogram (VCUG) that involves urinary bladder catheterization and subsequent fluoroscopy. There is no doubt that this procedure is a difficult one, and the children in the Merritt et al. study exhibited higher levels of stress than those observed in the studies of memory for the details of routine doctor visits. Indeed, both salivary cortisol assays and behavioral measures during the VCUG indicated that the children were very distressed by the procedure. Interestingly, however, the cortisol and behavioral measures of stress were not correlated with each other, indicating that stress that is measured at the hormonal level is not necessarily reflected in behavioral indicators that can be observed by the medical and research staff. Moreover, Merritt et al. found that the salivary cortisol measure of stress was not related to memory performance, whereas the behavioral measures were negatively linked to recall, such that higher levels of stress
were associated with lower levels of recall performance. These findings thus underscore the need to articulate a type of conversion process whereby an “objective” stimulus event (the VCUG in this case) can be transformed and hence encoded in unique ways by different individuals.

As we wrestle with these issues, it is essential to recognize that the encoding process that results in the construction of a representation in memory can be extended in time, as it involves the interpretation of an event on the basis of prior knowledge. Not only does the (often unconscious) activation of knowledge lead to the establishment of event representations that “go beyond the information given,” but these interpretative processes can continue long after an experience has ended. Further, when the relevant knowledge is not activated—because of age differences in making knowledge-based inferences (Baker-Ward et al., 1997)—or lacking, the input from parents or other adults can be most important for interpretation and subsequent remembering. Indeed, especially with young children, this “extended encoding” of an event involves the joint involvement of the two members of an adult-child dyad both during and after an experience. These lengthy encoding operations may also continue as some children engage in a considerable amount of post-event reflection and rumination, a process that may lead to self-modification of the representation, as in the case of autosuggestion (Binet & Henri, 1894; Brainard & Reyna, 1993), thus blurring the line between the normal encoding of information and suggestion (Baker-Ward et al., 1997).

Searching for Mediators of Developmental Change

Although much has been learned about children’s memory for salient events, there are patent gaps in our understanding. As suggested in our speculative account of extended encoding, a great deal needs to be learned about the ways in which a variety of factors come together in the construction of representations in memory. In this regard, it seems clear that adults have a great role in facilitating children’s understanding and hence the encoding of information in memory. Moreover, as indicated above in our brief discussion of social communication as a potential mediator of change, adults most likely are also involved in helping to “drive” developmental changes in remembering, a topic about which the literature on memory for salient events is largely silent (Ornstein et al., 2004). Indeed, because research concerning children’s memory for salient events is largely cross-sectional in nature, very little can be said about developmental changes within individuals and the factors that serve to bring about these changes. However, these issues are at the core of a series of studies that focus on adult-child conservation as a mediator of developmental changes in remembering (Farrar & Reese, 2000; Haden et al., 1997; Haden et al., 2001; McCabe & Peterson, 1991; Reese, Haden & Fivush, 1997).

Conversational Styles for Talking about the Past

Studies of naturally occurring conversation reveal that between 18 and 24 months of age, children begin to verbally reference the past (e.g., Hudson, 1990; Nelson, 1986). Children’s skills for recalling experienced events develop rapidly between 2 and 4 years of age, such that they become able to give coherent, well-organized accounts of routine, everyday activities (e.g., Nelson, 1986), and can also provide information about novel, one-time past experiences. Indeed, by 29–35 months of age, in response to only general “open-ended” prompts (e.g., “Tell me about Disneyland.”), children are able to recall in somewhat coherent form events that they experienced only once or twice, such as a visit to a zoo or a museum, more than six months in the past (Fivush, Gray, & Fromhoff, 1987).

These skills notwithstanding, it is also clear that children’s early reports of their past experiences are limited both in content and structure (see Fivush & Haden, 1997, for review). For example, when parents and children first begin conversing about past events, the discussions are usually initiated and heavily scaffolded by an adult. To illustrate, consider the following excerpt of a conversation that we recorded between a mother and her 24-month-old about a time they visited an aquarium:

**Mother:** Do you remember when we went to the aquarium? Remember when we saw fish? (pause) What kind of fish did we see?

**Child:** Um.

**Mother:** We saw sharks. Do you remember the sharks?

**Child:** Um.
MOTHER: Was there a man in the water? What was he doing? What was he doing for the fish?

CHILD: Eating.

MOTHER: Yeah! That's right. They were eating. Do you remember seeing the dolphins?

CHILD: Mmhmm (= yes).

MOTHER: What did they do?

CHILD: They be on the water!

MOTHER: Yeah! Did they have toys?

CHILD: Yeah.

MOTHER: What kind of toys did they have?

CHILD: Balls.

MOTHER: Yeah, (laughs) they had balls. Did they also hear whistles?

CHILD: Yeah.

MOTHER: Were they very loud?

CHILD: Yeah.

MOTHER: Did the dolphins do something that went way up high in the air?

CHILD: Yeah.

MOTHER: What did they do?

CHILD: (unintelligible).

MOTHER: They jumped?

CHILD: Yeah.

MOTHER: Who went . . .

CHILD: (interrupts) He.

MOTHER: Hmm?

CHILD: He jumped.

MOTHER: Yes, they jumped . . . Who else jumped? . . . Do you remember the penguins? Did they jump and dive in the water?

CHILD: Yeah.

MOTHER: Did you like them very much?

CHILD: Yeah.

MOTHER: Was there anything else that you liked? What else?

Previous research focusing on such mother-child conversations indicates that the nature of mothers' talk with their children about past experiences has an immediate and long-term impact on children's remembering. Consider, for example, two different styles that mothers use to engage their children in conversations about past events. In contrast to low-elaborative mothers, high-elaborative mothers—such as the one in the above illustration—frequently ask questions and continually add new information to cue memory, even when their children do not provide much in the way of spontaneous recall (Fivush & Fromhoff, 1988; Haden, 1998, Hudson, 1990, McCabe & Peterson, 1991; Reese et al., 1993). Importantly, longitudinal data indicate clearly that differences in maternal style are associated with later differences in children's independent abilities to generate information about past events. To illustrate, Reese et al. (1993) have shown that mothers' elaboration during early conversations with their 40-month-olds was associated positively with children's independent contribution of memory information in conversations at 58 and 70 months of age. Also, other research (e.g., Hudson, 1993; McCabe & Peterson, 1991) demonstrates that the more elaborative mothers of 2-year-olds were, the better their children's independent skills for remembering events with an examiner as much as a year and a half later. In these studies, children with high elaborative mothers were better able to respond to questions posed by an examiner and to produce longer reports concerning their personal experiences, in comparison with children of low-elaborative mothers. As such, mothers who are highly elaborate early in development seem to facilitate their children's abilities to report on their past experiences in a detailed manner. Moreover, it can be argued that as these linguistic skills are mastered, children actually come to understand and represent personally experiences in more elaborated ways (Fivush & Haden, 1997). This scaffolding of children's remembering is interestingly parallel to the positive effects of external environmental support on remembering in older adults (Craik, 1993).

Conversations During Ongoing Events

Just as adult-child conversations about the past can influence the recovery and reporting of information, verbal interactions that occur as events unfold may also have positive mnemonic consequences. As indicated above, it is well known that prior knowledge can affect comprehension, encoding, and subsequent remembering (Bjorklund, 1985; Chi & Ceci, 1987; Ornstein, Shapiro, et al., 1997). However, in the absence of such knowledge, parents and other adults may be able to provide information during an ongoing event that may facilitate children's understanding of the experience, and thus serve to organize the result-
ing representation in memory. For example, by naming component features of an ongoing event, a mother may focus her child’s attention on various aspects of the situation that are particularly salient (Haden et al., 2001). Moreover, if this naming is followed by her verbal elaboration (or better yet, that of the child), a more enriched representation may be established. In this way, mothers and children who are experiencing an event together may come to construct the event in a way that makes it more accessible in the future.

A series of studies that we have carried out supports this notion of linkages between narrative interactions during specified events and children’s subsequent memory for these experiences (see also McGuigan & Salmon, 2004; Tessler & Nelson, 1994). In an initial short-term longitudinal investigation, Haden et al. (2001) followed a sample of 21 children from 2.5 to 3.5 years of age, observing mothers and their children as they engaged in unique experiences at three time points across the year. Within the confines of each family’s living room, the mother-child dyad took part in a pretend camping adventure at 30 months, a birdwatching activity at 36 months, and the “opening” of an ice cream store at 42 months. Component features of the events (e.g., the backpack in camping) that were attended to by both members of the mother-child dyad—as judged by physical handling—were considered in analyses examining differences in recall as a function of the type of talk directed toward these features (e.g., joint-verbal, mother-verbal, no-verbal). For each event, Figure 10.1 depicts the percentage of features recalled of those that were jointly handled and jointly discussed, jointly handled and talked about only by the mother, and jointly handled and not discussed. Inspection of this figure indicates a dramatic effect of joint talk as the events unfold on the information the children provided in response to open-ended questions of the interviewers. As can be seen, those features of the activities that were handled and discussed by both the mother and child were better recalled than those that were jointly handled but talked about only by the mother, which, in turn, were

1-Day Delay

![1-Day Delay Diagram](image)

3-Week Delay

![3-Week Delay Diagram](image)

FIGURE 10.1. Proportion of features of the camping, birdwatching, and ice cream store events remembered in response to open-ended questions at the 1-day and 3-week interviews, as a function of the type of talk directed toward jointly handled features. (Adapted from Haden et al., 2001.)
better recalled than those not discussed. This pattern was observed at both memory interviews for each of the activities, with some indication of a drop in recall over the 3-week delay interval for features that had been jointly handled but only discussed by the mother.

The findings from this preliminary study indicate that children as young as 2.5 years of age show mnemonic benefits from conversations about events in the here-and-now. Joint talk between mothers and children about aspects of an ongoing event is associated strongly with children's open-ended recall as much as three weeks later. However, given the basically correlational nature of this finding, Boland, Haden, and Ornstein (2003) designed an experiment in which mothers were trained to use particular conversational techniques that previous work indicated should enhance children's remembering. Trained mothers were asked to use four specific conversational techniques to enhance 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 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. When observed engaging with their 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 (M = 45.42) exceeded those whose mothers had not received training (M = 36.98) in the production of *event elaborations*, defined in terms of elaborative details about the features (e.g., "Mine was red," when recalling the backpacks) or information that described the event in general (e.g., "We packed up all the food.").

Our exploration of the linkages between mother-child conversational interactions during specified events and children's subsequent remembering continues in an ongoing study of children's memory across the preschool years (see, e.g., Ornstein et al., 2004). As part of this longitudinal investigation, at 36 months of age, children in the sample engaged with their mothers in either the camping or the birdwatching activity. Talk during the event was coded in terms of the number of elaborative questions and statements made by the mothers and the children. Analyses were then conducted to predict the children's average recall across delays of 1 day and 3 weeks from the elaborations that they and their mothers produced during the events. Moreover, levels of maternal elaborativeness as the events unfolded were related to children's subsequent recall of details of the experiences (i.e., their *event elaborations*) beyond simply naming the features. Indeed, taking into account the children's language skills and their own elaborations during the activity, the total amount of maternal elaborative talk during the activity uniquely predicted approximately 5% of the variance in children's recall of embellished information about the events, enabling us to account for a total of 49% of the variance. This work thus adds to a growing body of evidence that shows mnemonic benefits from conversations about events in the here-and-now. The consistency of these findings across delay intervals, events, and different studies reinforces the view that mother-child interaction events contribute substantially to children's understanding and memory.

**LEARNING TO BE STRATEGIC**

Complementing children's increasing expertise in talking about the past are dramatic age-related changes in the deployment of deliberate strategies for remembering information. In contrast to the more or less incidental nature of event memory, the use of specific mnemonic techniques—such as rehearsal and organization—requires that a child behave intentionally in order to prepare for a future assessment of memory (Folds et al., 1990; Wellman, 1988). From this perspective, young preschoolers can certainly be shown to be "strategic," at least in some situations. For example, when asked to remember the location (e.g., under a pillow, behind a chair) of several familiar stuffed toys (e.g., Big Bird, Snoopy, etc.) so that they could be retrieved later, DeLoache, Cassidy, and Brown (1985) found that even 18-month-olds direct a variety of strategy-like behaviors (e.g., naming, pointing, and "peeking") toward the objects or hiding places. Although the deployment of these behaviors was not unambiguously related to memory performance, their use nonetheless suggests that the chil-
Children have a rudimentary understanding that they need to do "something" in response to a memory demand. Admittedly, the picture is complicated somewhat by the fact that young children exhibit these same behaviors in a hide-and-seek scenario in which there is no requirement to remember (e.g., Big Bird is "hiding" in plain view on top of a pillow), albeit to a lesser extent (DeLoache et al., 1985, Experiment 3). Moreover, such displays of mnemonic regulation appear to emerge initially in a rather unplanned fashion and as part of ongoing pleasurable activities (e.g., hide-and-seek) in highly salient and meaningful situations. In this sense, they might be more aptly characterized as *proto strategies* that may—or may not—be linked to later expressions of mnemonic skill (see Wellman’s [1988] discussion of the concept of intentionality).

These demonstrations are consistent with our view that *intentionality* is only one component of strategic behavior. Indeed, a consideration of two others—*consistency and effectiveness*—leads to an understanding of why it is not until the end of the elementary school years that children evidence mastery of a broad set of mnemonic techniques. Although the mature user of deliberate memorization strategies is able to apply them skillfully across a broad range of contexts (Brown, Bransford, Ferrara, & Campione, 1983; Ornstein et al., 1988; Pressley, Borkowski, & Schneider, 1989), young children’s use of these techniques is characterized by considerable context specificity. Indeed, the evidence suggests that children may initially evidence strategic "sophistication" only in some highly salient and supportive settings, but not in others (Ornstein et al., 1988). Similarly, young children’s initial strategic efforts may not facilitate remembering, and it is with age and experience that strategies come to be increasingly effective (Folds et al., 1990; Ornstein et al., 1988; Wellman, 1988).

Although longitudinal data are not available to chart on a within-individual basis this developmental progression in the use of mnemonic strategies, a rich cross-sectional literature documents age-related transitions from relatively passive to active styles of memorization (Ornstein & Naus, 1985; Ornstein et al., 1988). To illustrate the complexities of children’s changing skills, consider two seemingly simple classes of strategies—rehearsal and organization—as seen through paradigms that are designed to externalize these techniques. These memory strategies become increasingly effective over the course of the elementary school years and can serve to illustrate the definitional complexities involved in characterizing children’s strategic efforts.

### Rehearsal and Organization During the School Years

School-age children who are quite sophisticated in terms of reporting the details of salient events that they have experienced are rather limited in their use of deliberate techniques that require studylike behaviors. For example, consider the performance of 9- and 14-year-olds who are given a list of words to be remembered and asked to rehearse aloud as each item is presented. Under these conditions, the two groups of children appear to approach the task of remembering in rather different ways, with 9-year-olds focusing their rehearsal on each item as it is presented and 14-year-olds rehearsing each word along with several previously displayed items (e.g., Ornstein, Naus, & Liberty, 1975; Ornstein & Naus, 1978), as is typically the case with adults (Craik, 1973). A feeling for these differences in rehearsal style can be obtained by inspecting Table 10.1, in which several rehearsal sets for a typical eighth-grade child and a typical third-grader are displayed. By definition, only one item can be present in the first rehearsal set, whereas two can be included in the second set, three in the third, and so on. This protocol indicates that although the older child is mixing a relatively large number of items, the third-grader seems to be rehearsing the currently presented item in a very limited context. These differences in rehearsal style, moreover, are associated with corresponding differences in recall, especially in the recall of the initially presented items (i.e., in the primary section of the serial position function).

Paralleling these changes in the use of a deliberate rehearsal strategy are comparable differences in the deployment of organizational techniques. For example, when presented with relatively unrelated or low-associated items and told to "form groups that will help you remember," third- and fourth-graders will rarely sort on the basis of semantic relations but rather tend to form fragmented groupings that are not consistent from trial to trial (Bjorklund, Ornstein, & Haig, 1977; Liberty & Ornstein, 1973). In contrast, older children (sixth grade and above) and adults routinely form semantically constrained groups, even though the instructions make reference only to a memory goal and do not prompt semantic grouping. Thus, older individuals readily translate an instruction to form
TABLE 10.1. Typical rehearsal protocols

<table>
<thead>
<tr>
<th>Word Presented</th>
<th>Eighth Grader</th>
<th>Third Grader</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Yard</td>
<td>Yard, yard, yard</td>
<td>Yard, yard, yard, yard</td>
</tr>
<tr>
<td>2. Cat</td>
<td>Cat, yard, yard, cat</td>
<td>Cat, cat, cat, cat, yard</td>
</tr>
<tr>
<td>3. Man</td>
<td>Man, cat, yard, man, yard, cat</td>
<td>Man, man, man, man</td>
</tr>
<tr>
<td>4. Desk</td>
<td>Desk, man, yard, cat, man desk, cat, yard</td>
<td>Desk, desk, desk, desk</td>
</tr>
</tbody>
</table>

Source: Adapted from Ornstein et al. (1975).

groups that will facilitate remembering into one that involves a search for some form of meaning-based organization (Ornstein, Tabasso, & Johnson-Laird, 1974), whereas children in the middle elementary school grades approach the recall task in a seemingly strategic manner. These differences in sorting style are associated with corresponding age differences in recall, but it should be noted that the failure of the younger children to group items in a semantically constrained manner does not indicate a lack of understanding of the semantic linkages among the items. Indeed, a number of studies suggest that young children are aware of semantic relations, at least to some extent, both when the items are taxonomically related (Nelson, 1974) and when the organizational structure is less salient (Bjorklund et al., 1977; Liberty & Ornstein, 1973; Worden, 1975). As such, the apparent failure to organize in recall does not stem from a lack of knowledge of organizational structures but, rather, from a failure to apply this knowledge strategically.

Context Specificity in Strategy Development

An extensive literature documents these age-related differences in the use of rehearsal, organization, and other strategies for remembering. With both rehearsal and organizational techniques, training studies have been employed to demonstrate direct links between strategy use and recall. For instance, instructing younger children to rehearse more actively leads to improved recall, and asking older children to rehearse in a passive manner interferes with remembering (see Ornstein & Naus, 1978, for an overview). Moreover, young children’s recall can be facilitated by yoking them to the sorting patterns of older children (Bjorklund et al., 1977; Liberty & Ornstein, 1973) by giving them instructions to sort on the basis of meaning (Bjorklund et al., 1977; Corsale & Ornstein, 1980), or even by providing experience with highly organized materials (Best & Ornstein, 1986). Nevertheless, it must be noted that there are limits to the success of instructional manipulations, and these limits reflect the operation of several key factors that may underlie strategy production. As suggested above, young children benefit from instructions in active rehearsal techniques, but in order to do so they must expend more attentional effort than older children and adults (Guttentag, 1984), and age differences in remembering are typically not eliminated completely (Ornstein, Medlin, Stone, & Naus, 1985). However, by making it easier for young children to carry out the active rehearsal strategy—by combining instructions with a reduction in the information-processing demands of the task—dramatic improvements in strategy use and recall can be obtained. Again, there is a parallel here to work showing that older adults benefit differentially from instructions to employ memory strategies (Craik & Byrd, 1982).

Not only do contextual factors influence the success of training manipulations, they can also affect the likelihood that young children will spontaneously engage in activities that are judged to be strategic, as well as the “sophistication” of their efforts. For example, by permitting third-graders visual access to all previously presented items (thereby reducing the attentional demands of active rehearsal), some typically passive rehearsers will engage spontaneously in a more complex, active rehearsal strategy (Guttentag, Ornstein, & Siemens, 1987). In addition, variations in children’s knowledge and understanding of the materials to be remembered can have a profound impact on the strategies that they use when confronted with a memory goal (Ornstein & Naus, 1985). Age-
related changes in both the contents of the knowledge base and the ease of access to stored information may influence significantly just what can be done strategically with the to-be-remembered materials. In fact, it is possible that a child will appear to be strategic when trying to remember some types of items and nonstrategic with others, most likely leading to the first expressions of deliberate memorization with highly meaningful materials (Ornstein & Naus, 1985; Ornstein et al., 1988). Further, it is likely that the increasing articulation of the knowledge system may facilitate information retrieval and thus bring about a reduction in the effort required to execute various subcomponents of memory strategies (Ornstein et al., 1988).

The Development of Effective Strategy Use

As implied by this characterization of the context specificity of children's strategic deployment, with increases in age, children extend the range of situations in which their activities can be viewed as strategic. Paralleling this generalization across contexts, there are increments in the effectiveness of children's strategic efforts, as measured by improvements in remembering. This increased effectiveness, moreover, appears to reflect two different patterns. First, as already indicated, there are substantial changes in what children actually do when trying to remember. When asked to remember verbal materials, younger children engage in seemingly passive, rote-type memorization procedures, but with increases in age their strategies appear to be more active and involve a deliberate integration of the to-be-remembered information with existing knowledge. Second, even when the same strategy appears to be used by children of different ages, the procedure routinely has a more facilitative effect on the recall of older, as opposed to younger, children. Both of these types of effectiveness are discussed briefly here, prior to a treatment of some of the factors that may underlie these age-related changes.

With increases in age, not only are children more likely to engage in some form of strategy in response to the challenges of a memory goal, but also what they do to meet this goal changes dramatically. Of course, the nature of the materials to be remembered (and the children's understanding of these materials) can influence the types of strategies that can be deployed, but in general, over the course of the elementary school years there is a substantial movement to more active and effective memorization techniques (Schneider & Bjorklund, 1998). To some extent, the greater effectiveness of older children's strategic efforts reflects the acquisition of an increasing number of mnemonic techniques and their incorporation into a repertoire from which the most effective strategy can be chosen to meet the demands of particular task at hand (Folds et al., 1990; Schneider & Bjorklund, 1998).

Consistent with these data, there are many instances in which young children select a strategy that is inappropriate for the task, as is the case when preschoolers may choose techniques that do not facilitate performance in any way (see Wellman [1988] for a treatment of "faulty" strategies). However, there also are cases in which young children carry out a strategy that is quite appropriate to the goal of remembering but are not able to implement it so that memory performance is facilitated. For example, although Baker-Ward, Ornstein, and Holden (1984) showed that 4-, 5-, and 6-year-olds prepared for a memory goal in the context of an object-memory task by using quite comparable strategies of naming and visual inspection, they also found that these strategies only facilitated memory performance of the 6-year-olds. These data—and other demonstrations of utilization deficiencies (Bjorklund & Coyle 1995; Miller 1990)—illustrate that young children may understand the importance of doing "something" in order to respond to a memory demand, but that what they nominate may be quite ineffective.

What Factors Underlie These Changes?

How can we understand these changes in strategy effectiveness? We turn now to a brief treatment of several factors that may influence children's use of strategies and serve as mediators of the observed age-related progression: (1) changes in the knowledge base in permanent memory, (2) reductions in the effort requirements of strategy implementation, (3) increases in metamnemonic understanding, and (4) experiences in school.

Prior Knowledge

As mentioned above, variations in the contents and structure of the knowledge base can have a dramatic
effect on memory performance (Chi, 1978; Bjorklund, 1985; Ornstein & Naus, 1985). In recent years, moreover, there has been a growing consensus concerning the importance of both knowledge and strategies for remembering (Muir-Broadus & Bjorklund, 1999; Ornstein et al., 1988) and recognition that under some conditions the impact of the knowledge base may be mediated by its effects on strategy implementation (Ornstein & Naus, 1985; Rabinowitz & McAuley, 1990). This emerging interactional perspective stresses the extent to which the current state of the child’s knowledge system may enable the execution of particular strategies (Folds et al., 1990; Ornstein et al., 1988). There is no doubt that with highly salient and meaningful sets of materials, young children may appear to be quite strategic in their approach to the task of remembering, whereas they may be more tentative when asked to remember less structured items (e.g., Lange, 1978; Bjorklund, 1987). But how should these demonstrations of context specificity be interpreted, and what are their implications for development?

One explanation for the sometimes dramatic performance differences of young children under contrasting task demands is that they may lack knowledge about the study materials that would be necessary to implement a mnemonic strategy. For instance, knowledge of the 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 more articulated and richly interconnected, thereby contributing to the ease of access that is required for efficient strategy execution (Bjorklund, 1987; Bjorklund, Muir-Broadus, & Schneider, 1990; Ornstein et al., 1988). Thus, although it is possible that the automatic activation of strong associative links may make young children’s strategic efforts not entirely deliberate (Lange, 1978; Bjorklund, 1985), these linkages may increase the efficiency and effectiveness of the strategy use of older children. Moreover, increasing differentiation and integration of the knowledge base is believed to contribute to age-related increases in the likelihood that children will spontaneously use their knowledge in the service of a memory goal (e.g., Corsalle & Ornstein, 1980).

**Effort Requirements of Strategy Use**

Age-related changes in the effectiveness of children’s strategies may also reflect corresponding differences in the attentional resources required for strategy execution. If we assume a trade-off between the processing and storage operations necessary to carry out any given cognitive task (Case, 1985), then in the early stages of skill acquisition the execution of the strategy alone may require so much capacity that little remains to be allocated to encoding and storage processes (Bjorklund & Hanshagel, 1987). As a result, even though a child can make use of a particular memory strategy under some conditions, the effort required to do so may be great, and memory performance may not be facilitated. Consistent with this perspective, Guttenberg (1984) demonstrated that second-graders are capable of producing an active multi-item 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 & Hanshagel, 1987; Kee & Davies, 1988). In addition, Guttenberg et al. (1987) found that some children who used a passive strategy under normal presentation conditions switched to the utilization of more active procedures under conditions in which the resource demands of the more active procedures were reduced.

Given that young children may expend more cognitive resources on the processing component of strategy execution than older children, what factors account for age-related improvements in processing efficiency? Several possibilities can be mentioned. First, processing speed (e.g., Kail, 1981) increases across the elementary school years, a change that is believed to be largely maturationally determined. Second, as indicated above, developments in the knowledge base in terms of the greater coherence of the semantic network and increased ease of accessibility may contribute to more efficient processing (Bjorklund, 1987). Third, functional capacity may increase because specific aspects of a task come to require fewer resources, in part as a result of the automatization that usually accompanies repeated practice (Case, 1985; Ornstein et al., 1988; Siegler, 1996). Furthermore, consistent with the view that age-related differences in mental resources play a role in explaining the changing linkage between strategy use and memory performance, Hasher and Zacks (1979) noted
that deliberate memory tasks that require the use of strategies typically yield significant age-related differences in levels of performance.

**Metamemory**

With increases in age, there are corresponding changes in metamemory, or children's understanding of the operation of the memory system and the demands of various tasks that require remembering (Cavanaugh & Perlmutter, 1982; Flavell & Wellman, 1977, Schneider, 1985). However, even though metamemory has often been suggested as being of critical importance for mnemonic growth (e.g., Cavanaugh & Borkowski, 1980; Schneider, 1985), the results of correlational studies have been quite mixed. Examples of some of the difficulties in documenting the presumed linkage between metamemory and strategy deployment and effectiveness include cases in which children verbalize knowledge of a mnemonic technique but fail to actually use it (Sodian, Schneider, & Perlmutter, 1986) and situations in which children use what might be viewed as a deliberate strategy but are unable to demonstrate any corresponding metamnemonic awareness (Bjorklund & Zeman, 1982). On the other hand, early training studies that have included metamnemonic information along with strategy instruction (e.g., Paris, Newman, & McVey, 1982), and more recent studies involving improved methods of assessing young children's understanding (e.g., Schlagmüller & Schneider, 2002; Schneider, Schlagmüller, & Vise, 1998) provide convincing empirical evidence for the metamemory—memory development linkage. 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.

**Schooling**

A number of lines of research point to the potential impact of formal schooling on the development of memory strategies. For example, within the comparative-cultural literature, studies in Morocco (e.g., Wagner, 1978), Libena (Sternberg & Cole, 1978), and Mexico (Rogoff, 1981) reveal that children who attended formal school demonstrated superiority in the types of mnemonic skills that have typically been studied by Western psychologists and anthropologists. To illustrate, Rogoff reported that non-schooled children generally do not make use of organizational techniques for remembering unrelated items, and this led her to conclude that school seemed necessary for the acquisition of these skills. In addition, comparisons of same-age 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) document substantial differences in memorization skills, indicating that the first-grade environment may be especially important in shaping children's memory development (Morrison, Smith, & Dow-Ehrensberger, 1995).

Given that the evidence points to formal schooling as a mediator of children's strategy development, we (e.g., Coffman, Ornstein, & McCall, 2003) 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 our findings are consistent with Moely et al.'s (1994) important report that it is quite rare to find explicit instruction in mnemonic techniques by teachers throughout the elementary school grades. But even though mnemonic strategies are not generally taught by teachers in an explicit fashion, we find that first-grade teachers are engaging 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 training provided in a specific mnemonic strategy (clustering) than those children with low-mnemonically oriented teachers (Coffman et al., 2003; see Moely et al., 1992, for similar results). At such, this work suggests that just as “parent talk” about events can impact preschoolers' developing abilities to remember (e.g., Roland et al., 2003; Haden et al., 2001; McCabe & Peterson, 1991; Reese et al., 1993), “teacher talk” may also be relevant for the emergence and refinement of mnemonic skills.

**Determinants of Performance and Development**

Research on the factors considered here indicates clearly the complex and multiply-determined nature
of children's strategic memory. Knowledge, effort, metamemory, and schooling each can be viewed as a mediator of the performance of children at any given age. Moreover, three of these mediators—knowledge, effort factors, and metamnemonic understanding—are also relevant to a consideration of the deliberate memory performance of adults of different ages (see Zacks & Hasher, Chapter 11, this volume, for review of factors responsible for changes in memory with aging). These determinants of memory performance may also serve as potential mechanisms underlying developmental changes in strategic deployment and effectiveness. Clearly, changes with age in children's knowledge of the materials being remembered, the cognitive effort they need to exert to carry out tasks that involve remembering, and their understanding of the operation of the memory system all can contribute to developmental 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 above, given the importance of parent-child social communication in the development of early event memory, it seems likely that teacher-child conversation in the classroom is of great relevance for the development of a repertoire of strategies that can be deployed skillfully in the service of goals of remembering.

CONCLUDING REMARKS

The research summarized here indicates clearly that much has been learned in recent years about the complexities of children's memory. However, from our perspective, it is equally clear that much remains to be learned. As we see it, the rich database that has been amassed now sets the stage for the serious exploration of three critical and overlapping issues: (1) an integration of studies of event and deliberate memory performance; (2) a move from the study of children's memory to an understanding of the development of memory; and (3) a blending—at the conceptual level—of the child development and aging literatures. These three broad themes will be treated briefly below.

As indicated at the outset, our decision to treat the development of event and deliberate memory together stems in part from a belief that these seemingly different types of remembering could be understood in terms of the same underlying processes. Memory for events that have been experienced and materials that have been studied both can be analyzed in terms of the factors that affect information encoding, storage, and retrieval, along with subsequent reporting. Event memory and strategic memory also both require the activation of processes that are under the control of the child—as in directed memory searches, skillfully constructed narrative reports, or strategies such as rehearsal—and to a considerable extent it seems to be these control processes that change markedly with age and experience. Further, and somewhat more speculatively, children's skills in talking about salient events and in preparing for subsequent tests of memory both seem to arise in the social contexts of home and classroom. As such, parent- and teacher-child communicative interactions are implicated as mediators of the development of children's repertoire of skills. At a more general level, we feel that the social constructivist approach seems to be an ideal vantage point for the discovery of such mediators, emphasizing as it does the view that many cognitive processes have social origins in interactions between adults and children (Cox, Ornstein, & Valsiner, 1991).

We recognize that children's event and deliberate memory are not typically studied together, but the parallels that we see in the underlying cognitive and social processes lead us to believe that it would be profitable to do so. In addition, a developmental perspective would suggest that tasks that involve event versus deliberate memory performance might be located at different points on a continuum. Indeed, it seems likely that children's abilities to remember their previous experiences and to talk about past events precede their later skills in preparing deliberately for future assessments of remembering. Of course, descriptions of changes in these skills within individual children are rare, particularly those that make use of a multitask diagnostic strategy that can yield developmentally changing profiles of mnemonic competence (Guttenberg et al., 1987; Ornstein et al., 1988). Moreover, serious exploration of such a presumed developmental continuum requires that researchers commit themselves to move from studying memory development to the development of memory (Ornstein & Haden, 2001). Longitudinal research in which children are tracked over considerable periods of time—especially work that focuses on potential mediators of change—is central to such a commitment and certainly is not the norm in studies of cognitive develop-
ment (but see, e.g., Reese et al., 1993; Haden et al., 2001; Schneider & Sodian, 1997). Much can also be learned about developmental change from relatively short-term microgenetic studies (e.g., Siegler, 1996).

Finally, from our point of view, it would be equally important to effect some kind of integration of research on the development of children’s memory with that of explorations of cognitive aging. Although a comparison of this chapter with that of Zacks and Hasher (Chapter 11) indicates relatively few points of overlap, researchers in these two areas seem to be committed to an exploration of many of the same issues. For example, the memory performance of both young children and the elderly is very much driven by contextual factors, with seemingly minor changes in materials, instructions, conditions of assessment, and so on, having a substantial effect on remembering, and hence on estimates of underlying skill or competence. Similarly, although not the focus of our overview, developmental psychologists are as concerned about issues of accuracy and error in memory as are cognitive psychologists, and they are equally supportive of the application of basic research to issues such as eyewitness testimony (see, e.g., Ceci & Bruck, 1995). Further, researchers in both areas of study are concerned about understanding development, although there are clear differences at present in the potential mediators of change that are being explored. As we see it, these basic similarities might provide the foundation for fruitful collaborations that could lead to a truly integrated lifespan cognitive developmental psychology.

References


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