

Children's Testimony: A Review of Research on Memory for Past Experiences

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This review of children's testimony focuses on research related to memory for past experiences. The aspects of the memory system that are involved in testimony are discussed and the development of autobiographical memory is examined. Relevant research findings are summarized in the context of an information-processing model of memory and the implications of this work for clinical practice are outlined. We conclude that (1) under certain conditions, even very young children can remember and report past experiences with some accuracy over very long periods of time; (2) substantial and significant developmental differences have been demonstrated in children's abilities to provide eyewitness testimony; (3) children can be influenced in a variety of ways to provide complete and elaborated reports of events that never occurred; and (4) even experts cannot always tell the difference between true and false reports.

KEY WORDS: children's testimony; eyewitness memory; suggestibility; trauma.

In recent years, children's abilities to provide accurate accounts of their experiences have been studied extensively. This research has been fueled, in part, by concerns about the allegations of young children in several high-profile cases of child sexual abuse and the increased frequency with which children are asked to provide testimony in legal settings. Although multiple dimensions of individual functioning, including many aspects of socioemotional and cognitive development (see Saywitz, *in press*), certainly affect the testimony of young witnesses, memory is a basic prerequisite for children's abilities to provide accounts of their experiences. Stated simply, children cannot report what they cannot remember (Ornstein, Gordon, & Baker-Ward, 1992). Moreover, we argue that it is critical for clinical and legal professionals who work with child witnesses to understand the theoretical underpinnings of children's memory/testimony performance as well

as the practical implications of the research findings. Accordingly, our focus in this review of children's testimony is on their memory capabilities.

In general, two broad approaches have been taken in the study of children's eyewitness memory. One approach is to examine the abilities of children at different ages to accurately remember and report their experiences (e.g., Baker-Ward, Gordon, Ornstein, Larus, & Clubb, 1993; Fivush, 1997; Ornstein, Baker-Ward, Gordon, & Merritt, 1997; Saywitz, Goodman, Nicholas, & Moan, 1991). This approach typically involves questioning the child at various delay intervals about real-life past experiences (e.g., visits to the doctor or the emergency room, trips to a museum or amusement park) for which the details of the events in question can be specified. The results of this work have demonstrated clearly that under certain circumstances even very young children remember past events and can provide surprisingly rich accounts of these experiences (Bahrick, Parker, Fivush, & Levitt, 1998). Moreover, these memories often endure for very long periods of time (Howard, Osborne, & Baker-Ward, 1997; Peterson, 1999; Schwarzmueller, Boyle, & Fivush, 1996). Significant developmental differences also have been

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documented, however, indicating that early elementary school children are more accomplished at this task than are preschoolers. Older children, for example, provide more information in free recall, require fewer specific prompts for complete and detailed reports, and forget less information over time than do younger children, especially those below the age of about 4 years (Ornstein et al., 1997).

A second research approach involves exploration of the many factors that influence—for better or worse—the accuracy of children's eyewitness memory reports. Much of this work has involved exposing children to situations that provide analogs to robberies, abuse, and other crimes, and then manipulating the child's experiences during the retention interval or varying the nature of the postevent interview in ways that simulate aspects of forensic practice. Researchers have examined the effects of repeated interviews or repeated questions within one interview—the impact of long delay intervals between the occurrence of an event and a child's subsequent testimony, the consequences of suggestive or misleading questions (or both), and stress or trauma (or both) as an event is experienced, when a report is being made, or during both these situations (see Bruck, Ceci, & Hembrooke, 1998, for a review). The results of this research have documented a number of factors that can greatly reduce the accuracy of children's memory reports. Moreover, some children can even be induced to provide false information, claiming that certain events occurred when in fact they did not (see Ceci & Bruck, 1995). Indeed, the evidence suggests that young children, especially preschoolers, are more vulnerable to these types of suggestibility effects than are older children or adults. As a result of this work, specific recommendations for interviewing children involved with the legal system have been proposed, with the goal of improving the accuracy of children's testimony (e.g., American Academy of Child and Adolescent Psychiatry, 1997; American Professional Society on the Abuse of Children, 1990; Orbach et al., 2000; Poole & Lamb, 1998).

Currently, research in the area of children's testimony is focused on gaining a better understanding of the processes involved in remembering past events and the specific conditions under which some children may be vulnerable to suggestion whereas others are not. In this regard, this research is placed within the context of the rich theoretical framework and data provided by basic research in memory. Basic research indicates that remembering involves a series of information-processing steps, with each com-

ponent of the process affected by the nature of the to-be-remembered material, the conditions under which remembering transpires, and the developmental level of the rememberer. Hence, to understand children's memory and subsequent testimony, it is necessary to examine both the processes through which information is obtained, as well as the contents of memory storage. Although a comprehensive review of memory development is well beyond the scope of this paper (see Schneider & Pressley, 1997, for an extended treatment), this review focuses on the theoretical and empirical bases for understanding memory processes as they relate to children's abilities to provide accurate testimony. Thus, we begin with an overview of the aspects of the memory system that are involved in children's testimony. Next, we examine the emergence of autobiographical memory, a developmental transition that defines the earliest age at which a child can be expected to provide legal testimony. The major section of the paper provides a review of research relevant to understanding and facilitating children's testimony, summarized within the context of an information-processing framework. We conclude with a brief discussion of directions for future research and the implications of this work for clinical practice.

THE TYPES OF MEMORY INVOLVED IN CHILDREN'S TESTIMONY

When children are involved as witnesses in legal proceedings, they are asked to report events that transpired months or even years previously. Hence, the extent and quality of children's testimony is determined to a large extent by the retrievability of information in long-term memory. The long-term memory system includes two major representational subsystems, declarative memory, defined as memory for facts and events, and nondeclarative or procedural memory, which includes stored representations of nonverbal actions or behavioral sequences (Bjorklund, 2000). In other words, declarative memory involves the retention of information, whereas procedural memory concerns knowing how to accomplish specific tasks. Testimony typically calls for the use of declarative memory, more specifically a type of declarative memory termed episodic memory, or memory for information that can be linked to a particular occurrence. Because individuals can be consciously aware of the contents of episodic memory and can deliberately retrieve the information, episodic memory is sometimes described as explicit memory. In contrast, procedural

memory is a type of implicit memory, it is automatic and must be assessed indirectly (Schacter, 1992). Although questions sometimes arise about the role of implicit memory as the basis for evidence of child abuse (see Howe, 2000), testimony requires episodic memory, which is expressed verbally.

Episodic memory contains representations of ordinary experiences as well as unique events that become part of one's life story. In general, the events reported by witnesses are not only referenced in time and place, but are also important occurrences for the individual. In this regard, testimony typically calls for a type of episodic memory that is termed autobiographical memory, defined by Nelson (1993, p. 61) as "specific, personal, long-lasting, and (usually) of significance to the self-system." The developmental emergence of autobiographic memory can reasonably be considered to mark the earliest point at which a child can be expected to provide testimony, especially in cases in which the child is the alleged victim.

Another important characteristic of children's testimony involves the nature of the events under investigation. Assuming that crimes were actually committed, child witnesses are typically victims of abuse or close observers of violent acts, often involving family members. They can be expected to have suffered some degree of trauma, and in many cases, may have experienced repeated abuse for some extended period of time. As a consequence, in many instances the effects of trauma on memory at both neurobiological and psychological levels are additional influences on children's testimony.

A final consideration in examining children's testimony involves the flow of information through the memory system. Before witnesses can report events, they must first have encoded the information and established representations in memory. Thus, changes in the memory representation that occur over time must be understood in order to evaluate children's capacity to provide accurate testimony. Information also must be retrieved from long-term memory, and retrieval is not always an automatic or perfect process. Hence, skills in monitoring what is in memory and in accessing one's own memory also are important in understanding testimony.

THE DEVELOPMENTAL EMERGENCE OF AUTOBIOGRAPHICAL MEMORY

Investigations conducted over the past 15 years have established that very young children have

much better memory capabilities than was previously thought to be the case. Even infants and toddlers can encode, store, and retrieve a great deal of information about the events they experience (Howe, 2000). Indeed, newborns can recognize voices and stories to which they were exposed prenatally, as evidenced by modifications of their sucking patterns (DeCasper & Spence, 1986). Recent work with toddlers, using elicited imitation tasks, in which action sequences that produce an event are demonstrated by an experimenter and subsequently reproduced by the children (see Bauer, 1995; Bauer, Hertsgaard, & Dow, 1994) has established that very young children form specific episodic memories and retain them for long periods of time. Such results, of course, strongly contradict the "tenacious and influential assumption" (Bauer, 1996, p. 39) that children cannot remember their own lives before the age of three or four (see also Meltzoff, 1995; Rovee-Collier & Shyi, 1992).

These findings regarding very early memory capabilities can be applied directly to children's testimony only if two conditions are met. First, early memories, which are demonstrated behaviorally by preverbal children, must subsequently be accessible for verbal reporting after language is established. Although it is clear that preverbal experiences may have long-term effects on children's behavioral responses, there is no way to directly link a particular behavior, even a manifestation of fear or anxiety, with the details of a specific occurrence. Second, the accessible memories must be autobiographical and not just episodic in nature. That is, they must represent the child's memory for personal experiences that involve the individual, rather than general recall of events without the incorporation of a personal context.

The evidence regarding children's abilities to verbally report early experiences after they have acquired language is mixed. Bauer and her colleagues (Bauer, Kroupina, Schwade, Dropik, & Wewerka, 1998), for example, found that 16- and 20-month-old infants demonstrated nonverbal evidence of memory at a 6-month delayed assessment. Children who were 20 months old at the time of exposure to the events made utterances that provided verbal evidence of recall, whereas those in the younger group at the initial sessions did not. It is interesting that productive vocabulary at the time of exposure to the event was not correlated with later verbal memory. The authors concluded, "Children who likely encoded events without the benefit of language are capable of subsequent verbal mnemonic expression of them" (Bauer et al., 1998, p. 675). It appears, however, that there is a lower age

limit for the maintenance of information in memory after long delays, at least when verbal access is required.

Although Bauer et al. provide evidence for delayed recall of very early experiences among older toddlers, the extent to which their reports reflect autobiographical memory is questionable. Howe (2000), in a discussion of this work, notes that evidence for autobiographical memory would include reports of aspects of the personal experience of the laboratory visit, not just the reconstruction of interactions with objects. Bauer et al. (1998), although pointing out that their research participants' verbalizations included specific episodic information about the overall event, acknowledge uncertainty as to the extent to which the reports represent autobiographical recall.

In contrast to the work of Bauer et al., Peterson and Rideout (1998) clearly examined verbal reports of an autobiographical memory among very young children. The participants in this investigation were children between 13 and 34 months of age who had had a traumatic injury requiring emergency medical treatment. Verbal interviews were conducted with the children at 6-month intervals until 2 years after their accidents. The presence of verbal narrative skills (defined as the ability to talk about events that are removed in time and space from the immediate context) at the time of the event emerged as a determinant of subsequent verbal memory. Children who were at least 2 years of age and who had narrative skills at the time of the experience were able to report at least two central components of the event after a delay of 2 years. In contrast, although slightly younger children who did not demonstrate narrative abilities at the initial assessment provided some verbal information about the experience, the majority of these accounts were quite fragmentary and included substantial levels of inaccuracy. In addition, there was little evidence that preverbal memories could become verbally accessible. Only 2 of the 12 children in the youngest group provided verbal information about the experience at the 12-month delayed interview, when they had acquired narrative skills. Moreover, there were some concerns that these children's reports represented aspects of family history conveyed by their parents after the event, rather than the retention of initially encoded information.

In summary, although there is some emerging evidence that young children can report aspects of experiences that are encoded before the onset of productive language, it seems unlikely that such memories are retained among children who are much younger

than 2 years of age at the time of the experience, at least over the very long delays that often characterize legal proceedings. Further, the information that is provided appears to be fragmentary and accompanied by inaccurate responses. For these reasons, it can be concluded that, at least in most instances, children cannot be expected to testify about events that transpired before they were at least 2 years of age.

AN INFORMATION-PROCESSING PERSPECTIVE ON CHILDREN'S TESTIMONY

A simple conceptual framework based on the stages of information-processing—that is, how information is encoded, stored, and retrieved—allows one to organize data relevant to the accuracy of children's testimony. Because inaccuracies in recall can result from disruptions at any of these stages, this informal model can also be used to understand the range of factors that can influence children's remembering (Gordon, Schroeder, Ornstein, & Baker-Ward, 1995; Ornstein, Larus, & Clubb, 1991). This framework consists of five broad themes: (1) not everything gets into memory, (2) what gets into memory may vary in strength, (3) information in memory changes over time, (4) retrieval is not perfect, and (5) not everything that can be retrieved is reported.

Encoding: Not Everything Gets Into Memory

In attempting to understand inaccuracies in children's memory reports, it is important to keep in mind that simple exposure to an event, even a salient personal experience, is not sufficient to insure complete encoding of the experience. In a study of memory for a routine pediatric examination (Baker-Ward et al., 1993), for example, children were interviewed immediately after their checkups in order to obtain an estimate of the extent to which they encoded the experience. Even when strong retrieval cues in the form of very specific questions were provided, recall was not perfect; the children reported 75%, 82%, and 92%, at ages 3, 5, and 7, respectively, of the procedures that comprised the examination. Such encoding failures may arise from either selective attention in that individuals may not notice some aspects of their experiences as they transpire, or from the failure to transfer information from short-term to long-term memory after it enters the memory system.

Selective Attention

A number of factors have been shown to influence the likelihood that information will be attended to and encoded. One important determinant of encoding is what one knows about the event before it occurs. Knowledge affects how an individual monitors the world, interprets events, and selectively attends to certain types of stimuli while ignoring other types (Bjorklund, 1985; Chi & Ceci, 1987; Ornstein & Naus, 1985). A considerable body of evidence indicates that children's understanding of the events to which they are exposed will have a profound effect on what is encoded and stored in memory (Clubb & Ornstein, 1992; Nelson, 1986; Ornstein, Shapiro, Clubb, Follmer, & Baker-Ward, 1997; Ricci & Beal, 1998). As an example, Goodman, Quas, Batterman-Faunce, Riddlesberger, and Kuhn (1997) found that prior knowledge of a stressful medical procedure predicted subsequent memory performance of children aged 3 to 10 years, independently from the age of the child.

Given that knowledge in most, if not all, domains increases with age, there should be comparable developmental differences in the types of specific details that are noticed and encoded. There is, however, little research that identifies specific age-related changes in the content of children's memories. Eisen and Goodman (1998) argue that what is memorable to any individual child, regardless of age, and hence most likely to be encoded, is anything that is personally significant to that child. Events or actions that affect a child's sense of well-being, safety, or social acceptance are considered to be personally significant and thus, more likely to be remembered (Goodman, Rudy, Bottoms, & Aman, 1990). Similarly, others (Bowers & Sivers, 1998; Howe, 2000) indicate that aspects of an event are more likely to be encoded if they are "interesting" or "distinctive," either because they are unexpected or emotionally arousing, to the child. Very traumatic experiences, for example, may be remembered very clearly despite a lack of prior knowledge because of their distinctiveness. It has also been noted, however, that high arousal, such as might occur during a traumatic experience, results in a narrowing of attention. Thus, many details of such an experience may not be encoded because the child focuses on only a few highly salient features (Bowers & Sivers, 1998). In this regard, it is not surprising that children remember central features of even neutral events better than more peripheral features (Fivush, Gray, & Fromhoff, 1987; Goodman, Hirschman, & Rudy, 1987). What is

central for a specific child depends on what is most relevant to that child, including the most threatening or most feared aspect of a traumatic experience.

In situations in which children lack knowledge about an event, interactions with adults may compensate for their developmental limitation. Fivush (1998) argues that conversations about an event (as opposed to simply labeling things) between children and adults that occur as the event unfolds are a critical factor in determining the features that children encode and remember. She suggests that these ongoing jointly constructed conversations provide children with a better understanding of their experiences and help them to attend to important aspects of events. Indeed, several researchers have demonstrated this linkage between adult-child conversations and superior subsequent memory performance (Haden, Ornstein, Eckerman, & Didow, in press; Pipe, Dean, Canning, & Murachver, 1996; Tessler & Nelson, 1994). Parents' provision of information as events unfold may supplement children's relatively limited knowledge and hence play a central role in the children's comprehension and subsequent memory for novel experiences (Haden et al., in press).

Failure of Encoded Information to Reach Long-Term Storage

Even when individuals attend to features of their experiences, this information may never enter long-term storage. The information-processing model posits a sequence of steps through which experience is transferred to long-term memory. Perceptions of an event are held very briefly in a nonlinguistic, sensory-based store, the sensory register. Unless sensory information about an event is immediately transferred to short-term memory, it will fade without having entered consciousness. Although there appear to be few age related changes in the total capacity of the sensory register, the likelihood that information will be moved to the next level of information-processing increases substantively with age (Schneider & Bjorklund, 1998). This has been attributed to both changes in strategies, such as selective attention, and developmental increases in processing speed.

When perceptions enter consciousness, they are held in short-term working memory (STWM). This stage of information-processing has been compared with RAM in a computer (Goldhaber, 2000). STWM, like RAM, can get information from permanent memory storage as well as external sources. Hence,

perceptions of new experiences can be transformed in short-term memory through integration with previously stored material. An implication of the active processing of information in STWM is that the stored representation transferred to long-term memory is to some extent an interpretation of the experience, rather than a veridical representation of the action as it transpired. That is, memory is not like a videotape that can be replayed at any time. Rather, in encoding an event, the individual constructs a coherent story of the experience out of fragments of memories and perceptions that are combined or blended (Baker-Ward, Ornstein, & Principe, 1997; Bowers & Sivers, 1998).

STWM increases substantially with development. This increase, however, does not appear to be attributable to simple changes in the capacity of short-term memory storage (Schneider & Bjorklund, 1998). If this were the case, age-related improvements would be observed in memory span regardless of the type of information that is to be remembered. In contrast to such a domain-general improvement, memory span is domain-specific; that is, it differs for an individual on the basis of his or her interest and knowledge in the content of the to-be-remembered information. Moreover, knowledge appears to affect memory span by increasing speed of processing. Although neurological development (such as myelination of areas of the cortex) is likely to have some effects on speed of processing, this important variable must be understood in terms of experiential as well as maturational influences (Schneider & Bjorklund, 1998).

It is clear from this brief overview that simple exposure to an event, even a salient personal experience, is not sufficient to insure complete encoding of the experience. The likelihood that a detail of an event will be encoded and subsequently become a part of permanent memory is influenced significantly by an individual's prior knowledge and the nature of the experience itself. Developmental differences in memory capacity must be interpreted within the context of a child's knowledge in a particular domain and the extent to which the event in question is consistent with or distinct from that knowledge. Simply put, what we already know determines, to a large extent, what we can and cannot remember.

Memory for Stressful and Traumatic Experiences

Given that child witnesses will undoubtedly be asked to remember experiences that are quite stressful, considerable research has been devoted to de-

termining the effects of high levels of stress on the encoding and storage of information in memory (see Cicchetti & Toth, 1998 for a review). Many of these investigations have examined children's memory for medically indicated procedures that typically invoke some level of distress among children, including emergency room treatment (Peterson & Bell, 1996) and urinary catheterization-procedures (Goodman & Quas, 1997; Merritt, Ornstein, & Spicker, 1994). Although the relation between stress and recall has been the subject of considerable past debate, the accumulation of evidence now supports the conclusion that, when a significant relation is revealed, higher levels of stress are predictive of lower levels of remembering (see Ornstein, 1995). These findings are consistent with expectations based on the Yerkes-Dodson law that postulates an inverted-U-shaped relation between arousal and performance. In general, when stress is moderate, recall may be enhanced; in contrast, when stress is very high (or very low), memory performance is debilitated (see Gold, 1987; Pezdek & Taylor, in press).

It should be noted that a considerable amount of complexity is masked by this general conclusion regarding the relation between stress and recall. As noted earlier, indicators of stress and memory performance are not always associated, even when presumably stressful events are under investigation. Moreover, different indicators of stress are not always correlated with each other within the same investigation and the relation between stress and memory may differ across multiple assessments. Merritt et al., for example, found that a fine-grained observational measure of children's distress during a painful invasive medical procedure was correlated with children's total recall for component features of the procedures during an interview conducted shortly after the experience. This measure, however, was not associated with memory performance as assessed 6 weeks after the procedure. Moreover, a physiological indicator of stress obtained through salivary cortisol assays was unrelated to the observational data or to measures of memory.

At this point in time, it appears clear that the effects of stress on children's memory must be interpreted within the context of multiple influences on performance. Individual difference variables in areas such as temperament (specifically reactivity to stress), psychopathology (e.g., depression or generalized anxiety), coping style, and even parental attachment may mediate the relation between stress and memory (Goodman et al., 1997; Howe, 1998). In addition,

intervening experiences between a stressful event and delayed memory assessments, including relevant naturally occurring or therapeutic adult-child conversations, may affect children's understanding and consequently, the likelihood that specific details of the experience will be subsequently reported (Fivush, 1998). Also, the constructive processes that characterize memory for everyday events apply to traumatic experiences, as well. For example, in contrast to the widespread belief that "flashbulb" memories for very salient events remain vivid and accurate after long delays (see Brown & Kulik, 1977), prospective investigations of children's reports of the Challenger explosion revealed both forgetting and reconstructive errors (Warren & Smartwood, 1992; also see McCloskey, Wible, & Cohen, 1988, for similar findings with adults).

The personal significance of the emotions aroused by an event is another important factor in understanding how well stressful experiences will be remembered. In a review of laboratory research examining the linkage between emotion and memory, Bowers and Sivers (1998) conclude that there are two consistent findings. First, when the emotions that are aroused are relevant to or caused by an experience, memory for that information, particularly information that is perceived of as personally meaningful, is enhanced. Second, when the emotion aroused is irrelevant to the experience (such as in the case of test or performance anxiety or chronic generalized anxiety) memory is reduced or diminished. Maltreated children, for example, tend to focus their attention on aggressive stimuli and have difficulty screening out distracting information, presumably because of their ongoing experience of abuse. This effect has obvious implications for encoding and remembering aggressive versus more neutral information (Pollack, Cicchetti, Klorman, & Brumaghim, 1997; Pollack, Cicchetti, & Klorman, 1998).

In addition, aspects of emotional development affect an individual's personal experience, such that the same event may induce very different degrees of arousal for children with different histories. As an example, children who demonstrate insecure parent-child attachment behavior have been shown to have higher salivary cortisol levels (indicating greater distress) when faced with a stressful experience than do children who have a more secure attachment relationship (Hertsgaard, Gunnar, Erickson, & Nachmias, 1995). Further, consistent with the general finding that high levels of arousal negatively impact recall, children with insecure attachment designations

make more errors when recalling a stressful medical procedure than do more securely attached children (Goodman & Quas, 1997).

Some questions remain about the extent to which work with analog events such as medical procedures can be generalized to memory for the traumatic experiences that are the subject of legal proceedings. Despite similarities in discomfort and bodily contact, there are also important differences in parentally sanctioned and medically indicated treatments and the violation and violence of abuse. Nonetheless, recent work on memory for trauma has investigated whether or not the brain represents and stores traumatic experiences differently than everyday autobiographical memories (see Nadel & Jacobs, 1998). The data suggest that various aspects of an experience are represented in different parts of the brain. The amygdala is particularly important in memory for emotionally charged events. In contrast, the hippocampal formation functions to integrate event memories represented diffusely in different brain areas. Stress has a differential impact on these two separate areas and hence on alternative aspects of explicit memory. Stress appears to enhance the function of the amygdala, resulting in the strengthening of memories served by this structure. Alternatively, too little or too much corticosterone, the hormone produced by stress, appears to disrupt the function of the hippocampus and hence reduces the likelihood that the details of an experience are integrated into a coherent memory. As a result, memories for trauma may be represented as fragments, rather than as integrated event sequences (Nadel & Jacobs, 1998).

Other work indicates that chronic stress may actually lead to changes in brain structure, specifically in areas associated with learning and memory and that young children, because of their rapidly developing brains, may be particularly vulnerable to this effect (Nelson & Carver, 1998). It is interesting that women with histories of childhood physical and sexual abuse show elevated physiological responses to stress when compared with nonabused control participants (Heim et al., 2000). As research in the area of brain function, trauma, and memory progresses, it may help to explain some of the unusual symptoms of posttraumatic stress syndrome (i.e., intrusive recollections of the trauma, nightmares, and flashback memories) and the often fragmentary and jumbled nature of memory for highly traumatic experiences. Moreover, these findings are consistent with the increased likelihood of generating false memories among women with abuse histories (Bremner, Shobe,

& Kihlstrom, 2000). Because constructive processes apply to memories for trauma as well as everyday experiences, events that are stored as fragments may be particularly vulnerable to reconstructive error.

Storage: What Gets Into Memory May Vary in Strength

Given that details of an event are encoded and stored, many factors can potentially influence the strength of the resulting trace in memory and consequently the ease with which information may be retrieved at a later time. The extent to which information is embedded in a coherent, well-organized knowledge structure is one important determinant of the likelihood that it can be subsequently retrieved. Information that is less strongly elaborated within such a semantic network is also more subject to suggestibility (Pezdek & Roe, 1995). Stronger representations may be readily retrieved, even in response to open-ended questions, whereas weaker traces are more likely to be forgotten or may require more specific questions to be remembered. Several factors have been shown to influence the strength of the memory representation including whether one actively participates in an experience or watches others, the age or developmental status of the individual, and the amount of exposure to the events in question.

Participant Versus Observer

Considerable research has documented that children remember events in which they participate better than those that they merely witness (Bauer et al., 1998). Active participation results in more detailed memories (Baker-Ward, Hess, & Flanagan, 1990) as well as increased resistance to suggestion or misleading information (Rudy & Goodman, 1991), and this is especially true for preschool children. Bauer et al. (1998) argue that the superior memory that typically results from active participation may be a function of the tendency to pay attention to and encode features of events that are most relevant to the self. This is consistent with the argument that personally experienced events have greater trace strength because of the extent to which encoding benefits from greater knowledge. Thus, Bauer et al. hypothesize that certain types of witnessed events, such as those involving violence or abuse of a significant other, might be remembered as well as other more benign

participatory experiences. Supporting this possibility, Baker-Ward et al. (1990) found that the advantages of participation over observation in children's reports of a laboratory play event were present when randomly assigned classmates were observed, but were not present when the observed individuals were close friends.

Age

With increasing age, there are corresponding changes in a variety of cognitive functions that affect the acquisition and storage of information in the memory system. Other influences being equal, older children will acquire more information from comparable exposure to an event and will maintain a stronger memory trace than will younger children. This effect can be attributed to age-related changes in processing speed as well as the availability of more efficient strategies and an increased knowledge base (Ornstein et al., 1997). Moreover, it is likely that the age differences in forgetting that are commonly found in studies of autobiographical memory (e.g., Baker-Ward et al., 1993) reflect corresponding decreases in the strength of the underlying memory representations. Thus, the strength of the memory representation diminishes less over time for older as compared with younger children. As a result, stored representations of experiences become more difficult to access over time, especially among younger individuals (Howe & O'Sullivan, 1997).

A recent theoretical perspective on children's memory, Fuzzy-Trace Theory (e.g., Brainerd & Reyna, 1990; Reyna & Brainerd, 1995), postulates developmental differences in the nature of stored event representations. Within the context of this framework, every experience is thought to result in the establishment of multiple, independent memory traces. These representations can be ordered on a continuum ranging from verbatim traces, which are fairly exact representations of specific aspects of the event, to more imprecise "fuzzy traces," which preserve only the gist of the experience. Although even young children can extract gist, they are biased toward encoding and retrieving verbatim traces until the early elementary school years. In contrast, whereas older children and adults also store verbatim traces, they are biased toward extracting gist. Because verbatim traces decay more rapidly than gist does, preschoolers demonstrate greater rates of forgetting than do older individuals.

Amount of Exposure

Variations in the frequency and duration of exposure to an event are associated with differences in the strength of the resulting memory trace. Thus, in the case of a single occurrence of an event, the longer the exposure time to relevant features, the stronger will be the resulting representation in memory. Traumatic events to which one is exposed only briefly may be exceptions to this rule because of their distinctiveness (Howe, 2000). Hence, aspects of unique, traumatic events may sometimes be well remembered (e.g., Bahrack et al., 1998), particularly when these experiences can be openly discussed (Fivush, 2000). Very young children may not have the requisite experience from which to construct a coherent representation of this type of event, however, (Bauer et al., 1998) and as a result, their recall may be more fragmented and less consistent than that of older children.

Another factor associated with greater trace strength is the repetition of an experience. All other characteristics being equal, repeated exposures to a stimulus will yield stronger representations and consequently better recall (Marche, 1999; Pezdek & Roe, 1995). Fivush and Hammond (1989), for example, exposed 2-year-old children to a novel laboratory play event, and provided half of the children with a reenactment of the play scenario after a delay of two weeks. Memory was assessed among all the participants 3 months after the initial visit through a reenactment of the previous playroom experience. The children who received the additional exposure to the event, in comparison to those who did not, demonstrated more recall at the final assessment. Similarly, Powell, Roberts, Ceci, and Hembrooke (1999) recently reported that children who experienced a repeated event were more accurate than those who were exposed to one presentation when memory for the components of the event that remained consistent across repetitions was examined.

Fuzzy-Trace theory provides an explanation for the beneficial effects of repeated exposure to events on memory among young children. When an event is repeated with some variation in details, multiple verbatim traces containing conflicting information are produced. Because the verbatim traces are now inconsistent, young children may be encouraged to rely more on gist traces. This can result in less forgetting because gist traces are maintained over longer periods of time than are verbatim traces (Powell et al., 1999).

It should be noted, however, that repeated exposures to an event can have negative as well as positive

effects on children's memory performance. Children who repeatedly experience an event form "scripts" (defined as generic representations of familiar events; Nelson, 1986) for the common features across the episodes. Scripts enhance recall for the general structure of the experience at the expense of memory for particular episodes of the event (Hudson, 1990; Powell & Thomson, 1997). Thus, recall of repeated experiences may represent the child's memory of what "usually happens" rather than the details of a specific episode. Powell et al. (1999), for example, found lower levels of recall for features of an event that varied across repetitions than for features that were consistent. Based on analysis of the patterns of the children's intrusion errors, they concluded that repetition may increase the likelihood of confusing what happened when.

Storage: The Status of Information in Memory Changes Over Time

Information that has been successfully encoded and stored in memory is not frozen. Rather, memory is subject to a number of important influences over time and the status of information in memory can be altered in the interval between the occurrence of the event and the memory "test." Stored information can be updated or modified, and the strength of the memory trace may increase or decrease. These changes can occur through several processes with potentially different consequences for the accuracy of children's subsequent reports. Both the passage of time and prior knowledge exert a substantial influence on the underlying memory representation. Moreover, children may be exposed to a variety of experiences in the time between encoding and recall, some of which act to strengthen memory, whereas others interfere with recall performance.

The Length of the Delay Interval

As discussed in the preceding section, memory traces can deteriorate over time. Accordingly, the more closely the interview or testimony follows the event, the greater the likelihood of obtaining accurate and complete accounts of the details of children's experiences. Unfortunately, it is common for child witnesses to provide testimony weeks, months, and even years after the events in question. Hence, the effects of the delay interval on event memory is an

important consideration in evaluating a child's capacity to testify.

Considerable research has shown that preschool children's recall of experienced events, both traumatic and nontraumatic, can be quite good even over relatively long periods of time (Bauer et al., 1998; Fivush & Hammond, 1990; Fivush & Shukat, 1995; Howard et al., 1997). Peterson and Rideout (1998), for example, demonstrated that children who were at least 26 months of age at the time of an accidental injury and visit to the emergency room, accurately recalled the details of these experiences even after a 2-year delay. Similarly, Schwarzmueller et al. (1996) found that 8-year-old children could accurately recall events that had occurred when they were as young as 3 $\frac{1}{2}$ years old. Despite this remarkable display of memory, there was evidence of forgetting over these long delays in each of these studies, consistent with forgetting curves that reflect children's memory in general (Kail, 1989; Schneider & Pressley, 1997). Moreover, others have documented that the younger the child the more vulnerable he or she is to forgetting over time (e.g., Baker-Ward et al., 1993; Brainerd, Kingman, & Howe, 1985; Goodman et al., 1990; Ornstein, Gordon, & Larus, 1992; Poole & White, 1993). The exception to this appears to be long-term memory for particularly distressful experiences. Peterson (1999), for example, found no age differences in forgetting for an accidental injury among 2- to 13-year-old children.

Prior Knowledge

In general, as the interval between encoding and retrieval increases, the memory trace becomes weaker, and it is increasingly likely that the information in memory will be altered as a result of prior knowledge. Research on scripts documents one way in which memory can change as a result of prior knowledge. As memory for a particular episode fades over time, children are likely to assume that what usually happens actually occurred in this instance. Myles-Worsley, Cromer, and Dodd (1986), for example, demonstrated that over a 5-year period, children's memories of events experienced in a preschool class increasingly came to be reconstructions involving a combination of actual remembered information and general knowledge about similar experiences. Thus, with the passage of time, the details of a particular experience may be forgotten and the information in memory altered to be more consistent with what a child knows usually happens. To the extent that the

particular episode is consistent with the script, the report may remain accurate although detail may be lost.

Such reliance on event scripts, however, can lead to inaccurate reports when a specific experience is inconsistent with general expectations for an event. Ornstein and colleagues (Ornstein, Merritt et al., 1998) examined children's memory for a specially designed pediatric examination, in which some typical procedures (e.g., checking the heart) were omitted and some novel components (e.g., measuring head circumference) were included. Few intrusions were observed at the initial interview; however, after a 12-week delay, the children in some conditions spontaneously reported more than 20% of the expected-but-omitted features, while reporting essentially no other type of false information. In this situation, the change over time in the children's accounts resulted in the inclusion of inaccurate information. Moreover, the falsely reported actions, because they were reported without prompting and included as much elaborative detail as the correctly reported components, met criteria for credibility (see Gordon & Follmer, 1994).

Changes in Knowledge and Beliefs

An additional type of change over time is observed when stored memories of past experiences become more consistent with individuals' current knowledge and beliefs. Knowledge gained at a later date (i.e., as a child develops and learns more about how the world operates) may influence recall long after the event in question has occurred (Ornstein et al., 1991). Similarly, individuals whose attitudes change through either natural or experimenter-provided experiences subsequently report their initial attitudes in a manner more consistent with their changed views (see Ross, 1989). In these cases, however, it must be recognized that what is remembered at a later time represents a reinterpretation of the information that was originally encoded into memory, and, as such, the details recalled may be substantially altered. Greenhoot (2000), for example, read kindergarten children stories that included ambiguous actions by a central character, and subsequently provided information about the character's typical behavior. Experimenter-provided information about a character's typical behavior affected kindergarten children's subsequent memory of ambiguous actions that occurred within a previously presented story. On

the basis of the new information, the children altered their previous reports of the story. Thus, it is possible that experiences intervening between young witnesses' experiences and their subsequent legal testimony could provide an interpretative context that might similarly alter recollections.

If memories can be altered through the provision of additional information, stereotyping can be expected to produce even stronger effects. Leichtman and Ceci (1995) found that children who often heard "Sam Stone" described as a clumsy person reported that he had broken the toys that were found to be damaged after he made a brief and uneventful visit to the classroom. Such reconstructive processes could obviously have negative effects on the accuracy of children's testimony. For example, young witnesses who are told that their help is needed in keeping a bad person from hurting other children (as occurred in the prosecution of Kelly Michaels; see Ceci & Bruck, 1995), may selectively interpret and report neutral information as consistent with the stereotype of the defendant as a "bad person."

It should be noted that the process of alteration to the stored representation could feasibly safeguard as well as threaten the accuracy of a subsequent report. For example, information encoded after an event could enhance a child's understanding of the experience by providing links between component features or by adding elaborative detail to the representation. This modified event representation might increase trace strength and could facilitate retrieval (see Baker-Ward et al., 1997).

Exposure to Misleading Information

Considerable research has demonstrated that individuals exposed to information that is misleading or inconsistent with their experiences during the interval between encoding and retrieval typically perform less well during memory interviews than do those who do not receive such information (e.g., Loftus, 1979; Loftus & Palmer, 1974; Principe, Ornstein, Baker-Ward, & Gordon, 2000; Roberts et al., 1997). Exposure to misleading information can occur during the course of memory interviews (in the form of suggestive or very specific questions), before the interview occurs (e.g., conversations with parents or other family members), or in-between multiple interviews (e.g., some therapeutic procedures, television news or newspaper reports, reading stories about similar events).

Despite the fact that almost everyone is to some extent vulnerable to this type of suggestion, preschool children have been consistently found to be more so than older children and adults (Ceci & Bruck, 1995; Bruck et al., 1998; Bruck, Ceci, Francoeur, & Barr, 1995; Loftus & Pickrell, 1995; Poole & White, 1993). Indeed, Leichtman and Ceci (1995) demonstrated that preschool children will provide elaborate details about things that did not happen when they are subjected to pre- and postevent suggestive information. Moreover, some children will hold to their misguided beliefs even in the face of attempts by parents and experimenters to convince them that these things never happened (Ceci, Huffman, Smith, & Loftus, 1994; Levine, Stein, & Liwag, 1999). Bruck et al. (1995) extended this work by showing that misleading information (i.e., the shot didn't hurt; the child didn't cry much) provided at the time of a physical examination, coupled with repeated interviews that contained suggestions consistent with the misleading information, led to changes in 5-year-olds' perceptions of how much a previous inoculation had hurt, how much they had cried, and who had administered the shot.

A variety of other factors have been shown to increase the tendency to alter children's reports and presumably their memory representations. The timing of exposure to misleading information is one example. Information that is inconsistent with the child's experience has been shown to be more detrimental to memory accuracy, in the absence of repeated suggestive interviews, when it is provided just before the memory interview rather than earlier in the delay interval (Marche, 1997; Warren & Lane, 1995). This reflects the fact that memories are more vulnerable to distortion when the memory trace has weakened with the passage of time. That is, it is easier to recognize and reject information that is inconsistent with our experiences when that information is provided more closely in time to the event in question. Indeed, the study by Ceci, Huffman et al. (1994) indicates that suggestibility effects increase over the course of interviews that are repeated over time.

A second factor that has been shown to increase suggestibility is the perceived authority or credibility (or both) of the person providing the misinformation. Children are more suggestible, for example, when the misleading information is presented by an adult, as opposed to another child (Ceci, Ross, & Toglia, 1987), when the adult is perceived of as being more rather than less credible, knowledgeable, or authoritative (Simpson & Guttentag, 1996; Templeton & Hunt,

1997; Tolia & Ross, 1991), and when the misleading information is provided by a familiar and trusted person versus a stranger (Jackson & Crockenberg, 1998).

To what extent do inaccuracies in children's reports stem from changes in stored memory representations following exposure to inconsistent information as opposed to compliance or other social demand characteristics? From the perspective of Fuzzy-Trace Theory, there is a cognitive basis for the persistence of false memories (Brainerd, Reyna, & Brandse, 1995). As presented in this framework, information about events is stored as both precise verbatim traces and as the gist of the experiences. Questions about events that actually occurred can cue the retrieval of verbatim memories, resulting in the definite recollection of having experienced the action in question. In contrast, children who incorrectly accept misleading questions (i.e., produce false alarms) are likely to have retrieved the gist of an action that is similar to that referenced in the misleading probe. A vague feeling of familiarity with the suggested action may result, because of some congruence between the gist trace and the information conveyed in the misleading question. As time passes and verbatim traces become inaccessible, memory-based false alarms may be as stable as correct responses. Hence, when misleading probes activate related gist traces, simply testing a child's memory can result in the creation of stable incorrect responses as well as the maintenance of correct responses. The persistence of incorrect responses in some circumstances raises doubts about the validity of the use of consistency across interviews as a criterion for credibility (Brainerd & Mojardin, 1998).

In a recent discussion of the underlying bases of suggestibility, Bruck and Ceci (1999) note that some cognitive distortion is likely, in light of developmental changes in basic memory processes. Further, they note that in several investigations, children have continued to provide false reports even when they are asked to substantiate their claims or are given an additional opportunity to respond correctly. They also note, however, that previous false memories tend to fade over time when the suggestions have ceased. Bruck and Ceci conclude by presenting the hypothesis that "... a more detailed inspection of children's responses over time will reflect a more complex condition with a comingling of social (compliance) and cognitive (memory) factors ... children may start out knowingly complying to suggestions, but with repeated suggestive interviews, they may come to believe and incorporate the suggestions with their memories" (p. 434). It is interesting to note

that recent research indicates that these "false memories" may not persist over very long periods of time. Huffman, Crossman, and Ceci (1997) reported that after a 2-year delay, children "recanted" previously established false memories 77% of the time, whereas they maintained accurate memories 78% of the time.

Retrieval: Retrieval Is Not Perfect

The final phase of the memory process involves retrieval of the stored information. An original assumption of the information-processing approach was that, if information entered long-term memory, it remained there permanently and could be retrieved at any time, assuming that an effective cue was present (Shiffrin & Atkinson, 1969). In contrast to this view, it now appears that some memories are at least temporarily unrecoverable in their original form. Some explanations for retrieval failures emphasize information-processing determinants of recall, including the organization of the event representation in memory and the absence of effective retrieval strategies. From this perspective, the child's role in a recall failure is passive; the lack of retrieval is attributed solely to the absence of the needed information-processing components. Other approaches focus on psychological processes that actively prohibit the retrieval of experiences associated with psychological distress.

Factors Associated With the Likelihood of Retrieval

Assuming that a representation of an event remains in memory, several major factors are important in determining whether the information will be reported during a memory interview. First, as noted earlier, the absence of an effective retrieval cue is a widely accepted reason for retrieval failure. An interviewer's questions can be seen as representing one type of retrieval cue. In order to be effective, a cue must be part of the context that was present at the time of encoding (Tulving & Thompson, 1973). The encoding context involves multiple dimensions, including information that was presented along with the target material, prior memories and knowledge that were activated during the encoding of the target information, the physical environment in which encoding occurred, and the individual's internal state at the time of encoding. As an example, simply being

interviewed in the room in which an experience took place, in comparison to being interviewed in a neutral location has been shown to increase 5- to 7-year-old children's recall (Priestley, Roberts, & Pipe, 1999, Experiment 1).

Another factor that influences retrieval is the extent to which the representations of aspects of the event are embedded in an extensive knowledge structure (Bjorklund, 1987). Such a knowledge structure is an important determinant of trace strength. In addition, when information is incorporated in a rich knowledge base, a greater number of cues are effective in activating the memory of the target material.

An additional influence on the likelihood of retrieval is the distinctiveness of the event under consideration (see Howe, 2000). Distinctiveness is defined as the extent to which to-be-remembered information stands out from a background context. When one item in a list of to-be-remembered words represents a different semantic category than the remaining items, for example, the distinctive item is memorized more quickly and retained longer than the others. This phenomenon, which has been studied extensively in adults, is described as the von Restorff Effect. Howe argues that distinctiveness is equally important in natural environments, although this phenomenon is difficult to investigate in a controlled manner. In an extensive investigation of 2- to 13-year-old children's memory for an injury and resulting hospital treatment, Peterson (1999) provides evidence for the importance of distinctiveness in memory. Two years after the event, the children recalled more details regarding the injury than the treatment. Peterson noted that the majority of the children had visited the emergency room on multiple occasions, and argues that the uniqueness of the injury contributed to the greater recall of this component of the event, as compared with the emergency room procedures.

Finally, the extent to which children can use retrieval strategies, defined as planful operations used to access stored information (Schneider & Bjorklund, 1998), affects the likelihood of recall. As reviewed by Schneider and Bjorklund, the ability to actively search the long-term memory store effectively develops relatively late in childhood. Hence, preschoolers and even younger elementary school-aged children cannot be expected to spontaneously use retrieval strategies in recalling experiences, and their reports may consequently provide a real underestimation of what they know about an event. To some extent, an effective interviewer may compensate in part for this develop-

mental limitation by providing young witnesses with specific directions for searching their memories (see Fisher & Geiselman, 1992).

Hidden Memories of Childhood Abuse

An emotionally charged controversy surrounds the possibility that childhood sexual abuse may not be recalled because of the operation of psychological defense mechanisms and that the memories may be subsequently recovered during psychotherapy or in the context of other experiences (cf. Alpert, Brown, & Courtois, 1998; Ornstein, Ceci, & Loftus, 1998). A full discussion of this complex issue is well beyond the scope of this paper (for reviews, see Pope & Brown, 1996; Putnam, 1997; Roediger & Bergman, 1998). It should be noted, however, that children's responses to painful experiences have clear implications for information-processing, regardless of whether or not the concept of psychological repression is accepted. Dissociation (i.e., isolating the self from a painful thought or experience) is very common among children, particularly preschoolers, and is thought to be an adaptive mechanism for coping with stress. To the extent that this distancing curtails the encoding of an experience, memory failures can result (Eisen & Goodman, 1998). In this instance, components of the event simply do not exist in memory. Dissociation could also limit access to representations that exist in memory and are hence potentially retrievable. This could arise if memories for traumatic experiences exist as relatively isolated representations (for example, because memories for the traumatic experience are not linked to other memories involving the critical components of the event) and hence the number of cues that can gain access to the representation is reduced.

In contrast to dissociation, Eisen and Goodman (1998) suggest that it is also possible that individuals may banish memories of threatening experiences from consciousness after they have been encoded. Because the memory was actually encoded in these instances, it is possible that it may be subsequently retrieved when the appropriate cues are presented. Hence, adults who have "repressed" painful memories may be stimulated to recall the childhood trauma when they encounter a related experience, perhaps one associated with rearing their own children. It is important to note, however, that adults can be induced to construct pseudomemories of events that did not

occur (Loftus, 1993), and the risk of this happening when suggestive “memory recovery” techniques (e.g., hypnosis, guided imagery, journaling) are used is very high (see Lindsay & Read, 1994, for an analysis of the therapeutic practices that are most likely to result in the generation of such pseudomemories).

Despite many areas of disagreement about hidden memories of early trauma, the APA Working Group on Investigation of Memories of Childhood Abuse (1998), a group of psychologists representing widely disparate positions on the issue of hidden memories of early trauma, outlined the following areas of agreement: (1) Most people who were abused as children remember all or at least part of what happened to them; (2) It is possible to remember instances of abuse that have been forgotten for a long time; (3) It also is possible to construct convincing pseudomemories of things that did not occur; and (4) There is much yet to be learned about the process of remembering childhood trauma.

Retrieval: Not Everything That Can Be Retrieved Is Reported

Even when information can be retrieved from memory, it may not always be reported. Children of elementary school age may be hesitant to disclose actions they associate with embarrassment or shame (Saywitz et al., 1991). Preschoolers’ reports also may be constrained by the desire to avoid disclosing uncomfortable experiences. In addition, developmental limitations and individual differences among children in such areas as language, temperament, emotional status, and intelligence can influence the reporting of information during an interview (Saywitz, in press), particularly among preschool children. Hence, in the absence of optimal interviewing, younger children’s reports can underestimate the amount of information they may have in memory. Moreover, differences in interviewer behavior and the context of the interview itself also affect the accuracy and completeness of children’s memory reports (Ceci & Bruck, 1995; Poole & Lamb, 1998).

Language Development

A child’s level of language competency, at the time of both encoding and retrieval, can have an important impact on memory performance, particularly that of the preschool child (Saywitz, in press;

Walker & Warren, 1995). With increases in age, there are corresponding changes in the ability to use narrative structure to report what can be remembered (Mandler, 1990). It is likely that some of the age-related improvement in children’s recall (as discussed earlier) stems from these increases in narrative skill (Peterson & Rideout, 1998).

Because preschool children’s limited verbal skills are reflected in their difficulty in reporting all of the information they may remember, efforts have been made to enhance their reports through the use of dolls or other props. The results of this research have been consistent in indicating that the use of these types of contextual supports is not effective in improving the accuracy of children’s memory reports (Gordon et al., 1993; Greenhoot, Ornstein, Gordon, & Baker-Ward, 1999; Steward & Steward, 1996). Indeed, Bruck et al. (1995) found that using anatomically detailed dolls to interview 3-year-olds about a physical examination resulted in greatly increased false reports of genital touching and other inappropriate sexual actions. Similarly, Goodman et al. (1997) reported that use of dolls and other props increased inaccuracy among younger children. They also found, however, that use of dolls elicited more correct information than did free recall among older children (see also Gordon et al., 1993).

Children’s level of language competency also can affect their ability to understand and respond to the syntactic constructions, or the vocabulary (or both) used by interviewers (Carter, Bottoms, & Levine, 1996; Saywitz, Nathanson, & Snyder, 1993). Children may not be aware of when they do not understand complex questions and typically do not report these comprehension failures (Carter et al., 1996). Yet, children usually try to answer any question, even those they do not understand. As Saywitz and colleagues (Saywitz & Snyder, 1993; Saywitz et al., 1993) point out, children may think that they understand a term when, in fact, they do not (e.g., allegations = alligators). Saywitz and Snyder (1993) demonstrated that school-age children can be trained to monitor their comprehension of complex questions and indicate when they do not understand. This work and that of others (e.g., Gee, Gregory, & Pipe, 1999) indicates that preinterview training designed to discourage guessing and compliance can successfully enhance the memory performance of trained school-aged children as compared with untrained children. The extent to which this type of training is effective for preschool children is not yet known, however.

Personality/Temperament Characteristics

Individual differences in temperament have been shown to influence children's recall performance. Gordon et al. (1993), for example, found that children who were more at ease in new situations (adaptability) than were their peers provided more information, both verbally and nonverbally, about a physical examination. Similar findings were reported by Merritt et al. (1994) in their study of young children's recall of the details of an invasive radiological procedure. In this study, both adaptability and the tendency to approach others (as opposed to withdrawal or shyness) were found to correlate strongly with recall. It is likely that these and other personality characteristics interact with the interview setting and process to influence recall performance. That is, children who are more outgoing and adaptable adjust better to being interviewed and, as a result, are able to retrieve more information from memory. Further, it seems reasonable to expect that the performance of younger children would be more affected by temperament than that of school-aged children, who have had extensive experience with structured settings that require them to regulate their behavior.

Another individual difference variable that may affect memory performance is suggestibility. There is some evidence that suggestibility may be viewed as a personality "trait" rather than a solely developmental factor (Clarke-Stewart, Thompson, & Lepore, 1989). In almost all studies of suggestibility, a substantial proportion of even the youngest children do not report false information. In the study by Leichtman and Ceci (1995), for example, even under the most suggestive conditions one quarter of the 3- to 4-year-olds and two-thirds of the 5- to 6-year-olds resisted suggestion.

Research conducted by Candel, Merckelbach, and Muris (2000) suggests that individual differences in suggestibility can be reliably measured in children. Using the Bonn Test of Statement Suggestibility, they found that younger children had higher suggestibility scores than did older children. Moreover, within age groups, children who were judged by their teachers as being more suggestible had higher scores than did those who were judged to be not particularly suggestible. Similarly, using the Gudjonsson Suggestibility Scale (Gudjonsson, 1989) to measure individual differences in interrogative suggestibility, Richardson and Kelly (1995) found that suggestibility was significantly negatively correlated both with

intelligence and recall performance in 10- to 16-year-old boys.

The challenge for researchers is to begin to identify those characteristics that distinguish children who are more suggestible from those who are not. Work in this area has just begun (e.g., Goodman & Quas, 1997; Ornstein et al., 1997; Quas, Qin, Schaaf, & Goodman, 1997) with a focus on cognitive factors such as event knowledge and source monitoring abilities, and social/emotional variables including attachment styles, self-esteem, parenting styles, and the presence or absence of psychopathology. Children with high self-esteem, for example, have been found to be more resistant to misleading or suggestive questions when compared with those with lower self-esteem (Howie & Dowd, 1996; Vrij & Bush, 2000). Other work indicates that self-esteem may interact with the age (or cognitive developmental level or both) of the child in determining individual differences in suggestibility. Preschool children, who do not yet have a well developed sense of self, may be more influenced by developing cognitive abilities, such as the ability to distinguish the sources of their memories and to simultaneously consider more than one aspect of a problem, than by self-esteem. In contrast, self-esteem may play a more important role in individual differences in suggestibility among older children (Mazzoni, 1998; Muir-Broaddus, King, Downey, & Petersen, 1998; Welch-Ross, Diecidue, & Miller, 1997). Indeed, it may be that individual and age-related differences in these basic cognitive abilities underlie the increased susceptibility to suggestion that is consistently found among preschool children (Templeton & Wilcox, 2000)

Cognitive Factors

As children develop, they learn strategies for organizing material and retrieving it from memory. As a result, their narrative accounts of *who*, *what*, *why*, *where*, and *when* become more detailed, organized, and coherent. In addition, as children learn how narratives are structured, they are better able to retrieve specific information about an event, such as its setting, participants, conversation, affective states, and consequences (Mandler, 1990; Saywitz et al., 1993). On a very basic level, it is not surprising that intelligence is associated with the ability to provide reliable and accurate testimony (Geddie, Fradin, & Beer, 2000; Michel, Gordon, Ornstein, & Simpson, 2000; Richardson & Kelly, 1995).

A particularly interesting cognitive factor that contributes to individual differences in suggestibility is the ability of children to distinguish the sources of their memories, called source monitoring. As Ceci and Huffman (1997) point out, memories of our experiences potentially come from a variety of sources (e.g., thinking, talking, hearing, and reading about the event, as well as seeing it, participating in it or doing both). If children are not able to differentiate among these various sources of information, they will be more susceptible to error and suggestions, possibly misattributing information obtained from other sources to their actual experience. Considerable research has examined this topic and some consistent findings have emerged. Preschool children, for instance, have particular difficulty with most aspects of this cognitive task, whereas school-aged children are able to distinguish what they said from what someone else said (Foley, Johnson, & Raye, 1983), and what they did from what someone else did (Foley & Johnson, 1985). However, these older children do not perform as well as adults in distinguishing memories of activities they performed from those that were imagined (Foley & Ratner, 1998).

The Memory Interview

Just as children must be able to understand the questions asked, their memory performance also requires some comprehension of what is required in the interview process itself (Poole & Lamb, 1998). As an example, Steward and Steward (1996) found that many children in their study of memory for a medical examination, did not understand what they were supposed to talk about until the researchers explicitly told them. Children also may switch the topic of conversation in the middle of an interview, without warning and unbeknownst to the interviewer (Poole & Lindsay, 1996). Furthermore, when interviews are repeated, children may assume that the interviewer already knows the answers to the questions, and so may fail to provide sufficient information for the interviewer to make sense out of the response (Saywitz, 1995). These characteristics of children's "interviewee" skills can easily lead to misinterpretation of the child's statements, and may also contribute to the lack of consistency that is often noted in the reports of young children (Fivush & Hammond, 1990; Gordon & Follmer, 1994).

Many aspects of the memory interview have been shown to influence the accuracy and completeness of

children's retrieval. Research has examined ways to improve testimony by enhancing children's skills in effectively retrieving information from memory, and by changing interviewers' behaviors to minimize bias and hence to reduce suggestibility. In an attempt to compensate for children's lack of understanding of the interview process, research has focused on incorporating metacognitive factors into training programs designed to maximize the recall of children (Fisher & McCauley, 1995; Gee et al., 1999; Saywitz, 1995). Preinterview training in providing the types of information and the level of detail required for a forensic interview, in resistance to misleading questions, and in comprehension monitoring has been shown to improve the performance of school-aged children (Saywitz & Snyder, 1993) but not that of preschool children (Robinson & Briggs, 1997).

Fisher and McCauley (1995) describe a procedure called the Cognitive Interview that was designed to increase the completeness and accuracy of eyewitness reports (see Poole & Lamb, 1998 for a complete description of this procedure). The Cognitive Interview has been demonstrated to substantially improve the eyewitness accounts of adults when compared with a standard police interview (e.g., Fisher, Geiselman, Raymond, Jurkevich, & Warhaftig, 1987). Modifications to the Cognitive Interview format have been made to accommodate the special needs of children and use of this modified version has been shown to improve memory reports of school-aged children (McCauley & Fisher, 1995) and children with mental retardation (Milne & Bull, 1996). Despite the documented effectiveness of the Cognitive Interview over other methods, Poole and Lamb (1998) argue for caution in its use in forensic interviews with children where it is not possible to know precisely what a child experienced. This caution stems, in part, from the component of the interview that asks the child to visualize the context of his or her experience. Poole and Lamb argue that the act of visualization may result in false memories among children, a problem for which Ceci, Loftus, Leichtman, and Bruck (1994) provide compelling empirical evidence. It remains to be seen whether the Cognitive Interview is effective with preschool children.

The most important determinant of the success of the interview is the behavior of the individual conducting the interview. Children's acquiescence to interviewers' suggestions is a well-documented phenomenon (see Ceci & Bruck, 1993, 1995, for reviews). Although it is clear that younger children are particularly vulnerable to misleading or suggestive

questions, especially under conditions in which the power of the interviewer is asserted, the mechanisms underlying suggestibility remain in question.

One critical way in which interviewers influence children's reports is the extent to which they are biased. Interviewers who hold strong beliefs about what they think happened can influence children to provide memory reports that are consistent with these beliefs, regardless of the fact that these beliefs may be wrong (Bruck et al., 1998; Ceci & Huffman, 1997). According to Bruck et al. (1998), biased interviewers potentially influence children's reports in several ways. These include (1) failure to pursue alternative explanations for a child's statements; (2) use of selective attention to and reinforcement of responses that are consistent with their a priori beliefs; (3) failure to explore children's inconsistent or bizarre statements; (4) overuse of specific or leading questions aimed at confirming the interviewer's hypothesis; (5) introducing information about the suspected perpetrator that portrays him or her in a negative way; (6) inappropriate use of anatomically detailed dolls or other props; and (7) inappropriate use of guided imagery or memory work.

In a study demonstrating the powerful impact of interview bias, Ceci and his colleagues (White, Leichtman, & Ceci, 1997) provided an experienced interviewer with information about an event experienced by 3- to 4-year-old and 5- to 6-year-old children. Some of this information was accurate and some was not. When the children were interviewed 1 month later, 34% of younger children and 18% of the older children confirmed the false information. Two months later, the notes of the first interviewer were given to a second individual and the children were reinterviewed. At this time, the children not only continued to consent to false information but did so with increased confidence and embellishment. Another example of interviewer bias is provided by a study reported by Roberts and Lamb (1999) in which transcripts of actual investigative interviews with 3- to 14-year-old children who had made allegations of sexual or physical abuse were analyzed. Roberts and Lamb found that interviewers often distorted the details provided by the children. Moreover, the children rarely corrected these distortions and when they were not corrected, the interviewers continued to misrepresent the details throughout the remainder of the interview. Other work suggests that social pressure (e.g., asking children to endorse their peers' disclosures, inviting speculation, repeating previously answered questions) and selective reinforcement may have a

greater impact on children's suggestibility than simply asking misleading or suggestive questions (Garven, Wood, Malpass, & Shaw, 1998).

Repeated Interviews

In the absence of suggestive questions or misleading information, multiple interviews can have both positive and negative effects on memory performance. On the positive side, repeated interviews can sometimes enable the child to recall information not recalled earlier (Gordon & Follmer, 1994) and under some conditions may "innoculate" the child against forgetting (for reviews, see Poole & White, 1995; Warren & Lane, 1995). In some sense, then, repeated interviews may serve to maintain information in memory, in a process that is analogous to the construct of "reinstatement" by Campbell and Jaynes' (1966). For Campbell and Jaynes, partial repetitions (e.g., repeated interviews) of an initial event during a delay can serve to reinstate information that ordinarily would be forgotten. Peterson's (Peterson, 1999) study of children's memory for accidental injuries indicates that the reinstatement effect may be particularly beneficial when the information to be remembered is less "memorable," whereas there may be little effect for highly salient material.

Other research suggests that more than just simple repetition is necessary to reinstate memory. Poole and White (1995), for example, state that the timing and number of repeated interviews may be important in determining their effects. It is possible that an interview carried out immediately after the event in question may be more effective in maintaining memory than one that takes place some time later, particularly if the retelling of the event involves the opportunity to consolidate one's understanding of the event. Indeed, this may explain why Peterson (1999) found that children's memory for a traumatic injury was so well maintained over a 2-year period. In her study, parents reported many conversations about the injury with grandparents, other relatives, and friends immediately after the injury. Peterson argues that traumatic events become part of the child's and family's "life story" and as such are typically discussed at length immediately after the event, essentially providing a reinstatement of the features of the experience. In contrast to these positive effects, Warren and Lane (1995) argue that with multiple interviews over time, errors made at one time are likely to be repeated at a later time, intrusion errors are more likely, and guesses or

speculation that occur during an early interview tend to be incorporated into memory as fact in subsequent interviews. Brainerd and Reyna (1996) found that even a single interview consisting of specific yes/no questions that occurred immediately after an event resulted in false memory responses on delayed tests among 5- and 8-year-olds. Further, Ceci et al. (1994) found that merely asking preschool children to think about whether or not both true and false events had ever happened led to increased claims over the course of 11 nonsuggestive interviews that the children had experienced events that had never happened. Moreover, over time the children provided increasingly detailed and coherent narratives describing these false events. Ceci et al. suggest that these children actually came to believe they had experienced these false events, that is that the false events became part of the children's memory system. Evidence for this assumption was provided by the experimenter's inability to "debrief" the children about the fact that the events never happened. It should be noted, however, that in a follow-up investigation 2 years later, the children "recanted" their earlier false reports more than 77% of the time while maintaining high levels of assents to questions about true experiences (Huffman et al., 1997). The authors interpret the findings as suggesting that false memories, which are not elaborated through family discussions and other naturally occurring interactions, may fade in the absence of repeated questioning.

One of the purposes of conducting multiple interviews in legal cases involving children is to give children the opportunity to disclose information or experiences that they might be reluctant to discuss. Indeed, considerable work has documented that children often provide more details or new information when repeatedly interviewed. Unfortunately, it is also true that children provide more false or inaccurate information at later interviews (Bruck, Ceci, & Hembrooke, 1997; Salmon & Pipe, 1997). Further, if misleading or suggestive information is introduced during the course of any one of multiple interviews, this information may become an actual part of the individual's memory for the event (Bruck et al., 1995). Bruck et al. (1997) provide compelling evidence that repeated suggestive interviews lead children to provide more complete, elaborated, and spontaneous descriptions of events that never occurred and that these descriptions can be indistinguishable from those regarding experiences that the children actually had.

The Interview Context

Another aspect of the memory interview that has been shown to influence children's reports is the setting or context of the interview. Peters (1991), for example, suggests that a stressful, potentially confrontational interview can result in impaired performance. Saywitz and Nathanson (1993) demonstrated that children's perceived stress while being interviewed in a mock courtroom interfered with their recall. Thus, simply making the child feel comfortable and at ease during the interview can facilitate retrieval by reducing the child's level of stress (Goodman, Bottoms, Schwartz-Kenney, & Rudy, 1991; Hovde & Strapp, 1999). Poole and Lamb (1998), however, point out that when working with young children, it is not always easy to balance the competing demands of the investigative interview. Reducing the child's stress, for example, can involve provision of age-appropriate toys or activities, which may interfere with the need to maintain the child's focus of attention on the task at hand and the gathering of objective, reliable information.

SUMMARY AND IMPLICATIONS FOR FUTURE RESEARCH, CLINICAL PRACTICE, AND PUBLIC POLICY

The preceding review of the memory research leads to several general conclusions regarding children's ability to remember their experiences and provide accurate and reliable eyewitness testimony:

1. Even very young children remember past experiences over very long periods of time, particularly when they have some prior knowledge of the events in question.
2. When they are interviewed in a nonsuggestive, nonleading manner and are not exposed to misinformation, children older than age 3 can provide reasonably accurate and relatively complete accounts of these experiences.
3. There are robust age differences in children's abilities to provide eyewitness testimony that most likely reflect developmental changes in cognitive and metacognitive functioning. In general, school-aged children provide more accurate information, are more consistent, and require fewer specific prompts in recall when compared with preschoolers. Moreover, older children are less vulnerable

to the effects of misinformation than are their younger peers.

4. Children can be influenced in a variety of ways to provide complete and elaborated narratives about experiences that did not occur to such an extent that experts cannot tell these false reports from those that are true. It is suspected that many children actually come to believe that these false events really did occur.

Directions for Future Research

Despite the large volume of research on children's testimony that has appeared in the past 20 years, important questions remain to be addressed, especially in the broad area of individual differences. Research is needed to identify how individual differences in specific cognitive and social/emotional domains influence children's performance at all phases of the memory process. For example, differences in how children cope (e.g., active vs. avoidant styles) with stressful experiences may play a role in the amount and type of information that is encoded and thus, what is recalled at a later time. Specifically, the use of dissociation as a coping strategy among children warrants further investigation. Are some children more prone to use this method of coping than are others? Do dissociation and other styles of coping result in systematic memory failures?

Research also is needed to delineate the specific characteristics that distinguish children who differ in their vulnerability to suggestion, especially those within the same age groups. Although we know that preschoolers are more suggestible than are school-aged children, for example, any individual 4-year-old may be more or less vulnerable to incorporating inconsistent information into his or her report than are age peers. Further, it is particularly important to begin to understand the unique characteristics of children who have been abused and the impact these characteristics might have on the memory process. Abused children are more likely to be emotionally distressed, to have low self-esteem, to come from dysfunctional families, and to experience considerably more chronic life stress than are nonabused children. Research could help to determine what role, if any, these factors, as well as others, play in increasing a child's vulnerability to memory distortion.

Although the study of individual differences is of interest in its own right, this research also can in-

form clinical practice in important ways. For instance, research in this area might lead to the development of instruments designed to assess the relevant characteristics and abilities of individual children prior to conducting a forensic interview. The results of such assessment could then aid in the interpretation of the child's report.

Implications for Clinical Practice

The memory research reviewed raises several issues regarding clinical practice that merit some discussion. First, guidelines for interviewing young children that take into account many of the preceding research findings have been proposed (American Academy of Child and Adolescent Psychiatry, 1997; Lamb, 1994; Poole & Lamb, 1998). These guidelines spell out methods for conducting an appropriate forensic interview that are well accepted. For example, most people understand the importance of relying primarily on open-ended rather than specific questions, conducting the interview as quickly as possible, and minimizing the possibility of repeated interviews. What is not clear, however, is to what extent individuals who conduct these interviews are able to follow the published guidelines during the course of an actual interview. Perhaps the next step in the process of developing a "technology of interviewing" is to produce structured interviews such as those used in the diagnosis of child psychopathology. Although structured interviews have many disadvantages, this type of interview would allow systematic incorporation of questions designed to explore alternative explanations for the child's allegations. Moreover, the accuracy of information obtained through use of a structured interview could be tested against other interview methods (see for example Michel, 2001).

Second, it is not clear that the results of research on children's testimony are filtering down from the laboratory to clinical and legal professionals on the front lines of interviewing children. Researchers must view dissemination of their findings as one extremely important aspect of their work. Clinicians can be taught to use the research findings to analyze and evaluate the facts of individual cases according to the specific aspects of memory research that are most relevant. In one case, for example, issues of source monitoring might be important, whereas in another, negative stereotyping might have influenced the child's report. Evaluation of a child's allegations

should include detailed examination of all occasions during which the child was asked to discuss the events in question, including those in informal settings (e.g., with parents or other family members), particularly when these discussions preceded the forensic interview. Given that memory is a constructive process, the most reliable piece of "data" available to the clinician is the child's first report of his or her experiences. Hence, detailed information (e.g., what was said, to whom it was said, whether it was spontaneous or prompted, and the context of this conversation) should be gathered regarding the circumstances surrounding this report. This type of analysis ensures that the clinician's ultimate judgment as to if or by whom a child has been abused, or both, is based on systematic review of all the possibilities.

Third, although aspects of traumatic experiences may remain vivid in memory because of their distinctiveness, it is important for clinicians to understand that these memories are subject to the same reconstructive processes as are memories for everyday experiences. Hence, the risk of creating false memories through suggestive questioning, biased interviewing, the use of certain therapeutic techniques such as hypnosis and repeated visualization, or a combination of these, is great (Lindsay & Read, 1994). Because there is no reliable method for distinguishing "true" from "false" memories in the absence of external corroborative evidence, clinicians who work with clients (both adults and children) whose symptoms or allegations suggest the possibility of childhood trauma are urged to exercise great caution in pursuing this possible interpretation. Explanations for the symptoms or allegations other than abuse should always be examined. Moreover, clinicians should inform their clients of the possibility of false memories.

Fourth, it is evident that interviewing children who are alleged to have been abused is a very complex endeavor, requiring highly skilled professionals. The need for training should be obvious. Unfortunately, there is little evidence that even the most intensive training programs have much effect on the behavior of interviewers in the long term (Aldridge & Cameron, 1999; Warren et al., 1999). Research is needed to determine the most effective methods for training and providing ongoing supervision of potential interviewers. It is possible that training potential interviewers before they begin to practice and become "set in their ways" would be more effective than retraining experienced interviewers. Moreover, ways of maintaining training effects over the long term must be examined.

These might include "booster sessions," provision of ongoing supervision, or both.

Finally, given that it is so difficult to change the behavior of experienced interviewers and in light of the possibility of the generation of false memories, it is critical that all interviews with potential child witnesses be recorded. There is considerable controversy about the issue of recording interviews, and many clinicians are resistant to doing so for fear that their interviewing skills will be "dissected" in court. It is only by having a concrete record of the interview, however, that the child's responses can be evaluated in light of the prompts used by the interviewer to elicit them. Videotape recording is particularly important to evaluate subtle interviewer behaviors, such as differential reinforcement or systematic ignoring of information reported, that have been shown to contribute to children's false statements.

Some Policy Implications

Researchers clearly have a role in influencing legislation that determines how child witnesses will be handled in legal proceedings. Although some important steps have been taken, much remains to be done. For example, having a child appear in person to testify can be an advantage or a disadvantage, depending on the circumstances of the case and whether one is the prosecutor or defense attorney. Consider, for example, the case of a child who was alleged to have been abused at age 5, but does not appear in court to testify until age 10. Because changes in the child's developmental/cognitive status and the potential for events that influence the child's memory during the 5-year interval are enormous, the quality and perceived credibility of this child's testimony would clearly be different if she had testified at age 5. The research reviewed above suggests that a videotaped interview made when the child was 5 years old would provide a better, more accurate means of having the child testify than having the 10-year-old appear in person. Moreover, young children often have difficulty providing adequate testimony because of the surroundings in which they are asked to do so. A videotape record made in a more comfortable, child-friendly setting would provide better information in many cases.

A related concern is the use of expert witnesses in legal proceedings (see Ceci & Hembrooke, 1998, for a review). In the past, experts have become caught in the adversarial process that often characterizes legal

proceedings with the result that it is becoming increasingly difficult to get researchers to agree to perform this function. Ideally, experts should be able to function as "friends of the court" rather than being forced to align themselves with the prosecution or defense. The expert's responsibility then becomes to inform or educate the jury about the relevant aspects of memory research. As an example, in the case described earlier, the videotape recording of the 5-year-old's interview might have been completed several months after the initial allegations came to light. During this time, numerous things with the potential to interfere with the accuracy of the child's report could have occurred. The role of the expert would be to describe for the court the aspects of the memory process that would enable the jury to better evaluate the child's videotaped testimony.

Although continuing research is needed to build a knowledge base that can more fully inform practice, the existing literature represents significant advances in the understanding of children's testimony over the past decade. At present, the empirical work on children's reports of personally experienced events succeeds not only in describing age-related changes but in identifying some causal explanations for developmental and situational differences in performance as well. A major challenge for psychologists, including both researchers and clinicians, is to utilize this knowledge more fully. Collaboration within the profession is needed to apply and disseminate existing findings as well as to design further investigations that can effectively inform practice. This work can help to optimize children's participation in legal proceedings.

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