

Memory Development

The overview that follows is offered to help the trier of fact understand how memory changes across childhood. It does not attempt to be exhaustive. Its purpose is to define the terms a court is likely to encounter and to summarize, in plain language, the principal findings on which testimony about memory development rests.

Memory begins to develop visibly within a child's first two to three years, a period in which children make substantial gains in declarative memory — the memory for facts and events that can be consciously brought to mind. Those gains do not stop in early childhood; short-term memory, working memory, long-term memory, and autobiographical memory all continue to mature through adolescence (Siegler, 1998).

Some forms of declarative, or explicit, memory appear earlier than was once assumed and can be detected in infants well under two years of age. Newborns less than three days old, for example, already show a measurable preference for the sound of their own mother's voice, indicating that some encoding occurs even before birth (DeCasper & Fifer, 1980).

Cognitive Neuroscience of Memory Development

Declarative memory advances quickly across the first two years of life, alongside broader cognitive gains in attention, language, and general knowledge. The brain systems that support explicit and implicit memory, however, mature on different timetables. Implicit memory — the unconscious memory expressed in skills and habits — relies on structures that come online very early, including the striatum, cerebellum, and brain stem, which together support implicit learning (Schacter & Moscovitch, 1984).

Explicit memory depends on a separate system that matures later, reaching a functional level somewhere between roughly eight and ten months of age. That system is anchored in the medial temporal lobe, particularly the hippocampus and the surrounding parahippocampal cortex. Much of this circuitry is in place before birth, although it continues to develop afterward: at birth the dentate gyrus of the hippocampus contains only about seventy percent of the cells it will have in adulthood (Richmond & Nelson, 2007).

During the first year, the axons of the central nervous system undergo rapid myelination — the insulating process that speeds the transmission of neural signals. This increase in processing speed helps explain why older infants process information more quickly than younger ones (Webb, Long, & Nelson, 2005).

Working Memory

Working memory is the system that holds and manipulates information over short intervals while a task is underway. In the influential model proposed by Baddeley and Hitch, it has three components. The central executive directs the system, governing attention, the control of action, and problem solving. The phonological loop holds and rehearses verbal and acoustic material. The visuospatial sketchpad holds visual and spatial material. The central executive works closely with both of the other components, while the phonological loop and the sketchpad operate largely independently of each other. Across development, working-memory performance rises in a roughly linear fashion from about age four into adolescence (Baddeley & Hitch, 1974).

Central Executive

In children younger than about four, a limited storage capacity constrains the more demanding forms of comprehension, because so much of the available capacity is consumed by the processing itself. As children mature, familiar operations require less effort, freeing capacity that can then be devoted to holding information in mind (Gathercole, 1998).

Phonological Loop

Performance supported by the phonological loop also climbs steadily from about age four through adolescence. Before roughly age seven, children's immediate verbal recall is mediated by the phonological store without deliberate rehearsal; young children do not yet silently repeat material to keep it active and instead tend to rely on the visual features of what they are trying to remember. Two observations make this clear: younger children show no outward signs of rehearsal, such as lip movement, and they show no advantage for short over long words when given nameable pictures. Around age seven, children begin to

use subvocal rehearsal to hold material in the store, and as development continues they increasingly recode non-auditory material into a phonological form the loop can maintain (Gathercole, 1998).

Visuospatial Sketchpad

Children under about five rely more heavily than older children or adults on the visuospatial sketchpad to hold visual material in mind. Older children begin to recode pictures into words where they can, recruiting the phonological loop to assist on tasks that appear, on their face, to be purely visual. Visual memory span grows considerably between the ages of five and eleven, by which point performance approaches adult levels (Gathercole, 1998).

Long Term Memory

Explicit memory improves markedly over the course of development. Implicit memory, by contrast, changes comparatively little with age — likely because it rests on more basic processes than declarative memory and is therefore less sensitive to a child's expanding cognitive abilities.

Pre-school Children

Even very young infants organize experience into categories. By around seven months, infants can distinguish broad categories such as animals and vehicles, and somewhat older infants can tell apart objects belonging to different settings, such as a kitchen and a bathroom (Mandler, Fivush, & Reznick, 1987). Crude though these early concepts are by adult standards, they support meaningful distinctions and lay a foundation for later knowledge, helping to organize information in storage and to shape how new information is encoded. By sixteen months, infants can draw on semantic knowledge to generalize and to make inferences; by twenty-four months, toddlers can use such knowledge to acquire and retain new information, and can lean on their grasp of how events ordinarily unfold to recall a sequence of events.

What matters for retention is not the sheer amount of knowledge but how well that knowledge is organized: information that is more cohesive and more richly elaborated is remembered better. Familiarity and repeated experience likewise shape how information is stored, for preschoolers and older children alike (Fivush, Gray, & Fromhoff, 1987). Children who lived through an event twice, for instance, recalled it better three months later than children who experienced it only once, and their recall at three months was as good as the once-exposed children's recall at two weeks.

School Age Children

Much of the difference in memory between younger and older children traces to the growth of their underlying knowledge base. What a child already knows affects what the child encodes, how that information is organized, and how readily it can later be retrieved; the richer the relevant background knowledge, the better new information is remembered (Fivush, Gray, & Fromhoff, 1987). Because older children generally know more, they outperform younger children on most memory tasks. Tellingly, when the familiarity and meaningfulness of the material are held equal across ages, the developmental gap in memory performance largely disappears.

Two further developments drive age-related gains in memory, especially in the later childhood years: children's growing use of deliberate memory strategies and the maturation of their metamemory — their understanding of how their own memory works (O'Sullivan & Howe, 1998). Knowledge aids memory by easing retrieval, by allowing activation to spread among related items, and by supporting the use of strategies, and it provides the elaboration that strengthens how information is stored.

Episodic Memory

By school age, the typical child can recall the details of past experiences and arrange them into a coherent narrative. Memories formed at this age and later are more likely than earlier memories to endure and to be recalled in adulthood. Younger children can sometimes hold onto information from a particular episode for very long periods, but what a child of a given age will retain over a given interval is difficult to predict, depending on the nature of the event and on individual differences such as the child's gender, language ability, and the way parents talk with the child about the past (Fivush, Gray, & Fromhoff, 1987).

Autobiographical Memory

How much a child can later recall of a personal experience depends heavily on the child's age when it occurred. One- and two-year-olds can remember personal events, but typically only in fragments when asked about them months later. Even so, two-year-olds do form autobiographical memories and can retain them across periods of several months or more (Fivush, Gray, & Fromhoff, 1987).

Assessing memory in very young children is complicated by their limited language, because memory is usually measured through verbal report. It is often unclear whether a low score reflects a weak memory for the event or simply an inability to put the memory into words. Tests that do not depend on speech bear this out: using nonverbal photograph recognition and behavioral re-enactment, researchers found signs of recall as early as twenty-seven months, whereas reasonable verbal recall did not appear until about thirty-three months (Simcock & Hayne, 2003).

Childhood Amnesia

Infantile, or childhood, amnesia refers to the near-universal scarcity of autobiographical memories from before about age five. Although autobiographical memories begin forming between ages two and three and can persist for some months, they are almost always lost by adulthood — a pattern often attributed in part to young children's failure to rehearse what they remember. Two leading explanations have been offered. They proceed from different starting points but are not mutually exclusive.

Cognitive Self

The first explanation locates the onset of autobiographical memory in the emergence of a sense of self — for only once a child recognizes a self to whom events can personally happen can experiences be stored as belonging to that self (Howe & Courage, 1997). Evidence of such a self-concept appears toward the end of the second year, roughly between twenty-one and twenty-four months. The arrival of this cognitive self supplies a framework around which memories can be organized, and with it autobiographical memory emerges and infantile amnesia recedes (Lewis & Brooks-Gunn, 1979).

Social Cultural Influences

The second explanation emphasizes language and culture. How parents talk with a child about the past — in particular, how richly and elaboratively they reminisce — influences how the child encodes and later recalls those events. Children whose parents discuss the past in detail are given more opportunity to rehearse their memories, and the language parents use at the time of an event can shape how the child remembers it. Differences across cultures in parenting style and in the parent–child relationship can therefore contribute to how early and how fully autobiographical memory develops (Fivush & Nelson, 2004).

Memory Strategies

Memory strategies are deliberate ways of organizing information to improve later recall, ranging from simple verbal rehearsal to mnemonic devices. Both the kinds of strategies children use and how effectively they use them change with age (Miller, 1994).

Metamemory

As children grow, they show increasing metamemory — knowledge about their own memory and how it operates (Siegler, 1998). The evidence strongly suggests that greater awareness of one's memory leads to more frequent use of memory strategies and, in turn, to better recall (Henry & Norman, 1996).

In children younger than seven, the links among metamemory, strategy use, and recall are weak or absent. This is apparent on sorting tasks, in which children are asked to group related objects together — for instance, by category such as animals — and then to recall them: older children, past about age seven, behave differently from preschoolers (Schneider, 1985).

Preschool Children

Preschoolers use rudimentary tactics to remember but do not yet deploy genuine mental strategies, and they tend not to distinguish remembering from simply perceiving. To remember objects they typically name them aloud or inspect them visually, and they apply memory strategies only intermittently, even when they know a strategy would help (Henry & Norman, 1996). Young children use strategies more consistently

when they are repeatedly reminded and taught to do so each time they encounter something to be remembered (Paris, Newman, & McVey, 1982).

By age 7

Around age seven, children begin to appreciate that memory strategies aid learning. The aim at this stage is for children to recognize the advantage of strategies such as grouping items by category, rather than merely looking at or naming them (Justice, 1985). At this age children also start, on their own, to use rehearsal to improve short-term recall, and retrieval strategies begin to appear spontaneously, without prompting from others (Paris, Newman, & McVey, 1982).

Late Elementary School

By the late elementary years, children organize material on their own initiative and can impose a meaningful structure on what they are trying to remember. A child packing a school bag, for example, can mentally walk through each part of the day and think of the items each part requires (Paris, Newman, & McVey, 1982). Children this age understand the value of memory strategies and will use approaches such as categorization in place of looking or naming, particularly when prompted to think about how they will learn the material beforehand (Justice, 1985).

Early Adolescence

In early adolescence, children begin to use elaborative rehearsal, processing material more deeply rather than merely holding it in mind. They increasingly favor strategies such as categorization over simple rehearsal, looking, or naming, and they apply these strategies spontaneously, without needing to be prompted to think about how they will remember (Justice, 1985).

The Law of Children's Memory and Testimony

Historically, the law treated very young children as presumptively incompetent witnesses and required a threshold showing that the child understood the duty to tell the truth (see *Wheeler v. United States*, 1895). Modern practice has largely abandoned categorical age bars. Under the Federal Rules of Evidence and most state codes, every person is presumed competent to testify, and concerns rooted in a child's developing memory generally go to the weight a fact-finder gives the testimony rather than to its admissibility. The competency inquiry that remains asks whether the child can perceive, recall, and communicate the event and appreciates the obligation to be truthful, and a defendant's exclusion from that preliminary inquiry does not offend the Confrontation Clause where full cross-examination is available at trial (*Kentucky v. Stincer*, 1987).

Because a child's account is often central and uniquely sensitive, the manner of taking it has generated a distinct line of constitutional decisions. In *Coy v. Iowa* (1988), the Court held that placing a screen between a child witness and the defendant violated the Sixth Amendment right to face-to-face confrontation. Two years later, *Maryland v. Craig* (1990) permitted a child to testify by one-way closed-circuit television, but only on a case-specific finding that the procedure is necessary to spare the particular child the serious emotional trauma that would prevent the child from communicating. The framework was reshaped by *Crawford v. Washington* (2004), which barred admission of "testimonial" out-of-court statements unless the declarant is unavailable and the defendant had a prior opportunity to cross-examine. Whether a child's statement is "testimonial" then became decisive. In *Ohio v. Clark* (2015), the Court held that a three-year-old's statements to his preschool teachers identifying his abuser were not testimonial and could be admitted, reasoning that statements made to meet an ongoing emergency, by a very young child unlikely to grasp their prosecutorial use, fall outside Crawford's bar.

A parallel concern is the reliability of a child's account when it reaches the court through an interviewer rather than the child's own live testimony. In *Idaho v. Wright* (1990), the Court excluded a young child's hearsay statements admitted under a residual exception, holding that their reliability had to rest on "particularized guarantees of trustworthiness" drawn from the circumstances of the statement itself, and it

expressly identified suggestive or leading interviewing as a factor that undermines trustworthiness. State courts have built procedural safeguards on the same science. In *State v. Michaels* (1994), the New Jersey Supreme Court recognized that coercive or highly suggestive interviewing can so taint a child's memory that a pretrial “taint hearing” is warranted; once the defendant shows sufficient evidence of unreliability, the burden shifts to the State to prove by clear and convincing evidence that the resulting statements are nonetheless reliable. These decisions track the developmental research summarized above: younger children encode less, are more dependent on external cues, and are less able to monitor the source of a remembered detail, and they are therefore more susceptible to having their reports shaped by the questions they are asked.

Whether an expert may explain this body of research to the trier of fact is governed by the rules on scientific evidence. In federal court and the many states that follow it, *Daubert v. Merrell Dow Pharmaceuticals* (1993) assigns the trial judge a “gatekeeping” role, assessing whether proffered scientific testimony rests on a reliable foundation and fits the facts of the case, and *Kumho Tire Co. v. Carmichael* (1999) extended that gatekeeping to all expert testimony, including the behavioral sciences. Other jurisdictions retain the older *Frye v. United States* (1923) standard, which admits expert evidence only when its underlying methodology is “generally accepted” in the relevant scientific community. Under either standard, testimony about how memory develops, and about the conditions that enhance or degrade a child's account, is offered to inform the trier of fact about matters outside common experience, not to opine on whether a particular witness is telling the truth, a judgment the law reserves to the fact-finder.

Special Issues in Legal Practice

The principles described above apply with equal force to every party in a legal proceeding. Memory operates the same way regardless of who is asking the questions, and the science summarized here favors no side. What differs between the parties is not the science but the vantage point — the particular places where memory issues tend to surface, and the particular errors each party is best positioned to guard against. The two summaries below identify those recurring issues. They are offered for orientation, not as litigation strategy; in every case the controlling question is what the evidence in that case will, and will not, support, and the expert's role is to inform the trier of fact rather than to advocate for either side.

Special Issues for Prosecutors

For the State, a child's memory evidence often must be both obtained and presented under conditions the prosecution can document. Where a child's account was elicited through developmentally appropriate, non-leading interviewing and preserved early, those features are affirmative indicators of reliability that the State is well positioned to establish, and they map onto the trustworthiness factors courts examine under decisions such as *Idaho v. Wright* (1990). The errors the State is best positioned to guard against are largely procedural: repeated or suggestive questioning, long delay before the first interview, and techniques known to distort a young child's report, each of which can compromise otherwise genuine evidence and, in some jurisdictions, invite a taint inquiry (*State v. Michaels*, 1994). An interpretive issue also recurs. Ordinary features of children's memory — fragmentary recall, gist in place of verbatim detail, and accounts that grow more complete or shift somewhat with development and retelling — should not be mistaken, by the State or by the jury, for fabrication; and a child's age-typical difficulty in testifying is best addressed through sound interviewing and, where the necessary findings are made, procedures that allow the child to communicate effectively (*Maryland v. Craig*, 1990).

Special Issues for Defense

For the defense, the recurring task is to show how the specific conditions under which a child's account was gathered map onto the factors known to affect a developing memory's reliability — recognizing that a

sincere child can sincerely report something that did not occur, or did not occur as described. Some conditions are developmental: very young children encode less, retain peripheral detail poorly, depend more on external prompts, and are less able to identify the source of a remembered detail, all of which bear on whether the original memory could support a dependable account. Others concern how the evidence was obtained: suggestive, repeated, or leading interviews, long delays before the first interview, and confirmatory feedback can shape a child's report after the fact and may warrant a reliability or taint inquiry (*Idaho v. Wright*, 1990; *State v. Michaels*, 1994). The same body of law contemplates that these concerns be placed before the trier of fact — through cross-examination, through challenges to the interview methods, and, where the governing standard is met, through expert testimony on the development of memory (*Daubert v. Merrell Dow Pharmaceuticals*, 1993; *Frye v. United States*, 1923). Because suggestive interviewing has figured in documented wrongful convictions, careful attention to these conditions is the defense's central memory concern here.

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