

# Temporal Issues in Forensic Interviews of Children

*A Bibliography*



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## **Scope**

This bibliography provides citations and abstracts to literature pertaining to temporal aspects as related to children’s memories about events. Included are articles, book chapters, and books.

## **Organization**

This bibliography lists publications in date-descending order. Links are provided to full text publications when possible.

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# Temporal Issues in Child Forensic Interviews

## A Bibliography

Friend, O. W., Henderson, H. M., & Lyon, T. D. (2022). 4-to 15-year-old children's misinterpretation of invitations asking “about the time” as requests for temporal information in forensic interviews. *Child Abuse & Neglect*, *129*, Advance online publication. <https://doi.org/10.1016/j.chiabu.2022.105675>  
[Full text](#)

We examined the rates at which children misinterpreted invitations containing the word “time,” comparing invitations asking “about” an episode to invitations asking what “happened” during an episode. This study examined 827 forensic interviews of children aged 4 to 15 (Mage = 8.1 years) in cases of suspected sexual abuse. We identified 1405 invitations using the word “time,” and coded them for whether they asked “about” or what “happened.” Children's responses were coded for whether they gave exclusively conventional temporal information, expressed temporal ignorance or uncertainty, requested clarification, or gave a don't know response. Children responded to About invitations with higher rates of conventional temporal information (11%) than Happened invitations (6%,  $p < .001$ ). Children were also more inclined to express uncertainty about temporal information when asked About invitations ( $p = .04$ ). In a third of the cases where children exhibited misunderstanding, interviewers failed to clarify their intentions. Forensic interviewers can reduce children's unresponsiveness to invitations by using Happened invitations that overcome the ambiguity associated with “time.”

McWilliams, K., Williams, S., Henderson, H. M., Evans, A. D., & Lyon, T. D. (2022). Pseudotemporal invitations: 6-to 9-year-old maltreated children's tendency to misinterpret invitations referencing “time” as solely requesting conventional temporal information. *Child Maltreatment*. Advance online publication. <https://doi.org/10.1177/10775595221104829>

Forensic interviewers ask children broad input-free recall questions about individual episodes in order to elicit complete narratives, often asking about “the first time,” “the last time,” and “one time.” An overlooked problem is that the word “time” is potentially ambiguous, referring both to a particular episode and to conventional temporal information. We examined 191 6-9-year-old maltreated children's responses to questions about recent events varying the wording of the

invitations, either asking children to “tell me about” or “tell me what happened” one time/the first time/the last time the child experienced recent recurrent events. Additionally, half of the children were asked a series of “when” questions about recurrent events before the invitations. Children were several times more likely to provide exclusively conventional temporal information to “tell me about” invitations compared to “tell me what happened” invitations, and asking “when” questions before the invitations increased children’s tendency to give exclusively conventional temporal information. Children who answered a higher proportion of “when” questions with conventional temporal information were also more likely to do so in response to the invitations. The results suggest that children may often fail to provide narrative information because they misinterpret invitations using the word “time.”

Tillman, K. A., Fukuda, E., & Barner, D. (2022). Children gradually construct spatial representations of temporal events. *Child Development*. Advance online publication. <https://doi.org/10.1111/cdev.13780>  
[Full text](#)

English-speaking adults often recruit a “mental timeline” to represent events from left-to-right (LR), but its developmental origins are debated. Here, we test whether preschoolers prefer ordered linear representations of events and whether they prefer culturally conventional directions. English-speaking adults (n = 85) and 3- to 5-year-olds (n = 513; 50% female; ~47% white, ~35% Latinx, ~18% other; tested 2016–2018) were told three-step stories and asked to choose which of two image sequences best illustrated them. We found that 3- and 4-year-olds chose ordered over unordered sequences, but preferences between directions did not emerge until at least age 5. Together, these results show that children conceptualize time linearly early in development but gradually acquire directional preferences (e.g., for LR).

Deker, L., & Pathman, T. (2021). Did I visit the polar bear before the giraffe? Examining memory for temporal order and the temporal distance effect in early to middle childhood. *Applied Cognitive Psychology*, 35(3), 785-794. <https://doi.org/10.1002/acp.3804>  
[Full text](#)

Memory for the temporal order of past events is a critical capacity; however, relatively little is known about its development and the processes that support it in early to middle childhood. The aim of this study was to examine children's memory for the temporal order of real-world events. Four–five-year-old (n = 36), 6–7-year-old (n = 45) and 8–10-year-old (n = 46) children participated in a week-long camp at a local zoo, which involved engaging activities and visits to animals each day. On the last day of camp, we tested children's memory for the order of pairs of animals visited. The elapsed time (lag) between event pairs was manipulated to test whether children's accuracy would show the temporal distance effect and give us insights into the processes supporting temporal memory. We found that 8–10-year-olds, but not younger groups, showed the temporal distance effect. Implications for our understanding of the cognitive processes supporting temporal memory development are discussed.

Arterberry, M. E., & Albright, E. J. (2020). Children's Memory for temporal information: The roles of temporal language and executive function. *The Journal of Genetic Psychology*, 181(4), 191-205. <https://doi.org/10.1080/00221325.2020.1741503>

The ability to recall the temporal order of events develops much more slowly than the ability to recall facts about events. To explore what processes facilitate memory for temporal information, we tested 3- to 6-year-old children (N = 40) for immediate memory of the temporal order of events from a storybook, using a visual timeline task and a yes/no recognition task. In addition, children completed tasks assessing their understanding of before and after and the executive functions of inhibition using the Day/Night Stroop task and cognitive shifting using the Dimensional Change Card Sort (DCCS) task. Older children (Mage = 69.25 months) outperformed younger children (Mage = 52.35 months) on all measures; however, the only significant predictor of memory for the temporal ordering of events was cognitive shifting. The findings suggest that the difficulty in memory for temporal information is related to development of a general cognitive ability, as indexed by the DCCS, rather than specific temporal abilities.

Hamamouche, K., & Cordes, S. (2020). Learning about time: Knowledge of formal timing symbols is related to individual differences in temporal precision. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 46(1), 117-126. <https://doi.org/10.1037/xlm0000714>

Throughout the life span, we are capable of representing quantities in the absence of language, or nonsymbolically. Additionally, over the course of development, we learn many symbolic measurement systems for representing quantities such as time and number. Despite substantial evidence of a relation between the acquisition of symbolic and nonsymbolic numerical acuity (see Halberda, Mazocco, & Feigenson, 2008), no work has explored whether a similar relation exists between understanding temporal units of measurement and timing precision. That is, does a child's understanding of words like "second," "minute," and "hour" have any relation to their ability to tell which of two events lasted longer? Six- and 7-year-old children (n = 102, Mage = 83.44 months, 52 females), who are in the process of learning temporal units of measurement, completed a temporal discrimination task (assessing nonsymbolic temporal acuity) and a symbolic timing assessment. Results revealed a positive correlation between children's nonsymbolic temporal acuity and their understanding of temporal units of measurement. Importantly, this correlation held when controlling for age and numerical acuity, suggesting a unique relation between children's temporal acuity and their understanding of temporal units of measurement. This study is the first to show a relation between symbolic and nonsymbolic representations of time. (APA PsycInfo Database Record © 2019 APA, all rights reserved)

Loucks, J., & Price, H. L. (2019). Memory for temporal order in action is slow developing, sensitive to deviant input, and supported by foundational cognitive processes. *Developmental Psychology*, 55(2), 263-273. <https://doi.org/10.1037/xlm0000714>

Executing actions in a specific order is a critical component of many action sequences that children must acquire, the majority of which are learned through observation and imitation of others. Although a wealth of evidence indicates that children can process and represent temporal order in memory, relatively little is known about the development of this ability and the cognitive mechanisms that support it in the context of imitation. The present research investigated 4- through 8-year-old children's ability to learn the temporal order of novel, arbitrary action sequences via imitation. On Day 1, children observed and imitated four instances each for two different multistep



sequences. One sequence was easy and the other was difficult, in terms of categorizing the items used in each instance. For one sequence, the experimenter also performed one instance in a deviant temporal order, which occurred either early or late in learning. Memory generalization for each sequence was assessed on Day 2. Results indicated significant effects of age and sequence difficulty on children's ability to recall the individual actions as well as the standard order. Experiencing the deviant order also uniquely disrupted children's ability to generalize the order. Experiencing the deviant early in learning globally lowered children's memory for both sequences. Thus, children's ability to learn temporal order develops slowly over childhood, is supported by foundational cognitive processes that operate in a hierarchical fashion, and is highly sensitive to variable temporal input. These results have implications for theories of imitation and cultural learning more broadly.

Zhang, M., & Hudson, J. A. (2018). The development of temporal concepts: Linguistic factors and cognitive processes. *Frontiers in Psychology, 9*, 2451.  
<https://doi.org/10.3389/fpsyg.2018.02451>  
[Full text](#)

Temporal concepts are fundamental constructs of human cognition, but the trajectory of how these concepts emerge and develop is not clear. Evidence of children's temporal concept development comes from cognitive developmental and psycholinguistic studies. This paper reviews the linguistic factors (i.e., temporal language production and comprehension) and cognitive processes (i.e., temporal judgment and temporal reasoning) involved in children's temporal conceptualization. The relationship between children's ability to express time in language and the ability to reason about time, and the challenges and difficulties raised by the interaction between cognitive and linguistic components are discussed. Finally, we propose ways to reconcile controversies from different research perspectives and present several avenues for future research to better understand the development of temporal concepts.



McCormack, T., & Hoerl, C. (2017). The development of temporal concepts: Learning to locate events in time. *Timing & Time Perception*, 5(3-4), 297-327.

[Full text](#)

A new model of the development of temporal concepts is described that assumes that there are substantial changes in how children think about time in the early years. It is argued that there is a shift from understanding time in an event-dependent way to an event-independent understanding of time. Early in development, very young children are unable to think about locations in time independently of the events that occur at those locations. It is only with development that children begin to have a proper grasp of the distinction between past, present, and future, and represent time as linear and unidirectional. The model assumes that although children aged two to three years may categorize events differently depending on whether they lie in the past or the future, they may not be able to understand that whether an event is in the future or in the past is something that changes as time passes and varies with temporal perspective. Around four to five years, children understand how causality operates in time, and can grasp the systematic relations that obtain between different locations in time, which provides the basis for acquiring the conventional clock and calendar system.

Rattat, A. C., & Tartas, V. (2017). Temporal categorization of familiar actions by children and adults. *Timing & Time Perception*, 5(1), 61-76. <https://doi.org/10.1163/22134468-00002080>

Although it is very useful in daily life, children have difficulties to estimate durations using conventional time units. The aim of the present study was to examine whether young children aged three, five and eight years and adults are able to categorize familiar actions according to their duration, by using a new task not relying on knowledge of conventional time units. Participants performed a forced-choice categorization task in which short, medium or long target action durations had to be paired with one of three comparison action durations (short, medium or long). Results showed that as age increased so, too, did the percentage of accurate temporal categorizations, while that of temporal categorization errors decreased. Moreover, except at three years, the least frequent error consisted in categorizing a short action as a long one. These results are discussed in the light of event representation theory and the role of experience in temporal cognition.

Ribordy Lambert, F., Lavenex, P., & Banta Lavenex, P. (2017). The “when” and the “where” of single-trial allocentric spatial memory performance in young children: Insights into the development of episodic memory. *Developmental Psychobiology*, 59(2), 185-196. <https://doi.org/10.1002/dev.21479>

Allocentric spatial memory, “where” with respect to the surrounding environment, is one of the three fundamental components of episodic memory: what, where, when. Whereas basic allocentric spatial memory abilities are reliably observed in children after 2 years of age, coinciding with the offset of infantile amnesia, the resolution of allocentric spatial memory acquired over repeated trials improves from 2 to 4 years of age. Here, we first show that single-trial allocentric spatial memory performance improves in children from 3.5 to 7 years of age, during the typical period of childhood amnesia. Second, we show that large individual variation exists in children's performance at this age. Third, and most importantly, we show that improvements in single-trial allocentric spatial memory performance are due to an increasing ability to spatially and temporally separate locations and events. Such improvements in spatial and temporal processing abilities may contribute to the gradual offset of childhood amnesia.

Thomas, M., Clarke, D., McDonough, A., & Clarkson, P. (2017). Framing, assessing, and developing children’s understanding of time. 40 years on: We are still learning!, 64. (Proceedings of the 40th annual conference of the Mathematics Education Research Group of Australasia) Melbourne: MERGA

An understanding of time which goes beyond the reading of clocks and calendars is crucial to full participation in society. This paper reports on classroom experiences and pedagogies that assisted Year 3/4 children’s development when learning about time, drawing upon a Framework for the Learning and Teaching of Time, interview data, an eight-lesson intervention and student improved performance on the interview following the intervention.

Cleveland, K. C., & Quas, J. A. (2016). Adults' insensitivity to developmental changes in children's ability to report when and how many times abuse occurred. *Behavioral Sciences & the Law*, 34(1), 126-138. <https://doi.org/10.1002/bsl.2211>

In legal settings, children are frequently asked to provide temporal information about alleged abuse, such as when it occurred and how often. Although there is a sizeable body of work in the literature regarding children’s ability to provide such information, virtually nothing is known about

how adults evaluate the veracity of that information. This omission is especially noteworthy given that adults' evaluations are critical to the progression and outcome of legal cases. We examined adults' perceptions of children's reports of temporal details regarding alleged sexual abuse. We varied both children's age (6 vs. 11 years) and how certain children were when providing such details to assess whether adults were sensitive to changes in how children of different ages typically talk about temporal information. With regard to credibility, adults were insensitive to children's age, perceiving younger and older children who reported temporal details with confidence as more credible than those who reported information tentatively. Normative developmental trends, however, would suggest that, with age, children are often tentative when reporting true temporal details. With regard to perceptions of children's accuracy in reporting temporal information, adults found younger children who were confident to be the most accurate. Regarding guilt judgments, adults rated defendants as having a higher degree of guilt when children were confident in reporting temporal details. The findings have implications for juror decision-making in cases of alleged sexual abuse in which children report when or how often abuse occurred. © 2016 John Wiley & Sons, Ltd.

Droit-Volet, S. (2016). [Development of time](#). *Current Opinion in Behavioral Sciences*, 8, 102-109.

The aim of this study was to examine whether age-related changes in the speed of information processing are the best predictors of the increase in sensitivity to time throughout childhood. Children aged 5 and 8 years old, as well adults, were given two temporal bisection tasks, one with short (0.5/1-s) and the other with longer (4/8-s) anchor durations. In addition, the participants' scores on different neuropsychological tests assessing both information processing speed and other dimensions of cognitive control (short-term memory, working memory, selective attention) were calculated. The results showed that the best predictor of individual variances in sensitivity to time was information processing speed, although working memory also accounted for some of the individual differences in time sensitivity, albeit to a lesser extent. In sum, the faster the information processing speed of the participants, the higher their sensitivity to time was. These results are discussed in the light of the idea that the development of temporal capacities has its roots in the maturation of the dynamic functioning of the brain.

McWilliams, K., Lyon, T. D., & Quas, J. A. (2016). [Maltreated children's ability to make temporal judgments using a recurring landmark event.](#) *Journal of Interpersonal Violence*, 34(4), 873-883.

This study examined whether maltreated children are capable of judging the location and order of significant events with respect to a recurring landmark event. One hundred sixty-seven 6- to 10 year-old maltreated children were asked whether the current day, their last court visit, and their last change in placement were “near” their birthday and “before or after” their birthday. Children showed some understanding that the target event was “near” and “before” their birthday when their birthday was less than 3 months hence, but were relatively insensitive to preceding birthdays. Therefore, children exhibited a prospective bias, preferentially answering with reference to a forthcoming birthday rather than a past birthday. The results demonstrate that the recurring nature of some landmark events makes questions about them referentially ambiguous and children’s answers subject to misinterpretation.

Blything, L. P., Davies, R., & Cain, K. (2015). [Young children's comprehension of temporal relations in complex sentences: The influence of memory on performance.](#) *Child Development*, 86(6), 1922-1934.

The present study investigated 3- to 7-year-olds’ (N = 91) comprehension of two-clause sentences containing the temporal connectives before or after. The youngest children used an order of mention strategy to interpret the relation between clauses: They were more accurate when the presentation order matched the chronological order of events: “He ate his lunch, before he played in the garden” (chronological) versus “Before he played in the garden, he ate his lunch” (reverse). Between 4 and 6 years, performance was influenced by a combination of factors that influenced processing load: connective type and presentation order. An independent measure of working memory was predictive of performance. The study concludes that the memory demands of some sentence structures limits young children’s comprehension of sentences containing temporal connectives.

Roberts, K. P., Brubacher, S. P., Drohan-Jennings, D., Glisic, U., Powell, M. B., & Friedman, W. J. (2015). Developmental differences in the ability to provide temporal information about repeated events. *Applied Cognitive Psychology, 29*(3), 407-417.

Children (n =372) aged 4–8 years participated in one or four occurrences of a similar event and were interviewed 1 week later. Compared with 85% of children who participated once, less than 25% with repeated experience gave the exact number of times they participated, although all knew they participated more than once. Children with repeated experience were asked additional temporal questions, and there were clear developmental differences. Older children were more able than younger children to judge relative order and temporal position of the four occurrences. They also demonstrated improved temporal memory for the first and last relative to the middle occurrences, while younger children did so only for the first. This is the first systematic demonstration of children’s memory for temporal information after a repeated event. We discuss implications for theories of temporal memory development and the practical implications of asking children to provide temporal information. Copyright © 2015 John Wiley & Sons, Ltd.

Gosse, L. L., & Roberts, K. P. (2014). Children’s use of a ‘time line’ to indicate when events occurred. *Journal of Police and Criminal Psychology, 29*(1), 36-43.

Children who allege abuse are often asked to provide temporal information such as when the events occurred. Yet, young children often have difficulty recalling temporal information due to their limited knowledge of temporal patterns and linguistic capabilities. As time is an abstract concept (we cannot see it), some investigators have begun to use ‘timelines’ or pictorial representations of time to aid children. Yet, there is no published research testing whether children are able to use time-lines and whether they can provide adequate temporal information using them. We tested whether children could indicate the time-of-day of events using a pictorial timeline and then compared their responses to their parents’. Seven- to 8-year-olds were most consistent with parental estimates while 4-year-olds were least consistent. Responses from the 5- to 6-year-olds depended on the temporal task. Guessing and using general knowledge to estimate the time-of-day were ruled out, and so children were genuinely drawing on episodic memory when making time-line judgments. Thus, there was a developmental progression in children’s use of physical representations to communicate abstract information. These results are promising for the use of the time-line in forensic settings but much more research is needed.

Wandrey, L. E. (2013). " How many times did he do this to you?" Attorneys' temporal questions during child sexual abuse trials [Doctoral dissertation]. University of California, Irvine.

Bisson, N., Tobin, S., & Grondin, S. (2012). [Prospective and retrospective time estimates of children: A comparison based on ecological tasks](#). *PLoS One*, 7(3), e33049.

Children's time estimation literature lacks of studies comparing prospective and retrospective time estimates of long lasting ecological tasks, i.e. tasks reflecting children's daily activities. In the present study, children were asked to estimate prospectively or retrospectively how much time they played a video game or read a magazine. Regardless of the task, the results revealed that prospective time estimates were longer than the retrospective ones. Also, time estimates of the video game task were longer, less accurate and more variable than those of the reading task. The results are discussed in the light of the current literature about time estimation of long lasting ecological tasks.

Wandrey, L., Lyon, T. D., Quas, J. A., & Friedman, W. F. (2012). [Maltreated children's ability to estimate temporal location and numerosity of placement changes and court visits](#). *Psychology, Public Policy, and Law*, 18(1), 79-104.

Research examining children's temporal knowledge has tended to utilize brief temporal intervals and singular, neutral events, and is not readily generalizable to legal settings in which maltreated children are asked temporal questions about salient, repeated abuse that often occurred in the distant past. To understand how well maltreated children can describe temporal location and numerosity of documented, personal experiences, we assessed 167 6- to 10-year-old maltreated children's temporal memory for changes in their living arrangements and prior visits to court. Small percentages of children were capable of providing exact temporal location information (age, month, or season) regarding their first or last placement or court experience, or numerosities for placements or court visits. Greater knowledge of current temporal locations did not predict better performance. However, older children's performance for several temporal judgments was better than chance, and their reports were not largely discrepant from the truth. Findings suggest caution when questioning maltreated children about when and how many times prior events occurred.

Friedman, W. J., Reese, E., & Dai, X. (2011). Children's memory for the times of events from the past years. *Applied Cognitive Psychology*, 25(1), 156-165.

This study tested 8–12-year-olds' ability to localize in time parent-reported events from four time intervals ranging from 6 months to 4 years ago. Memory for content was very accurate, and children's time estimates showed substantial agreement with the times provided by their parents. Accuracy of year judgments declined with retention interval, with the greatest change occurring between the 1–2-year and 2–3-year intervals. Season, month and time of day accuracy were much more stable over time. There were significant improvements with age in performance on measures of conventional time knowledge, and this performance was correlated with the accuracy of time estimates on the long time scales, controlling for age and general cognitive ability. © 2010 John Wiley & Sons, Ltd.

McCormack, T., & Hanley, M. (2011). Children's reasoning about the temporal order of past and future events. *Cognitive Development*, 26(4), 299-314.  
<https://doi.org/10.1016/j.cogdev.2011.10.001>

Four- and five-year-olds completed two sets of tasks that involved reasoning about the temporal order in which events had occurred in the past or were to occur in the future. Four-year-olds succeeded on the tasks that involved reasoning about the order of past events but not those that involved reasoning about the order of future events, whereas 5-year-olds passed both types of tasks. Individual children who failed the past-event tasks were not particularly likely to fail the more difficult future-event tasks. However, children's performance on the reasoning tasks was predictive of their performance on a task assessing their comprehension of the terms “before” and “after.” Our results suggest that there may be a developmental change over this age range in the ability to flexibly represent and reason about the before-and-after relationships between events.

Pyykkonen, P., & Jarvikivi, J. (2011). Children and situation models of multiple events. *Developmental Psychology*, 48(2), 521-529.

The present study demonstrates that children experience difficulties reaching the correct situation model of multiple events described in temporal sentences if the sentences encode language-external events in reverse chronological order. Importantly, the timing of the cue of how to organize these events is crucial: When temporal subordinate conjunctions (before/after) or converb



constructions that carry information of how to organize the events were given sentence-medially, children experienced severe difficulties in arriving at the correct interpretation of event order. When this information was provided sentence-initially, children were better able to arrive at the correct situation model, even if it required them to decode the linguistic information reversely with respect to the actual language external events. This indicates that children even aged 8–12 still experience difficulties in arriving at the correct interpretation of the event structure, if the cue of how to order the events is not given immediately when they start building the representation of the situation. This suggests that children's difficulties in comprehending sequential temporal events are caused by their inability to revise the representation of the current event structure at the level of the situation model.

Yan, T., Chan, R., & Shum, D. (2011). The development of prospective memory in typically developing children. *Nueropsychology*, 25(3), 342-352.

This study aimed to use specifically designed tasks to capture time-based, activity-based, and event-based prospective memory (PM) performance in typically developing school-age children. Two PM tasks (Fishing Game & Happy Week) were used to examine the developmental patterns of PM in these children. Retrospective memory (RM) was also examined in these tasks. A total of 120 children aged between 7 and 12 years (10 girls and 10 boys in each age band) were recruited. Tests of working memory, inhibition, and IQ were also administered. The age effect on PM accuracy was significant, with improvements identified between ages 7 to 8 and 10 to 11 years. For both tasks, performance on the time-based PM task was significantly poorer than that on the event-based PM task, which in turn was significantly poorer than that on the activity-based PM task. In terms of errors, results indicated that while errors associated with the PM component of the tasks decreased with age, errors associated with the RM component showed an inverted-U shape. The different patterns of errors suggest qualitative as well as quantitative differences in PM development in children. Finally, IQ, working memory, and inhibition were found to relate to PM when age was partialled out. Results of the study highlight the importance of contextual cues, such as activities and events, for prospective remembering in children. In addition, they have provided a general picture of PM development in school-age children and have implications for educators and parents.

Morris, G., Baker-Ward, L., & Bauer, P. (2010). What remains of that day: The survival of children's autobiographical memories across time. *Applied Cognitive Psychology, 24*(4), 527-544.

In this study we investigated the contributions of the content and the coherence of initial event reports to the survival of autobiographical memories during part of the lifespan eventually obscured by childhood amnesia. Over 100 children reported personal experiences when they were 4, 6 or 8 years old, enabling a determination of age-related differences in two aspects of narrative coherence: Theme and chronology. Content was assessed separately through the presentation of directed memory probes. After a 1-year delay, younger children more frequently failed to report target experiences. Multilevel modelling indicated that the survivability of a memory was predicted over and above the child's age by high thematic coherence of the initial memory narrative, but not by the memory content. It is possible that memories described in a highly thematically coherent narrative are indicative of well-integrated event memories, and thus likely to be cued more often, resulting in their long-term survival. Copyright © 2009 John Wiley & Sons, Ltd.

Ryan, R. (2010). Age differences in explicit memory of crimes and source monitoring ability: Adolescents and young adults. *North American Journal of Psychology, 12*(2), 401-414.

In the current study an adolescent sample was compared to a young adult sample on measures of explicit memory and source monitoring. Compared to adolescents, young adults were found to recall significantly more details pertaining to person, object, and surroundings of videotaped staged crimes. There were no significant age differences pertaining to details concerning action for these crimes, implying a developmental component to our ability to recall different aspects of events. The young adult sample was also found to perform better compared to the adolescents on a source monitoring task. Findings are discussed in terms of developmental differences in memory ability and developmental neuroscience. The current study contributes to our knowledge base concerning developmental differences in these cognitive abilities and provides information that may be applied in a forensic setting.

Kulkofsky, S., Wang, Q., & Ceci, S. J. (2008). Do better stories make better memories? Narrative quality and memory accuracy in preschool children. *Applied Cognitive Psychology*, 22(1), 21-38.

The present study examines how the quality of children's narratives relates to the accuracy of those narratives. Sixty-one 3- to 5-year-olds played a novel game with a researcher in their schools. Children were questioned in an interview that included an open-ended free recall prompt followed by a series of directed questions. Children's narratives were coded for volume, complexity and cohesion as well as for accuracy. Correlational results showed that overall, narrative skills enable the reporting of more information, while decreasing the proportion of information that was accurate. These results appeared to be driven by a quantity-accuracy trade-off; in an ensuing regression analysis with all narrative variables entered into the model, volume was associated with decreases in accuracy while narrative cohesion was associated with increases in accuracy. We discuss the results in terms of their relationship to the development of autobiographical memory as well as implications for forensic contexts. © 2007 John Wiley & Sons, Ltd.

Friedman, W. J. (2007). The development of temporal metamemory. *Child Development*, 78(5), 1472-1491.

In two studies of knowledge about the properties and processes of memory for the times of past events, 178 children from 5 through 13 years of age and 40 adults answered questions about how they would remember times on different scales, how temporal memory is affected by retention interval, and the usefulness of different methods. The adults showed quite accurate knowledge about the main properties of memory for time and the processes that underlie it. Different properties and processes were first understood at ages ranging from 8 years to 12 years or later. Knowledge of the roles of reconstruction and impressions of temporal distances appear well after children use them to remember the times of events.

Lindblad, F. (2007). Reflections on the concept of disclosure. In M.-E. Pipe, M. E. Lamb, Y. Orbach, & A.-C. Cederborg (Eds.), *Child sexual abuse: Disclosure, delay and denial* (pp. 291-301). Mahwah, NJ: Lawrence Erlbaum Associates.

Orbach, Y., & Lamb, M. E. (2007). Young children's references to temporal attributes of allegedly experienced events in the course of forensic interviews. *Child Development, 78*(4), 1100-1120.

Developmental differences in references to temporal attributes of allegedly experienced events were examined in 250 forensic interviews of 4- to 10-year-old alleged victims of sexual abuse. Children's ages, the specific temporal attributes referenced, and the types of memory tapped by the interviewers' questions significantly affected the quantity and quality of temporal references produced. The findings documented age-related increases in 4- to 10-year-olds' references to temporal attributes, using the appropriate relational terminology, both spontaneously and in response to temporal requests. More references to temporal attributes were elicited from recall than from recognition memory, highlighting spontaneous reporting capabilities. Implications for theories concerning the developing understanding of temporal concepts and for the design of effective, age-appropriate, forensic interview techniques are discussed.

Lyon, T. D., & Saywitz, K. J. (2006). Post-mortem to preventive medicine: Next steps for research on child witnesses. *Journal of Social Issues, 62*(4), 833-861.

Five directions for future child witness research are proposed by the authors, inspired by recognition of the day-to-day realities of the legal system and the opportunities of psychology to react proactively to challenges child witnesses face. These directions include (1) the refinement of developmentally sensitive questioning aids that increase completeness without increasing suggestibility, (2) the development of approaches to non-disclosure and recantation, including understanding of the reasons underlying non-disclosure and the potential for building rapport and increasing trust, (3) the construction of interventions that meet mental health needs of child victim witnesses without creating false memories or tainting testimony, (4) a focus on details of children's narratives that are often lacking, including temporal information and emotional reactions, and (5) expanding our attention beyond child sexual abuse allegations in criminal court and considering

the many contexts in which child witnesses are questioned, including areas in which preferences rather than memories are elicited.

Friedman, W. J., & Lyon, T. D. (2005). Development of temporal-reconstructive abilities. *Child Development, 76*(6), 1202-1216.

In a study of the ability to reconstruct the times of past events, 86 children from 4 to 13 years recalled the times of 2 in-class demonstrations that had occurred 3 months earlier and judged the times of hypothetical events. Many of the abilities needed to reconstruct the times of events were present by 6 years, including the capacity to interpret many temporally relevant cues, but there were substantial changes well into middle childhood in the availability of temporally useful episodic information. Children were poor at remembering the events' proximity or order with respect to a major holiday, but the order of the 2 target events was well recalled by 6 years.

Bastin, C., Van der Linden, M., Michel, A. P., & Friedman, W. J. (2004). The effects of aging on location-based and distance-based processes in memory for time. *Acta Psychologica, 116*(2), 145-171.

Retrieving when an event occurred may depend on an estimation of the age of the event (distance-based processes) or on strategic reconstruction processes based on contextual information associated with the event (location-based processes). Young and older participants performed a list discrimination task that has been designed to dissociate the contribution of both types of processes. An adapted Remember/Know/Guess procedure [Can. J. Exp. Psychol. 50 (1996) 114] was developed to evaluate the processes used by the participants to recognize the stimuli and retrieve their list of occurrence. The results showed that aging disrupts location-based processes more than distance-based processes. In addition, a limitation of speed of processing and working-memory capacities was the main predictor of age-related differences on location-based processes, whereas working-memory capacities mediated partly age differences on distance-based processes.

Nelson, K., & Fivush, R. (2004). The emergence of autobiographical memory: A social cultural developmental theory. *Psychological Review, 111*(2), 486-511.

The authors present a multicomponent dynamic developmental theory of human autobiographical memory that emerges gradually across the preschool years. The components that contribute to the

process of emergence include basic memory abilities, language and narrative, adult memory talk, temporal understanding, and understanding of self and others. The authors review the empirical developmental evidence within each of these components to show how each contributes to the timing, quantity, and quality of personal memories from the early years of life. The authors then consider the relevance of the theory to explanations of childhood amnesia and how the theory accounts for and predicts the complex findings on adults' earliest memories, including individual, gender, and cultural differences.

Westcott, H. L., & Kynan, S. (2004). The application of a 'story-telling' framework to investigative interviews for suspected child sexual abuse. *Legal and Criminological Psychology*, 9(1), 37-56.

This study investigated the usefulness of a 'story-telling' approach to understanding investigative interviews with children suspected of being sexually abused. Method. An innovative framework for understanding children's allegations of sexual abuse was devised from the 'story-telling' literature, which examined the degree to which essential elements of a story, as well as order or disorder of narrative, were present in accounts of alleged abuse. Other features of the interview, such as the presence of free narrative, reliance on specific questions to elicit an account and bizarre or 'off-topic' responses from the child, were also recorded. Transcripts of 70 interviews with children aged up to 12 years, from England and Wales, were coded using a scheme devised specifically for the purpose of the study. Results. The results suggest that although, superficially, the accounts adhered to a story structure, they were often incomplete, ambiguous and disordered to a degree which would impact on understanding. Reliance on specific questions, and other digressionary or non-verbal responses from the child also compounded difficulties. Age differences in responding were noted, with the youngest children responding differently from their older peers. Conclusions. Implications for practice include the importance of careful questioning and the value of a second interviewer monitoring the interview. The story-telling framework was a useful tool in suggesting where difficulties may arise for the child in presenting his/her account, and for an observer (e.g. juror) in making sense of the child's experience as elicited in the interview.

Curran, T., & Friedman, W. J. (2003). [Differentiating location-and distance-based processes in memory for time: An ERP study.](#) *Psychonomic Bulletin & Review*, 10(3), 711-717.

Memory for the time of events may benefit from reconstructive, location-based, and distance-based processes, but these processes are difficult to dissociate with behavioral methods. Neuropsychological research has emphasized the contribution of prefrontal brain mechanisms to memory for time but has not clearly differentiated location- from distance-based processing. The present experiment recorded event-related brain potentials (ERPs) while subjects completed two different temporal memory tests, designed to emphasize either location- or distance-based processing. The subjects' reports of location-based versus distance-based strategies and the reaction time pattern validated our experimental manipulation. Late (800–1,800 msec) frontal ERP effects were related to location-based processing. The results provide support for a two-process theory of memory for time and suggest that frontal memory mechanisms are specifically related to reconstructive, location-based processing.

Friedman, W. J. (2003). The development of children's understanding of the past and the future. In R. Kail (Ed.), *Advances in Child Development and Behavior* (Vol. 31, pp. 229-269). San Diego, CA: Academic Press.

Lamb, M. E., Sternberg, K. J., Orbach, Y., Esplin, P. W., Stewart, H., & Mitchell, S. (2003). Age differences in young children's responses to open-ended invitations in the course of forensic interviews. *Journal of Consulting and Clinical Psychology*, 71(5), 926

To elucidate age differences in responses to free-recall prompts (i.e., invitations and cued invitations) and focused recognition prompts (i.e., option-posing and suggestive utterances), the authors examined 130 forensic interviews of 4- to 8-year-old alleged victims of sexual abuse. There were age differences in the total number of details elicited as well as in the number of details elicited using each of the different types of prompts, especially invitations. More details were elicited from older than from younger children in response to all types of prompts, but there were no age differences in the proportion of details (about 50%) elicited using invitations. Cued invitations elicited 18% of the total details, and the number of details elicited using cued invitations increased with age. Action-based cues consistently elicited more details than other types of cues. (PsycINFO Database Record © 2012 APA, all rights reserved)



Larsson, A. S., Anders Granhag, P., & Spjut, E. (2003). Children's recall and the cognitive interview: Do the positive effects hold over time?. *Applied Cognitive Psychology, 17*(2), 203-214.

Most studies investigating how the Cognitive Interview affects children's recall have employed short retention intervals (a week or less). In our study children (10–11 years old) saw a film picturing an extraordinary performance by a professional fakir. Half of the children were interviewed after seven days ( $n = 24$ ) and the other half after six months ( $n = 25$ ). At each test session, half were interviewed according to the Cognitive Interview (CI), and half according to the Structured Interview (SI). We found that: (a) the children in the CI condition recalled significantly more correct information than the children in the SI condition (both after seven days and after six months), and (b) the children interviewed after seven days recalled significantly more correct information, and less confabulations, compared to the children interviewed after six months. The results suggest that the CI can be used as an investigative tool both after short and long retention intervals. Copyright © 2002 John Wiley & Sons, Ltd.

Tartas, V. (2001). The development of systems of conventional time: A study of the appropriation of temporal locations by four-to-ten-year old children. *European Journal of Psychology of Education, 16*(2), 197-208.

The research is about the construction of conventional time through the appropriation of different tools used to locate events in time by 200 children between the ages of 4 to 10 years old. Temporal locations are examined through an interview task and the children's ability to construct order of different temporal frameworks (daily, weekly, yearly) is studied using a card arrangement task. The same children took part in these two tasks. The results show that the tools children use to locate events in time change with their age and school experience: the youngest use relative locations or scripts (events are used as tools to locate other events) whereas older children use absolute locations (hours, days, months then become tools for locating events in time). Moreover, children use conventional temporal tools to locate events before being able to use them to put different events into the same temporal sequence. The study highlights developmental phases between the use of temporal locations and the construction of their meanings.

Bradburn, N. M. (2000). Temporal representation and event dating. In A. Stone, J. S. Turkkan, C. A. Bachrach, Jobe, J. B., Kurtzman, H. S., & V. S. Cain (Eds.), *The science of self-report: Implications for research and practice* (pp. 49-62). Mahwah, NJ: Erlbaum.

Thompson, L. A., Gomez, R. L., & Schvaneveldt, R. W. (2000). The salience of temporal cues in the developing structure of event knowledge. *American Journal of Psychology*, *113*(4), 591-620.

Two experiments used a novel method called Pathfinder to examine whether the salience of temporal cues embedded in event structure increases developmentally and whether people link event actions by simple adjacency relationships or embed them in an organized whole. A sequential format for eliciting knowledge was compared with a less structured format for dinner and bedtime events. Adults and their 8- and 10-year-old children demonstrated well-developed script organizations regardless of format, and organization improved across this age range. In Experiment 1, temporal cues were not a salient basis of comparison for 6-year-olds, but in Experiment 2 they could use temporal cues when instructed to do so. The results suggest that temporal salience increases between 6 and 10 years and that temporal knowledge of event actions is highly organized in this age range. Furthermore, children's event knowledge functions partly in the interaction between their developing event knowledge and the support provided by sequential constraints in the environment.

Buckner, J. P., & Fivush, R. (1998). Gender and self in children's autobiographical narratives. *Applied Cognitive Psychology*, *12*(4), 407-429.

In this study, we examined relations among gender, self-concept and children's autobiographical narratives. Twenty-two white middle-class children 8 years of age (50% female) were administered the Children's Self-View Questionnaire (CSVQ). In addition, children were asked to recall a specific experience associated with each of the nine self-concept dimensions assessed by the CSVQ, including Achievement, Alienation, and Social Closeness. Consistent with previous research with adults, girls' autobiographical narratives were longer, more coherent and more detailed than were boys' narratives. Girls were also more likely to place their autobiographical narratives in a social context, to refer to more affiliative themes, and to mention more people and more emotions than were boys. In all these ways, girls' narratives were more socially contexted

and relational than were those of boys. However, no relations were found between specific dimensions of self-understanding and children's autobiographical narratives. Theoretical implications of these findings are discussed. ©1998 John Wiley & Sons, Ltd.

Friedman, W. J., & Kemp, S. (1998). The effects of elapsed time and retrieval on young children's judgments of the temporal distances of past events. *Cognitive Development, 13*(3), 335-367.

Young children have very limited knowledge of long-term time patterns, but recent studies show that impressions of temporal distances provide them with some sense of the times of past events. These studies were investigations of (a) the function relating subjective to objective distances in the past for events whose ages range from less than 1 month to 1 year and (b) the effects of retrieving events on their subjective recency. In Study 1, 825 children (5-, 6-, and 7-year-olds) compared the recency of two school events from many months in the past shortly after one of the events was retrieved. In Study 2, 162 children (mean age 4.9 years) judged the distances in the past of their birthdays, summer, and 4 holidays by placing cards on a spatial continuum. In Study 3, 148 children (mean age 4.8 years) performed a similar task after the prior retrieval or priming of some of the events. Subjective temporal distance increased with real distance up to about 5 months, with no evident increase thereafter. Retrieval and priming had no effect on subjective recency. These findings show that early developing characteristics of memory provide young children with a differentiated sense of the times of events from past months. However, simple strength models cannot explain this ability.

Thompson, C. P., Skowronski, J. J., Larsen, S. F., & Betz, A. (1996). *Autobiographical memory: Remembering What and Remembering When*. Mahwah, NJ: Erlbaum.

Friedman, W. J. (1993). [Memory for the time of past events](#). *Psychological Bulletin, 113*(1), 44-66.

Laboratory and autobiographical studies of normal adults' memory for the time of past events are reviewed, and the main phenomena that have been discovered are described. A distinction is introduced among several kinds of information on which this knowledge could be based: information about distances, locations, and relative times of occurrence. The main theories of

memory for time are classified in these terms, and each theory is evaluated in light of the available evidence. In spite of the common intuition that chronology is a basic property of autobiographical memory, the research reviewed demonstrates that there is no single, natural temporal code in human memory. Instead, a chronological past depends on a process of active, repeated construction.

Friedman, W. J. (Ed.). (1992). *The Development of Children's Representations of Temporal Structure*. New York: Kluwer Academic/Plenum Publishers.

Friedman, W. J. (1991). The development of children's memory for the time of past events. *Child Development*, 62(1), 139-155.

Previous research on adults' and children's memory for the time of past events has generally overlooked the fundamental distinction between knowledge of temporal distance in the past and knowledge of temporal locations. This study applied the distinction to the development of time memory. Children of 4, 6, and 8 years of age experienced 2 target events, one 7 weeks and the other 1 week before testing. They were asked to judge the relative recency of the 2 events and to localize the older event by time of day, day of the week, month, and season. Even the 4-year-olds were successful in judging the relative recency of the 2 events and localizing the older event by time of day. However, on the 3 longer time scales, only the 6- and 8-year-olds could localize the older event, reason about possible times that it could have occurred, or tell the present time. The great accuracy of the time-of-day judgments at all 3 ages is almost certainly not due to distance-type information. The results show the separate development of distance and location judgments.

Friedman, W. J. (1990). Children's representations of the pattern of daily activities. *Child Development*, 61(5), 1399-1412.

An important part of humans' knowledge of time depends on forming mental representations of recurrent temporal patterns. This study was an attempt to characterize the representations of one such pattern—the relative times of occurrence of daily activities such as waking, lunch, dinner, and going to bed in 4–9-year-old children. The results of 3 experiments showed that by 5 years of age children can judge the backward order of daily activities, judge the forward order from multiple

reference points within the day, and evaluate the lengths of intervals separating daily activities. By about 7 years, children can also judge backward order from multiple reference points. These findings impose constraints on the types of representational models that can explain young children's knowledge of this pattern. The results also show that certain operations can be performed on this content about 6 years earlier than on 2 other temporal contents—the patterns of days of the week and months.

Strube, G., & Weber, A. (1988). The development of memory for dates and the reconstruction of the temporal order of past events. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, 20, 225-238.

Friedman, W. J. (1986). The development of children's knowledge of temporal structure. *Child Development*, 57(6), 1386-1400.

Adults have a rich understanding of a number of time systems, but little is known about how this knowledge develops. 3 experiments were conducted to test a model in which the first representations of the days of the week and months of the year have verbal-list properties, and these are later supplemented by image representations. In Experiments 1 and 2, fourth or fifth graders could judge forward relative order for these contents, but not until adolescence could backward order judgments be made accurately. In Experiment 3, fourth graders used a serial process to solve a categorical distance judgment task, whereas older groups shifted to a process with more rapid access to information about the position of remote items. The results are interpreted as supporting the 2-stage model and appear inconsistent with a number of alternative models.

Fivush, R., & Mandler, J. M. (1985). Developmental changes in the understanding of temporal sequence. *Child Development*, 56(6), 1437-1446.

In 3 experiments, 4-, 5-, and 6-year-olds' ability to sequence events was examined. We hypothesized that children initially construct temporal sequences by relying on the organization of their world knowledge instead of inferring logical relations among actions. In the first experiment, children generated picture sequences of familiar and unfamiliar events in forward and backward order without having seen the pictures in their correct sequence. In the second experiment, children

reconstructed previously seen sequences, and in the third experiment, children were shown forward and backward sequences and reconstructed them in the opposite direction. Across experiments, the same pattern of performance was found; familiar events in forward order were the easiest to sequence, then unfamiliar events in forward order, familiar events in backward order, and finally unfamiliar events in backward order. These results are discussed along with other findings suggesting a similar pattern of performance across a wide developmental age span.

Winograd, E., & Soloway, R. M. (1985). Reminding as a basis for temporal judgments. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 11(2), 262-271.

In the normal course of events, some events bring to mind earlier events. This reminding or, in the context of list learning experiments, study-phase retrieval can serve as a basis for the accurate judgment of the relative recencies of the two events in question. In this article, evidence for this position is presented in three experiments. By manipulations of encoding using visual imagery instructions and word associations, appropriate conditions were arranged for reminding to occur. The results of all three studies support the position that reminding provides a direct basis for later judgments of the relative recency of events.

French, L. A., & Nelson, K. (1981). Temporal knowledge expressed in preschoolers' descriptions of familiar activities. *Papers and Reports on Child Language Development*, 20, 61- 69.

Forty-three children, 2;11 to 5;6, described six familiar activities: making cookies, going to the grocery, having a birthday party, going to a restaurant, getting dressed, and having a fire drill. They described each event three times. The descriptions were elicited by initially asking "What happens when...?" or "What do you do when...?" and then providing non-directive probes such as "Can you tell me more?" and "Anything else?" Reviews of the children's descriptions indicate that the request for description of events divorced from the immediate context elicits a sophistication in temporal structure and relational vocabulary that is often not accessed in either experimental or free-play settings with preschoolers. Performance in such settings can considerably expand what is known about preschoolers' cognitive and linguistic abilities. The baseline competency demonstrated in these settings can provide the foundation for more controlled research that attempts to establish how experimentally based competency gradually develops into the more

abstract, decontextualized knowledge that characterizes adults' understanding of relational terms.  
(Author/JK)

Tzeng, O. J., & Cotton, B. (1980). A study-phase retrieval model of temporal coding. *Journal of Experimental Psychology: Human Learning and Memory*, 6(6), 705-716.

Two experiments were conducted to evaluate three different theories of temporal coding. In the first experiment, subjects learned a list of categorizable words presented in a random fashion. In the second experiment, similar categorical instances were presented block by block. After list presentation, subjects were asked to make recency judgments on 10 pairs of intracategory items and 10 pairs of intercategory items. A strength theory predicts no performance difference between these two types of test pairs. A tape-recorder theory predicts a difference favoring the intercategory pairs. On the contrary, a study-phase retrieval model of temporal coding predicts better performance for the intracategory pairs than for the intercategory pairs. The results of both experiments strongly support the last model. The conceptualization of automaticity in temporal coding is also discussed with respect to developmental data.

Friedman, W. J. (1978). Development of time concepts in children. In H. W. Reese, & L. P. Lipsitt (Eds.), *Advances in child development and behavior* (Vol. 12, pp. 267-298). New York: Academic Press, Inc.

Friedman, W. J. (1977). The development of children's understanding of cyclic aspects of time. *Child Development*, 48(4), 1593-1599.

Developmental psychological approaches to the study of time have fallen into 3 categories: studies of time perception; studies of logical, reconstructive abilities; and studies of the understanding of conventional time systems. The present work examines problems spanning the latter 2 categories--the development of children's understanding of temporal cycles and the relationship between cyclic concepts and cognitive development. 62 children, ranging in age from 4 to 10 years, were administered Piagetian tests of classification and seriation and a variety of specially designed cyclic tasks. Results show major progress in the representation of cyclic order and recurrence during the age period examined. For a variety of particular cycles, order responses were shown before continuity responses. The ability to produce a correct order is related to seriation performance but not classification performance when the variance attributable to age is partialled



out. Continuity responses appear to be unrelated to performance on either of the Piagetian tasks tested when age is controlled.