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Children Provide Reasonable, but Imprecise, Temporal Information About a Recently Experienced Event

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ABSTRACT

Despite considerable interest in children's ability to provide temporal information, there remain many unanswered questions about what children can provide and how to elicit this information. In Study 1, children (N = 147, aged 5 to 10 years) participated in an activity session. Either shortly after or 1 day later, children completed an interview focused on temporal concepts: duration, temporal distance, day of the week. Children generally provided imprecise temporal information, though there was evidence of a developmental improvement in accuracy. There was little evidence of a negative impact of delay to recall on children's accuracy. In Study 2, children (N = 139, aged 6 to 12 years) participated in an activity session and 3 days later completed an interview about duration and temporal distance. Overall, accuracy was low, but most estimates were reasonable. The present studies have implications for both what is considered an accurate response and for what degree of temporal precision is reasonable to request from children.

1 | Introduction

When recounting a prior experience, several types of temporal details might be provided. For instance, if a child were recalling a recently attended birthday party, an interested listener might query how long the child was there or how long ago it took place, including an estimation of the time that has passed since the event as well as requesting temporal markers to date the party (e.g., day of the week, month, season, year). Recalling such information may enhance the richness of an entertaining story, but when circumstances are more serious, such details can be critical for ensuring a child's safety. For instance, in a medical context, a child may be asked to recall for how long they have had a particular symptom (e.g., a headache). In a forensic context, temporal information can play a central role in assessing the likelihood that a crime has been committed, that a particular person committed the crime, or to provide sufficient detail to lay charges. Here, we focus on the forensic context.

Temporal information is often required in forensic settings and is regularly requested of child witnesses (e.g., Cameron et al. 2024; McWilliams et al. 2019; Woiwod and Connolly 2017). While children's developing temporal understanding (e.g., including temporal language production and comprehension, temporal cognition; see Zhang and Hudson 2018) has been examined in the literature, understanding children's abilities is complex. For example, there are various types of temporal information (e.g., temporal distance from one event to another, duration of an event) that vary in complexity and development. Furthermore, like many other memory tasks, autobiographical events akin to experiences relevant to the forensic setting are challenging to re-create in the laboratory (e.g., long durations; see Block and Zakay 2008; Friedman et al. 2010 for discussion). Most events that bring children to a forensic interview will involve durations from minutes to hours, delays to recall of days or longer, retrospective judgments, and complex events. Each of these factors warrants focused investigation, but each also often varies between studies without experimental manipulation.

While obtaining temporal information from victims and witnesses is central to forensic investigations, spontaneous reports of temporal information are only infrequently provided by children reporting autobiographical events (Friedman and Lyon 2008). Given the investigative value of such details, interviewers often have great interest in such information and will thus actively seek to elicit it. Further, the style of questioning among those in the legal system may interfere with children's ability to respond accurately to such questions; defense attorneys have been found to primarily ask children closed-ended questions about temporal information (Cameron et al. 2025), questions that are difficult to express uncertainty in response (e.g., McWilliams et al. 2019). These targeted efforts to obtain temporal information make exploring both children's developing capabilities and the methods which most reliably elicit this information critical.

The ages of 6–12 are crucial years for advancements in understanding and reporting a variety of temporal details. For instance, in a meta-analysis, Block et al. (1999) identified 7 to 12-year-olds as similar, but more variable, in time judgments compared to 13 to 18-year-olds. Furthermore, though children are able to provide some accurate duration information by 8 to 10 years, older children appear to differentiate varying durations of stimuli more accurately (Droit-Volet 2003); Pathman et al. (2023) observed developmental improvements (ages 4 to 5, 6 to 7, and 8 to 10-year-olds) in temporal clustering of a complex autobiographical event, and by 8 years, Friedman observed that children evinced similar predictable time estimation errors to adults (Friedman 2008). Further, Sutherland (2022) found that among children aged 6 to 14 years, older children provided more overall temporal information and were more accurate in their temporal detail recall than younger children when recalling details of the COVID-19 pandemic. There is also evidence that some temporal details (e.g., day of the week, month) are recalled better than chance by 6 years of age (Pathman et al. 2013; Friedman et al. 2011; but see Friedman 1991 for an exception with the day of the week). Thus, it appears that children in the mid to late elementary school years are in the critical age range for developing the ability to report different types of temporal detail.

The observed developmental differences might be attributed to the way in which a person arrives at a temporal estimate. Friedman's influential work has demonstrated that children's localization of events in time comes from a process of reconstruction. The reconstruction process takes into account specifically what is remembered about the event in addition to general knowledge of time patterns (e.g., month and weekday sequences, season, weather) and one's own autobiography (e.g., major events, daily routines). Recently, Jack et al. (2016) reported that reconstruction-based responses were most common for children reporting finer-grade time scales (time of day) than coarser-grain time scales (e.g., year) and that children's use of reconstruction may be less efficient than adults' (see also Pathman et al. 2013). Of course, as with many concepts, children's ability to discuss temporal concepts will precede their ability to comprehend these concepts, and the development of comprehension is protracted (Tillman and Barner 2015). These mechanistic explanations of children's abilities provide an important framework for studying how children recall temporal information, but much more research is needed that incorporates the complexity of events that children experience.

Children's ability to provide temporal information (e.g., duration, temporal location) and factors that influence accuracy have been examined across several different studies using a variety of methodologies. In one creative study, Friedman et al. (2010) asked 6 to 12-year-old children to estimate the duration of a pediatric examination either 1 week or 1 month after the exam. Children erred by an average of 13 min in their estimations (actual exam duration ranged from 5 to 45 min), and estimation accuracy was unaffected by delay to recall. Interestingly, children's estimates were not different from adults', who erred by an average of 12 min. In examining other types of temporal information, Wandrey et al. (2012) reported that children aged 6 to 10 years showed very poor ability to estimate the frequency and temporal location of two abuse-relevant experiences: visits to dependency court and placement changes. Wandrey et al. found little evidence for consistent developmental differences and that children of all ages experienced great difficulty in providing temporal information. For example, only 10% of the sample was able to correctly identify the month of past events. The authors highlighted children's limited experience with comparable events, children's maltreatment status, and that the events were nominated by researchers as factors that may have contributed to children's difficulty. Exploring a long delay and a variety of time scales (time of day, day of the week, month, season, year), Jack et al. (2016) asked children (9–11 years), adolescents (14–16 years), and adults about memory for a video clip and interview (a visit to the university) 8 months after the event took place. Importantly, the authors noted that children were equally accurate to adults on some time scales (but not day of the week and month), and adolescents performed the same as adults on all time scales. The authors hypothesized that the observed age differences could be due, in part, to improvements in conventional time knowledge (semantic knowledge about time). These studies introduce some of the many complexities in exploring children's recall of temporal information and provide valuable information about factors that might influence children's recall.

In Study 1, we focus on three different types of temporal information: duration, distance, and day of the week. Though all temporal information will at times be of interest, our aim was to select the types of information that would often be sought in investigative interviews of children. First, estimates of duration (i.e., the length of time an event takes place) may be of particular interest in forensic settings because duration information can contribute to the specificity of an account, and it may also provide detail which can be refuted (or confirmed) via suspect alibi. For example, if a child reports that an abusive incident began after they arrived home from school and took place for an hour, a suspect may be able to refute the claim as they would have been arriving at work within that time window. In contrast, if the child claims that the event only took place for a few minutes, the suspect's alibi may no longer stand. There is an organized and thorough body of literature that has explored children's estimates of duration in a laboratory setting (e.g., duration of an auditory tone; McCormack 2015), but one of the most critical findings from studies of personally experienced events is that children do not appear to reach adult levels in recalling duration until at least 10 to 12 years of age (Friedman et al. 2011; Pathman et al. 2013). This work indicates that there is developmental improvement in duration estimation, which has been attributed to developmental increases in sensitivity to duration (see McCormack 2015) and to children's increasingly effective use of duration language (e.g., Block et al. 1999). As children become more sensitive to detecting and describing variations in durations, we can infer that this ability is likely to contribute to more accurate reports of such information, and that this increasing sophistication will extend beyond basic laboratory tasks to more complex personally experienced events.

Similarly, estimates of temporal distance (i.e., how long ago an event took place) can be useful for placing an event within a particular time frame, often a critical detail when laying criminal charges. The extant literature that has explored children's ability to estimate the temporal distance between an event and the present indicates that this is a difficult task for children, and it becomes more difficult with greater temporal distance (e.g., in 5- to 7-year-olds; Hudson and Mayhew 2011). There is discussion surrounding the ages at which children show developmental improvements in temporal distance estimates, with some research indicating few developmental differences in middle childhood (Friedman 2005; Friedman et al. 2011), and other research showing improvements in later childhood (after 7 years; Pathman et al. 2022). Some of these observed differences may be a result of methodological variability (see Pathman et al. 2022), which indicates much more work is needed to fully understand the development of such skills. There is some evidence that children begin to show adult-like patterns of recalling temporal distance information at around the age of 8 to 10 years. Deker and Pathman (2021) explored the temporal distance effect (i.e., when temporal order accuracy is higher when two events are separated in time) in children aged 4 to 10 years and concluded that by 8 years of age, children began to benefit from distance-based judgments in which the temporal order of events is estimated based on perceptions of the relative strength of the memory traces. Despite a lack of clear age predictions in the acquisition of this ability, it is clear that middle childhood is an important time for children's ability to make judgments about temporal distance.

Finally, we were interested in children's ability to recall the day of the week, an example of conventional time knowledge. Though such concepts are often assessed with standardized tasks (see Pathman et al. 2022), children's ability to apply their knowledge of the days of the week to a prior event is of substantial interest in applied settings. There is evidence that children's use of conventional time scales is protracted in development and that there are likely considerable qualitative differences in the understanding of such concepts throughout childhood (see McCormack and Hoerl 2017). When assessed using standardized tasks, age-related improvements in children's use of conventional time scales have been observed, as has the extension to dating prior autobiographical events (e.g., Friedman et al. 2011). Thus, as with many other temporal concepts, the day of the week appears to show general improvement with development.

The question of precisely when a child will be able to recall accurate temporal information about an autobiographical event is likely unanswerable. Rather, like many other cognitive capabilities, we can provide estimates of when children might have the skills required to report such information, but accuracy will depend heavily on factors other than specific age. Questions surround the impacts of event type, delay, emotionality, development, and the nature of and manner in which the temporal information is requested. While applied parties will have great interest in how to postdict if a child's accounting of temporal details of a past event is accurate, it is clear that such a task is challenging for both children and adults, and that we are far from being able to provide such guidance. Given that this information is frequently requested of children in forensic settings (e.g., Cameron et al. 2024), we must continue to explore what information children may be able to recall and under what circumstances, as well as the best ways to elicit this information.

There is now a long history in the forensic interviewing literature recognizing that one of the most substantial influences on the type of information children provide is the way in which questions are asked of them (e.g., the suggestibility literature; Bruck and Ceci 1999). Thus, one promising avenue of investigation for promoting accurate temporal detail recall from children is to focus on the way in which a questioner elicits such information. The way in which a question is posed can have a substantial influence on children's response accuracy (see also the vast literature on the importance of open-ended questions in investigative interviewing; Lamb et al. 2018). For example, Price and Evans (2021) found that when 6- to 8-year-old children were asked to provide within-event sequencing information, specific visual cues were much more likely to result in accurate reports than open-ended prompts. Thus, it is worth further consideration of how particular prompts can help us to both understand children's capabilities and to understand which prompts will be most effective in eliciting accurate information.

1.1 | A Note on "Accuracy"

Though the extant literature provides guidance for anticipating what temporal information children may be able to recall, there remains a key challenge in applying this knowledge to forensic and likely other applied settings. Individual cases will vary in the importance of precision of temporal estimates (e.g., see McWilliams et al. 2019 for a discussion of events "near" in time). That is, in one case, it may be sufficient to know that a particular event took place in the afternoon, whereas in another case, it may be critical to know which hour in the afternoon. Thus, what response is considered "accurate" will vary depending on the context of the case. Researchers can make reasonable guesses about what precision is likely to be acceptable in forensic contexts broadly, but there are certainly circumstances under which less or only more precision will be of use to investigators. In the present study, we make decisions about which of children's responses are "accurate" (as described below), but we note here and throughout the relative capriciousness with which such decisions are made and the critical consideration of such ambiguity as the field continues to explore children's capabilities.

2 | Study 1

The extant literature is a patchwork of creative studies, capitalizing on naturalistic events, staging engaging events, and exploring recall in tightly controlled laboratory conditions. The research focused on autobiographical events often involves dating events that took place weeks, months, or even years ago (Friedman and Lyon 2005; Friedman et al. 2011; Jack et al. 2016; Pathman et al. 2013; Wandrey et al. 2012) or focuses on very short-term estimations—within minutes of the event. Thus, one area of critical foci is the delay from the event to recall. In Study 1, we compared children's almost immediate recall of temporal information (within 10 min of the event) with recall 1 day later. This latter delay may replicate conditions in which a child immediately reports a crime but must wait a short delay for a forensic interview. We compared this one-day delay condition with an immediate recall condition to explore the short-term decay of temporal information.

We assessed children's ability to provide information about three temporal concepts: duration, distance, and day of the week. Further, given the evidence in other domains that how questions are asked can influence how children provide specific information (e.g., Gosse and Roberts 2014; Price and Evans 2021), we selected one of our temporal concepts of interest, duration, and introduced varying levels of specificity in the way in which we asked children to provide duration information. We selected duration for this additional exploration because we anticipated that we would obtain the most variability in responses about this concept, given the relatively fine-grained detail responding to this question would require. The particular questions we selected were driven by our experiences reviewing forensic field interviews and the struggles that many interviewers both show and express in eliciting such detail. Questions used were designed to avoid the introduction of suggestive information and were either open, cued, or option-posing. For the duration question, in addition to an open-ended prompt, we also presented children with an anchoring question and an analogy question. The aim of the anchoring question was to observe children's response to a broad prompt using common duration lexicon with an option-posing question (i.e., a few minutes or more than a few minutes?). The aim of the analogy question was to assess the possibility that children's prior experience with the duration of familiar events could assist them in estimating the duration of events of similar length (Friedman 1990). We explored these concepts in a naturalistic event across a wide age range (5 to10-year-olds) and two delay intervals (immediately after the event, 1 day later). In exploring these concepts, we developed the following predictions:

1. Consistent with the broader literature on temporal information reviewed earlier, children's ability to provide accurate temporal information will improve with age.
2. Children will be more accurate in estimating an event's duration after a short than a long delay, given the relatively greater memory trace strength expected at a short delay (e.g., Baker-Ward et al. 2021).
3. Children will be more accurate in describing the temporal distance since the event after a long than a short delay due to the reduced precision required to make a larger-scale estimate.

In addition to the above predictions, we also explored how the way in which a question is asked influences recall accuracy of the event's duration. Previous research clearly demonstrates that open-ended questions are the superior prompt type for eliciting accurate recall of event details, but given the infrequency with which children naturally provide some temporal details (e.g., distancing, temporal location; Orbach and Lamb 2007), recalling some details might require additional cues that, under limited circumstances, could improve recall accuracy.

3 | Method

3.1 | Participants and Design

We recruited 147 children aged 5 to 10 years old (78 males, 69 females, $M = 7.15$, $SD = 1.13$; $n = 9$ 5-year-olds, $n = 29$ 6-year-olds, $n = 61$ 7-year-olds, $n = 34$ 8-year-olds, $n = 7$ 9-year-olds, $n = 7$ 10-year-olds) from a summer science camp and local child care facilities. A power analysis was conducted to determine the sample size for a binary logistic regression using algorithms described in Demidenko (2007, 2008) demonstrating an 80% chance of correctly rejecting the null hypothesis that age and delay condition are not related to accuracy with a sample of 190 participants (with $\alpha = 0.05$, $OR = 2.33$). However, given constraints on the number of children who participated in the camps, given parental consent rates and time constraints due to camp activities, we were unable to reach this number of participants. As a result, we note that caution is required in interpreting null findings. After participating in an activity session, children were randomly assigned (except where the camp or care center indicated the children were unavailable for interview for a particular delay) to either be interviewed the same day as the activity session (almost-immediate condition; henceforth referred to as same day condition) or 1 day later (delay condition; henceforth referred to as next day condition). Parental consent and children's verbal assent were obtained prior to interviews, and ethical approval was obtained from the institutional research ethics committee.

3.2 | Procedure

Children attending daytime-only summer camps or childcare participated in a novel interactive 45-min (approx.) science activity session (the "magnet games") with a care center/science camp visitor. The activity session was introduced as a lesson on magnets and involved four distinct magnet games, each with unique materials and scientific explanation. The activity leader did not make specific temporal references (e.g., to time of day, duration of activity, or day of the week), but a clock was available

TABLE 1 | Questions posed in Study 1.

Concept	Question Sequence →		
Duration	**Open Question:** *How long did it take to play all the magnet games?*	**Anchoring Question:** *Did you play the magnet games for a few minutes or longer than a few minutes?*	**Analogy Question:** *Did you play the games for as long as one TV show or more than one TV show?* If more than one, *How many? Which TV show?*
Temporal distance	*How long ago did the magnet games happen?*		
Day of the week	*What day of the week did the magnet games happen?*	If "*I don't know*", visual provided: *Which day was it on?* Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday	

Note: Though children were able to select which TV show to analogize duration, coders compared actual show length to determine accuracy.

in each facility. Either shortly after the magnet games (same day condition) or 1 day later (next day condition), children were individually interviewed about the games by a new researcher. The researcher asked children to think about when the visitor came to play the magnet games. Children first responded to a series of questions about the sequence of events within the activity session (see BLINDED). Children were then asked about the concepts of interest in the present experiment: duration, temporal distance, and day of the week. Table 1 displays the questions used to assess each concept. Duration questions were asked first, followed by the temporal distance question, then the day of the week question(s). For the final day of the week question, interviewers verbally named and pointed to the image of each day of the week.

3.3 | Coding

Two coders, blind to conditions, coded 50% of the sample to achieve intercoder reliability. Kappa values indicated good intercoder agreement (range 0.79–0.95) across all dependent variables. As noted in the introduction, the decision of what was an "accurate" response is somewhat arbitrary given that the level of precision required is likely to vary depending on context. Thus, we sought to establish a degree of precision that would seem reasonable when assessing real-world events.

3.3.1 | Duration

Children's responses to the open duration question, "How long did it take...?", were coded as accurate if their estimate was within 15 min of actual duration (45 min; range of 30–60 was 'accurate'). The 15-min time frame was selected to allow comparison with prior literature that has found children's estimates were on average within 13 min of an event's duration, for an event that lasted up to 45 min (Friedman et al. 2010). We selected 15 (rather than 13) minutes given the propensity for time estimates to be rounded. Children who provided verbal descriptions of duration that were not readily transferable into numbers, such as "not very long" or "less than a day" were coded as uninterpretable.

For the anchoring question, "Did you play the magnet games for a few minutes or longer than a few minutes?", responses that referred directly to the distinction between "few minutes" and "longer" were coded (e.g., less than a few). Children who reported more than a few minutes were coded as accurate, and those who reported a few minutes were coded as inaccurate. Uninterpretable (e.g., "daytime") and inconclusive responses (e.g., "don't know") were excluded from analyses. Note that children's responses to this question do not allow us to assess children's understanding of what "a few minutes" means. That is, responses to this question were interpreted as an adult would interpret "a few minutes" rather than offering insight into children's understanding of the phrase or the duration of the games.

We took a similar approach for the analogy question, "Did you play the magnet games for as long as one TV show or more than one TV show?" If the child stated it was longer than one TV show and they provided a number for the question "If more than one, how many?" we multiplied the duration of the show (after investigation of all reported show lengths) by the number provided by the child (if they provided an interpretable response to the question "Which TV show were you thinking of?"). As with the overall duration estimates coding, responses that were within 15 min of the accurate duration (30 to 60 min) were coded as accurate.

3.3.2 | Temporal Distance

For children in the same-day interview condition, interviews took place shortly after activity completion, and temporal distance estimates were coded as accurate if the estimate was under 1 h (due to variability in how quickly children were interviewed after the event, but children were all interviewed within 1 h). For children in the one-day delay condition, responses were coded as accurate if the child provided any response indicating the interview took place the day prior (e.g., yesterday).

3.3.3 | Day of the Week

Children's responses to the day of the week questions were coded as correct (e.g., correctly naming the day of the week the event

TABLE 2 | Proportion of all children who reported accurate temporal estimations by delay in Study 1.

	Duration			Temporal distance	Day of week
Delay	Open How long did it take?	Anchoring A few minutes or longer?	Analogy One TV show or more than one?	How long ago?	Day of the week?
Same day					
Interpretable responses	0.16 ($n=58$)	0.47 ($n=62$)	0.28 ($n=40$)	0.67 ($n=46$)	0.88 ($n=68$)
All children ($n=73$)	0.12	0.40	0.15	0.63	0.78
Next day					
Interpretable responses	0.05 ($n=62$)	0.51 ($n=71$)	0.09 ($n=46$)	0.93 ($n=55$)	0.76 ($n=69$)
All children ($n=74$)	0.04	0.51	0.05	0.51	0.70
Total ($N=147$)	0.08	0.46	0.10	0.57	0.74

occurred), incorrect (e.g., naming any other day of the week), or other response (e.g., the day I had baseball).

4 | Results

Because we collected data from all children with parental consent who were present in all care centers and summer camp groups, we were not able to obtain an equal number of participants of each age. Given the dearth of relevant literature on age differences, we retained the full sample and treated age as a continuous variable, using all of the 147 5 to 10-year-olds. We examined the proportion of children who provided accurate responses as a function of all children (i.e., including both interpretable and uninterpretable or non-responses in the denominator) in each delay condition. Table 2 provides the overall accuracy proportions for all responses by delay as well as the proportion of accurate responses as a function of interpretable responses only.

We conducted a series of binary logistic regression analyses on children's accurate responses (where 0 = inaccurate, 1 = accurate) to each of the five temporal questions as a function of age (as a continuous variable) and delay condition (same day or next day interview). Age and delay were each entered on separate steps. Where appropriate, we also conducted chance analyses to examine whether children were able to successfully (better than guessing) answer temporal questions.

4.1 | Duration

Three children accurately reported that the games took 45 min to complete ($M = 18.87$ min, $SD = 17.24$; range = 7 s to 70 min). As can be seen in Figure 1, children consistently underestimated the duration of the games. We examined whether age or delay influenced children's responses to the open duration question. The first step with age was not significant, χ^2 (1) = 2.56, $p = 0.109$, Nagelkerke $R^2 = 0.40$, nor was the second step with delay, χ^2 (1) = 3.17, $p = 0.075$, Nagelkerke $R^2 = 0.09$, indicating that when children were asked how long it took to play the games, their responses were not influenced by age or delay. Although these responses could not be compared to chance due to the lack of discrete response options, it should be noted that children's accuracy was quite poor with only 16% of interpretable responses correct (Table 2).

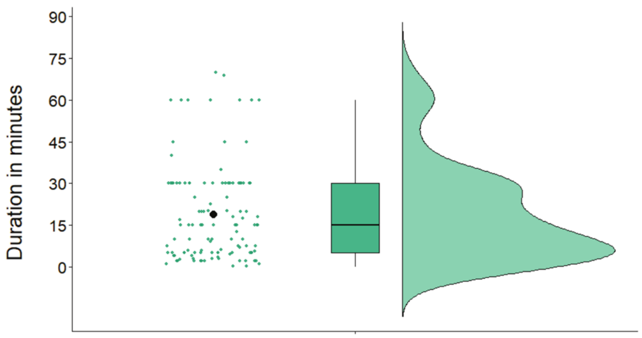

FIGURE 1 | Duration estimates raincloud plot. *Note*: Green dots represent raw data points, black dot denotes the mean value for children's duration estimates, the boxplot represents the spread and skewness of the data with the black line representing the median, and the density plot represents the approximate frequency of data points at each duration estimate timepoint.

Second, when examining whether age or delay impacted the accuracy of children's responses to the anchoring question, the model was again not significant; when asked if the game took a few minutes or more than a few minutes, there was no significant effect of age, χ^2 (1) = 1.05, $p = 0.305$, Nagelkerke $R^2 = 0.01$, or delay, χ^2 (1) = 1.83, $p = 0.177$, Nagelkerke $R^2 = 0.03$. Further, chance analyses revealed that children did not perform significantly different from chance ($M = 0.46$, $SD = 0.50$) in their response to the anchoring question, $t(146) = 1.07$, $p = 0.29$,

TABLE 3 | Proportion of accurate day of the week responses by age and compared to chance in Study 1.

	Age	*n*	Proportion accurate (SD)	df	*t*	*p*
Day of week	5	9	0.11 (0.33)			
	6	29	0.66 (0.48)			
	7	61	0.79 (0.41)			
	8	34	0.85 (0.36)			
	9	7	0.86 (0.38)			
	10	7	0.86 (0.38)			
	Overall		0.74 (0.44)	146	16.52	<0.001

Note: Chance performance was set to 0.14 (1 in 7).

suggesting that children struggled with accurately answering this question.

Third, when examining the influence of age and delay on children's ability to answer the analogy question, the first step with age was not significant, χ^2 (1) = 1.34, $p = 0.247$, Nagelkerke $R^2 = 0.026$. However, the second step with delay was significant χ^2 (1) = 5.849, $p = 0.016$, Nagelkerke $R^2 = 0.134$; children were significantly more accurate in comparing event duration to a TV show after a short than long delay ($B = 1.46$, Wald (1) = 5.18, $p = 0.023$, OR = 4.33). Although these responses could not be compared to chance due to the lack of discrete response options (children's accuracy was calculated based on their response to the initial option-posing question plus their responses to the follow-up questions), it should be noted that children's accuracy was again quite poor, especially after the longer delay (see Table 2).

Only one child accurately answered all three duration questions (a 7-year-old) and an additional eight children accurately answered two of three duration questions (all ages were represented in this latter group). To compare children's accuracy across duration question type, we included both children's interpretable and uninterpretable responses to allow consideration of children's ability to respond to the question. Children were most accurate in their responses to the anchoring question (0.46), relative to the open (0.08; $z = 7.95$, $p < 0.001$) and analogy (0.10; $z = 7.95$, $p = < 0.001$) questions. There was no difference in accuracy in response to the open and analogy questions, $z = 0.59$, $p = 0.554$.

4.2 | Temporal Distance

When examining the influence of age and delay on children's responses to the temporal question, the first step with age was significant, χ^2 (1) = 9.69, $p = 0.002$, Nagelkerke $R^2 = 0.088$; as age increased, children were significantly more accurate, $B = 0.52$, Wald (1) = 8.52, $p = 0.004$, OR = 1.68. However, the second, χ^2 (1) = 2.12, $p = 0.145$, Nagelkerke $R^2 = 0.106$, steps of the model were not significant.

4.3 | Day of the Week

For the open responses, the first step with age was significant, χ^2 (1) = 14.59, $p < 0.001$, Nagelkerke $R^2 = 0.139$; as age increased, children were significantly more accurate, $B = 0.73$, Wald (1) = 12.02, $p = 0.001$, OR = 2.07. However, the second, χ^2 (1) = 2.00, $p = 0.158$, Nagelkerke $R^2 = 0.157$, steps of the model were not significant. Children were significantly above chance at identifying the day of the week. Chance analyses could not be performed for each age due to some small ns; however, means by age can be seen in Table 3. Interestingly, most of the inaccurate children reported that the day of the games was 'Thursday' (the interview day) or 'today' ($n = 22$; 48.89% of errors).

Children were only asked the visual day of the week question (see Table 1) if they did not provide a response to the open-ended day of the week question. Most children ($n = 137$) provided a response to the open question, and thus, there were too few responses to the visual question ($n = 10$) to analyze.

5 | Study 1 Discussion

We investigated 5 to 10-year-olds' ability to accurately answer temporal context questions about duration, temporal distance, and days of the week. There were several findings of note related to each of the particular temporal concepts assessed. Children were most accurate on the day of the week question (overall 74% of children were accurate); however, this may have been a function of our delay and the setting in which we collected our data. Many of the children in our study were enrolled in week-long summer camps. The nature of a week-long camp is that each day may be marked by particular activities. Thus, there may be cues to the day of the week that are not present in other settings. Furthermore, the paradigm involved only a same-day or one-day delay, which required children to only know the current day of the week and/or the day prior, reducing the likelihood of intrusion of other days. If this was the case, we would expect our data to represent an overestimation of children's abilities to accurately report the day of the week. With a longer delay that involves multiple "Wednesdays," for example, determining which day of the week an event took place is likely to be more challenging.

Similarly, a small majority (57%) of children accurately responded to the temporal distance "how long ago" question, but again, the particular delay used in the current study must be considered. Though some prior studies have indicated that children struggle to estimate how long ago an event took place, our understanding of children's abilities is complicated by the scale of the estimates required, the variable delays, and the ways in which accuracy can be defined. Imagine a child is asked to recall how long ago a recent dentist appointment was. If the appointment took place that day, an accurate estimate will require precision to the hour, perhaps to the minute. However, if the appointment took place the prior week, we are more likely to consider the estimate to be accurate if the day of the week is recalled accurately. Each of these complications adds another layer that must be considered in research designs, interpretation of prior research findings, and in an applied setting.

The current data suggest that the way in which duration questions were asked matters. Children were much more accurate—though still less than 50%—in the anchoring option-posing question (few minutes/more than a few minutes) than either the open-ended question or the analogy question (TV show). Of course, the nature of the different questions required varying levels of precision, but what degree of precision is genuinely required in an applied context is an important question. Perhaps asking a question which yields a much broader response but is more likely to be accurate is an acceptable compromise. Nonetheless, the variability in children's responses as a function of question type must be considered when interpreting prior research in which temporal information is elicited with only one type of question. Importantly, recall that in the current design, questions were presented in a fixed order (from most open to most specific) because it was not possible to go from more probing to less. Between-subjects manipulation of question type is required in future designs, as is exploration of multiple temporal constructs, given the considerable variability in children's ability to provide accurate information in response to some questions in Study 1.

Related to question type, it is worth noting that a relatively large number of children provided uninterpretable responses to many of the questions. Because many of the questions posed to children were open-ended in nature, children often responded in ways that did not allow for coding (e.g., "not very long"). Such responses reflect children's lack of understanding of the specificity of the information requested and may not reflect a lack of understanding of the temporal concepts themselves. Similarly, children's relatively low accuracy on some of the questions where one may have anticipated higher accuracy (e.g., temporal distance in the same-day condition) may be a result of children 'rounding' their responses in a way that again reflects a lack of understanding of the precision requested rather than an inability to provide the information. Some children made time estimates in hours (e.g., "about an hour ago"), which were not precise enough in the current context to be coded as accurate. It is worth considering instructions for recall in future research to avoid such misinterpretations. These findings are an important consideration for future research and a critical caution for field practitioners who seek to avoid asking multiple questions about a single concept.

The findings related to age were largely consistent with the broader literature, with performance increasing with age. Importantly, while children were above chance at labeling the day of the week (but see 5-year-olds in Table 3 who appear to perform much worse than older children, albeit a small sample of 5-year-olds), they did not surpass chance in identifying whether the duration of the event was a few minutes or longer than a few minutes. This is somewhat surprising given that 45 min is considerably longer than "a few" minutes. It is critical to note, however, that the age range of children in our sample was wide and unevenly distributed. Though there were only 23 children who were 5, 9, or 10 years old, including them in the sample increased the variability in responses, as one would expect. We included these children in our analyses because there is limited data on recall of temporal details across different ages. However, it is clear that systematic study of a wide range of ages is needed, including consideration of longitudinal designs. It should also be noted that the current study did not have the power to detect smaller effect sizes and thus, future research is necessary with larger samples to assess the relation between age and delay (as well as many of the possible manipulations mentioned throughout this discussion). Sufficient statistical power is critical because it will allow for an understanding of which patterns are likely replicable and warrant further empirical attention.

A final observation from the Study 1 data relates to the impact of delay on children's accuracy. We were interested in exploring a short delay (1 day) and comparing that recall to children's same-day recall to explore memory decay of temporal detail recall. Studying varying delays is particularly important in recalling temporal information due to the complexity of scale effects, as described earlier. It is also a critical applied issue. Some investigative interviewers continue to believe that conducting a forensic interview at the first possible instance is the top priority. However, many guidelines recommend preparation of both the interviewer and the child for an interview as a top priority, with the cost of a very short delay worth the benefits of good preparation (e.g., American Professional Society on the Abuse of Children 2012). Our data do not make a clear case for a substantive cost for a one-day delay, but there are many methodological and coding issues discussed earlier that must be considered when drawing such conclusions. Of course, the present findings may not apply to longer delays as well. Clearly, this is another area in which much more research is needed.

There are many directions in which this research could be taken. For Study 2, we decided to extend Study 1's exploration of question type. The focus of Study 2 was primarily on the impact of the way in which questions were posed on children's ability to provide accurate information related to two of the concepts studied in Study 1: duration and temporal distance. Three question types were introduced for each temporal concept, and each child received one question about each concept. To elicit duration estimates, children were again asked the most common type of question about event duration, an open-ended question. Given the findings of Study 1 indicating that providing anchoring support improved children's duration estimates, we added two question conditions that provided anchoring support: a visual linear timeline or a clock-based timer (see below). We anticipated that the visual and concrete nature of these tasks might assist children in accurately reporting event duration, as might the restricted range of responses represented on the timeline/timer. For the temporal distance estimate, children were given an open-ended question or one of two anchoring questions: a visual forward linear timeline which required children to count the days since the event in a forward manner, and a backward linear timeline which required children to count backwards the number of days since the event (see below). Timelines were selected as anchoring support because of prior research indicating that children can effectively use visual timeline aids to reconstruct past events (e.g., Gosse and Roberts 2014). Though forward timelines have been shown to be more effective than backward timelines for recalling event order (Fivush and Mandler 1985), we opted to include a backward timeline for children's recall of temporal distance because counting back to a prior experience may be more intuitive than re-ordering backwards.

In Study 2, we prioritized a between-subjects manipulation. Using a similar paradigm to Study 1, children participated in science activities (this time much shorter: 8–10 min versus 45 min in Study 1) and were interviewed 3 days later. Because a short delay was not a particularly influential factor in Study 1, delay was not manipulated in Study 2. We hypothesized that:

1. Children would provide the most accurate duration responses to both anchoring questions compared to the open-ended question, given the observation in Study 1 that children struggled to provide interpretable responses to open-ended temporal questions. Differences between the two anchoring conditions were exploratory, but we anticipated that children's familiarity with clocks might make the clock-based timer superior to the linear timeline.
2. Children would provide more accurate temporal distance responses to the forward linear condition than the open-ended condition. Children's accuracy in response to the backward linear condition was exploratory, but given children's natural tendency to look forward in time (e.g., Fivush and Mandler 1985; Merriwether et al. 2023), we anticipated that children may be more accurate with a forward than a backward timeline.
3. As with Study 1, and consistent with the broader literature, we predicted that children's ability to provide accurate temporal information would improve with age.

6 | Study 2

6.1 | Method

We recruited 139 children ($M = 9.26$, $SD = 1.62$; $n = 6$ 6-year-olds, $n = 18$ 7-year-olds, $n = 20$ 8-year-olds, $n = 30$ 9-year-olds, $n = 33$ 10-year-olds, $n = 19$ 11-year-olds, $n = 13$ 12-year-olds from a science summer camp). As with Study 1, our participants were limited to the number of children who attended camp. After participating in a science-based activity session, children with parental consent and who themselves provided verbal assent were interviewed 3 days later. Each child received two questions: one duration question and one temporal distance question. There were six random pairings of questions, and no child received the same question type for the duration and temporal distance questions. Duration questions always preceded distance questions, but each type of question was counterbalanced across conditions. Ethical approval was obtained from the institutional research ethics committee.

6.2 | Procedure

Children participated in a novel interactive 8–10-min science activity session with a male science camp visitor (Liam) and a female assistant visitor who were purportedly there to try out some new science toys with the children. The activity session involved four distinct objects with scientific explanation (a magic wand shooting fire, a 100 lb. geode, an elevating ball, and magnetic slime). As with Study 1, the activity leader did not make specific temporal references, but a clock was available in each room. Activity sessions were on Tuesdays, and children were individually interviewed on Fridays. This delay was determined based on camp availability. The interview began with children instructed to think about when the visitors came to camp to demonstrate the activities. Children then responded to one of three duration questions (Open $M_{age} = 9.40$ years, $SD = 1.58$; Anchoring Timer $M_{age} = 9.11$ years, $SD = 1.71$; Anchoring Linear $M_{age} = 9.26$ years, $SD = 1.60$) and one of three temporal distance questions (Open $M_{age} = 9.32$ years, $SD = 1.63$; Anchoring Linear Forward $M_{age} = 9.20$ years, $SD = 1.52$; Anchoring Linear Backward $M_{age} = 9.30$ years, $SD = 1.72$).

6.2.1 | Duration Question Conditions

i. Open: How long was Liam in your classroom?
ii. Anchoring Timer: Children were presented with a handheld timer (similar to a kitchen timer, but which had a color band that filled to expand to represent the duration selected by the child) and given the following instructions: Look at this timer. I want you to tell me how long Liam was in your camp classroom using this timer. So, if he was in the classroom for 1 min, you would move the color line here (demonstrated). If he was in the classroom for an hour, you'd move the color line all the way around here. If it was somewhere in between 1 min and 1 h, show me how far (demonstrated).
iii. Anchoring Linear: Children were presented with a visual timeline that ranged from 0 to 60 and included small lines for each minute, with larger marked increments of 5 (Figure 2). Children were provided the following instructions: Look at the picture I have here. I want you to tell me how long Liam was in your camp classroom using this picture. If he was in the classroom for 1 min, mark the line over here (gestures). If he was in the classroom for 60 min—or an hour, mark the line over here (gesture). If it was somewhere between 1 min and 60 min, show me how long.

6.2.2 | Temporal Distance Question Conditions

After answering the duration question, interviewers told the children, "Now I'm going to ask you about how long ago Liam visited your camp."

i. Open: How long ago did Liam visit your classroom?
ii. Anchoring Linear Forward: This question began by asking if Liam visited the camp today. All children responded no.

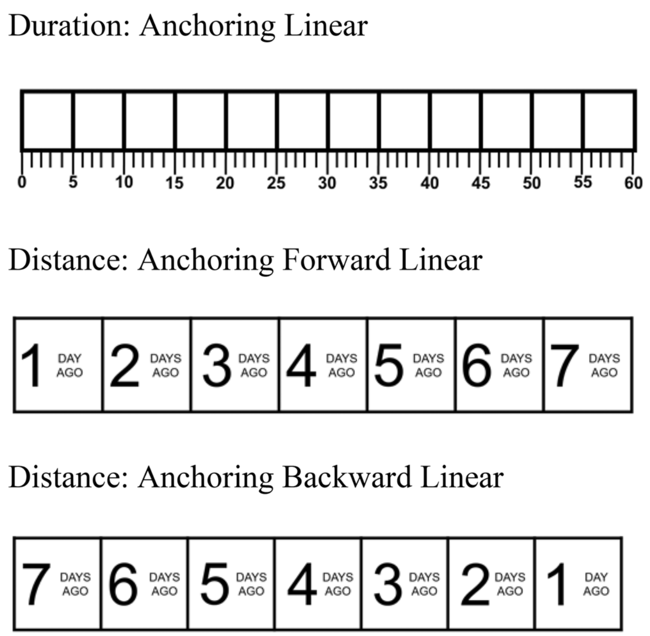

FIGURE 2 | Visual recall tools used in Study 2. Duration: anchoring linear; Distance: anchoring forward linear; Distance: anchoring backward linear.

Then, children were asked to look at an image (Figure 2) representing from 1 day ago to 7 days ago and given the following instructions: Look at the picture I have here. I want you to tell me how long ago Liam was in your camp classroom using this picture. If he was in the classroom1 day ago, point here (gestures). If he was in the classroom 7 days ago, point here (gesture). If it was somewhere between 1 day and 7 days, show me how many days ago he was here.

iii. Anchoring Linear Backward: This condition was the same as the Anchoring Linear Forward condition, but rather than the number of days presented in increasing numerical order, they were presented in decreasing numerical order.

6.3 | Coding

6.3.1 | Duration

The actual duration of the event was approximately 8–10 min. To align with criteria in Study 1 (an estimate within 15 min of the actual duration of 45 min was coded as accurate), an estimate within one third of the event duration was coded as accurate, with the outlying tails rounded due to the propensity for time estimates to be rounded. Thus, any response that ranged from 5 to 15 min was coded as accurate.

6.3.2 | Distance

Activities took place on Tuesday mornings with interviews on Friday mornings. Temporal distances were coded as accurate if a child either provided the day of the activities (Tuesday) or the number of days prior the activities took place (3 days ago). Three children (all in the open condition) responded with an “or” (e.g., Tuesday or Wednesday) or a range (e.g., “3 to 4 days ago”). Because the correct response was included, the small number of these responses was coded as accurate.

7 | Results

As with Study 1, we collected data from all children with parental consent that were present in the summer camp; we were thus not able to obtain an equal number of participants of each age. The full sample included 139 children (aged 6 to 12 years), and we treated age as a continuous variable. Two children were removed from the sample because they did not remember Liam's visit and were unable to respond to questions. One outlier was removed from the calculation of the average duration for responding that the activities took 8–9 h (Open condition); this participant was retained for the accuracy analysis. In response to the duration question, three children in the Anchoring Timer and two children in the Open condition responded with “I don't know” (IDK); these five responses were excluded from accuracy analyses. One child did not provide a response to the distance question (Anchoring Linear condition). Table 4 provides the proportion of children who responded accurately to the duration and temporal distance questions by condition. Overall, children were more accurate in their responses to duration questions (0.67) than temporal distance questions (0.47), $z = 3.51$, $p < 0.001$.

We conducted a series of binary logistic regression analyses on children's accurate responses (where 0 = inaccurate, 1 = accurate) to each of the two temporal concepts as a function of age (as a continuous variable) and question type (3 question types for each concept). Age and question type were each entered on separate steps. We also conducted chance analyses to examine whether children were able to successfully (better than guessing) answer temporal distance questions.

TABLE 4 | Proportion of children who reported accurate duration and temporal distance in Study 2.

	Duration			Temporal distance		
	Open	Anchoring: linear	Anchoring: timer	Open	Anchoring: linear forward	Anchoring: linear backward
N	46	46	43	47	44	48
Proportion accurate	0.63	0.63	0.74	0.45	0.57	0.40

TABLE 5 | Descriptive responses (in min) to the duration question (actual 8–10 min) in Study 2.

Duration			
	Open	Anchoring: linear	Anchoring: timer
M (SD)	13.01 (11.14)	15.40 (12.51)	13.07 (6.49)
Range	3–60	0.5–60	3–32

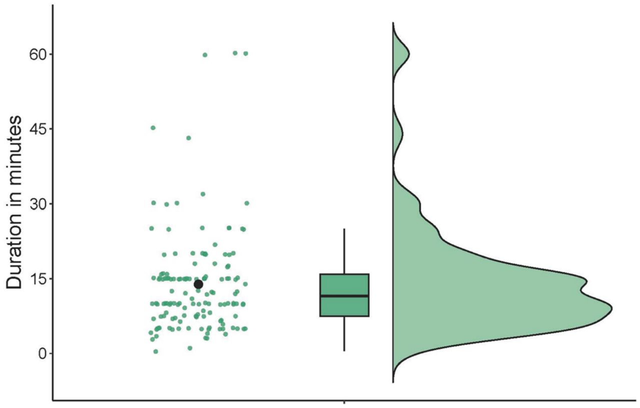

FIGURE 3 | Duration estimates raincloud plot. *Note*: Green dots represent raw data points, black dot denotes the mean value for children's duration estimates, the boxplot represents the spread and skewness of the data with the black line representing the median, and the density plot represents the approximate frequency of data points at each duration estimate timepoint.

7.1 | Duration

Descriptive statistics for children's responses to the duration questions are presented in Table 5. In contrast to Study 1, and as can be seen in Figure 3, children consistently overestimated the duration of the games. Children's accuracy in response to the duration questions did not differ across question type, $zs < 1.45$, $ps \geq 0.14$.

We examined whether age or question type influenced children's ability to report event duration. The first step with age was not significant, χ^2 (1) = 1.99, $p = 0.158$, Nagelkerke $R^2 = 0.02$, nor was the second step with question type, χ^2 (1) = 2.03, $p = 0.155$, Nagelkerke $R^2 = 0.04$, indicating that when children were asked how long it took to play the games, their responses were not influenced by age or question type. Although these responses could not be compared to chance due to the lack of discrete response options, more than half of the children in each condition were able to accurately estimate the duration of the science activities (see Table 4). Notably, when we expanded our definition of "accuracy" to require less precision by doubling the duration of the event (i.e., ≤ 20 min considered an accurate estimate), the large majority of children in each duration question condition was able to accurately estimate the event duration (Open 86%, Anchoring Linear 83%, Anchoring Timer 88%).

7.1.1 | Temporal Distance

Children's accuracy in response to the temporal distance questions did not differ across question type, $zs < 1.65$, $ps \geq 0.10$ (see Table 4), but about half of the children were accurate in each question condition. In response to the distance questions, the majority of inaccurate children provided estimates that were within 1 day of the correct day (84% in Open, 70% in Anchoring Linear Forward, 73% in Anchoring Linear Backward).

We examined whether age or question type influenced children's ability to report the temporal distance from the event. The first step with age was not significant, χ^2 (1) = 1.46, $p = 0.227$, Nagelkerke $R^2 = 0.01$, nor was the second step with question type, χ^2 (1) = 0.38, $p = 0.537$, Nagelkerke $R^2 = 0.02$, indicating that when children were asked how long ago the science activities took place, their responses were not influenced by age or question type.

8 | Study 2 Discussion

In Study 2, we continued the exploration of structured questions to examine various approaches to the provision of question support. However, we observed no differences across any of the question types. The mean accuracy across question conditions supported most of our hypotheses (i.e., increased accuracy for the duration timer question and the anchoring forward linear temporal distance question), but it is clear that the differences were not substantial enough to be observable statistically. We posit that the lack of differences may have been a function, at least in part, of the wide age range of children and resulting variability in responses. In addition, the children in Study 2 were, on average, 2 years older than those in Study 1 and thus may not have required as much support in reporting temporal information as their younger counterparts. The older average age, in addition to the wide age range, may also explain why no age differences were observed.

Despite the lack of question conditions and age differences, there was an important take-home message in Study 2: A large majority of children were within a reasonable range in their temporal estimates. We defined accuracy using an intuitive and practical approach that allowed for linkage to prior literature, but as we noted in our discussion of the Study 1 findings, perhaps such an approach needs to be adjusted when considering children's ability to provide temporal information. When we expanded our interpretation of an accurate response, a large majority of children were able to provide reasonable estimates of both event duration and temporal distance, often without the support of structured questions. The observations in Study 2 again highlight the critical role of defining what an 'accurate' response is and further the call for researchers to find ways to consider accuracy as falling on a continuum.

9 | General Discussion

Across two studies, children's ability to provide temporal detail about a recently experienced event was explored. Generally, children showed limited ability to provide precisely accurate temporal information (see also Sutherland 2022). Even when provided with question structures that we anticipated could increase their accuracy, provision of this information was challenging (as it also appears to be for adults, Friedman et al. 2010). Importantly, children's responses to the temporal questions were most often reasonable estimates, though not precisely accurate. In Study 2, more than 80% of children provided accurate duration information and more than 70% of children provided accurate distance information when we expanded our consideration of the degree of precision required to be "accurate." This finding, when considered in concert with the prior literature on children's provision of temporal details (e.g., Friedman et al. 2010), suggests that the optimal approach to obtaining temporal information from children is to consider seeking large-grain, rather than fine-grained estimates whenever possible. This finding also highlights a central issue in this body of research that we introduced earlier: what exactly is considered an accurate temporal detail will depend heavily on the context of a particular situation. The present findings, and the body of literature in which they are situated, clearly indicate a need to consider continuums of accuracy as we increasingly acknowledge the complexity of real-world situations in which children's temporal estimates are elicited. Experimental studies such as those presented here can only estimate the degree of precision that will be required in any given applied situation.

In the present studies, we focused on relatively short delays from the event to recall (i.e., a maximum of 3 days). While such delays will mirror many forensic situations in which children make an immediate allegation and are interviewed quickly, there are many other circumstances in which this may not be the case (e.g., delayed disclosure, difficulties in scheduling an interview with a trained interviewer). Even in cases where a child has made an immediate disclosure and an interviewer is available, an interview may take several days or weeks to arrange. Thus, our data likely represent close to the best-case scenario for children's recall of temporal information. Systematic research must continue to better allow contextualization of children's provision of such critical details within their capabilities. Relatedly, we know that evaluators of the credibility of witness statements tend to extend the evaluation of the accuracy of particular details to overall evaluations of a witness' credibility (Fisher et al. 2009). Importantly, recall of temporal information has previously been found to be unrelated to the accuracy of recall of event details (Friedman et al. 2010; Friedman and Lyon 2005), which should provide a caution for those concerned about the accuracy of children's reports of temporal details.

We observed different patterns between Study 1 and Study 2 in children's duration estimates. In Study 1, children showed a propensity to underestimate the duration of an event: The actual event lasted 45 min, but children reported the duration to be 18.87 min, on average. In Study 2, children overestimated the duration of the event: The actual event lasted 8–10 min, but children reported the duration to be an average of 13.85 min. We consider the opposite direction of these two estimate errors to likely be a function of the longer versus shorter event durations. This is a potentially fruitful avenue for future research.

A critical consideration in applying the findings related to question type from laboratory research to a real-world context is that actual temporal detail in the field is unknown. Thus, the judges of children's accuracy will ultimately decide the reasonableness of children's responses in the context of the particular event recalled. Of course, a critical barrier to accepting large-grain temporal estimates is that defending against a criminal allegation on the basis of an alibi requires that the evidence a child provides is specific enough that the accused could raise a time-and-place alibi (Behl and Kienzle 2022). This tension of what children are capable of reporting and how this information is typically used in the justice system is frequently encountered (e.g., Price et al. 2016).

Finally, as noted in the discussion of Study 2, children in Study 2 were about 2 years older than children in Study 1. As reviewed in the introduction, older children tend to be more capable of providing accurate temporal information than younger children (e.g., Sutherland 2022). As a result, older children may require less support in providing such information. The additional support provided by the prompts in Study 2 may thus not have yielded the same benefits for the older children as they did for the younger children in Study 1. The question of how much, and at what age, additional retrieval support is required is an important avenue for further investigation of children's memory for temporal detail.

10 | Limitations and Future Directions

We have already discussed many of the gaps that remain unaddressed and limitations to our present data. An additional consideration for future research is the way in which we calculated accuracy in Study 1. For example, we included children who provided uninterpretable responses in the denominator because it allowed us to assess the likelihood of accurate responses if the question is posed. The alternative calculation would be to exclude uninterpretable responses from the denominator, thus making the question one of children's accuracy among children who responded to the question with an interpretable response. The impact of this conservative decision is to underestimate the accuracy of children's responses under difficult circumstances (i.e., conditions that might result in a higher proportion of uninterpretable responses, such as a longer delay to recall), thus reducing the likelihood that we would observe a significant effect. In addition, we opted not to not push children to provide more precise time estimates. If a child did not answer with a specific time estimate in minutes, we did not further prompt them to do so due to the expectation that we may be accessing a weaker memory trace which would result in an underestimation of children's abilities. This strategy, too, should be the subject of future research. Further, in Study 1 we did not balance our "few minutes or more" duration question with an opportunity for children to overestimate duration. In retrospect, also assessing children's overestimation of duration would have been a more thorough way to obtain parameters for understanding how children conceptualize their responses. Relatedly, this anchoring question did not allow us to assess children's understanding of what "a few minutes" meant. Though we do not encourage the use of such a question in a forensic setting, gaining an understanding of children's interpretation of the question would advance our ability to interpret their responses.

Given the lack of a substantive literature, it is critical to study the many variables that have been shown to impact children's recall of other types of details. For instance, a common complication in estimating the duration of past events is how often similar events have been experienced. Wandrey et al. (2012) explored autobiographical events that occurred repeatedly over time after long delays and found that their sample of maltreated children had substantial difficulty on several time estimates (month, season, frequency of event). One possibility for children's challenges suggested by the authors was the enhanced difficulty introduced by tagging temporal information for instances of repeated events. In contrast, Friedman et al. (2010) asked children to recall temporal information associated with one instance of a visit to the pediatrician (and many children had been several times prior) and found children to be reasonably accurate in estimating the duration of the visit. The influence of event frequency on temporal estimations must be further explored. Finally, while the present study contributes to the understanding of children's recall of temporal information, future research should also focus on other factors that are likely to be present in forensic contexts such as the influence of stress (e.g., Friedman et al. 2010), delays, event complexity, and type of information elicited.

11 | Conclusion

Children had considerable difficulty in providing precise, accurate temporal context information. Though some questions were answered reasonably accurately by many children (e.g., day of the week), many were not. The way in which some of these questions were asked played a role in children's accuracy (Study 1), but more questions were raised than answered. Overall, our data concur with the larger literature on a general developmental improvement in children's ability to report temporal information, but it is also clear that age should not be the only consideration when estimating children's accuracy. Indeed, there are many influences that must continue to be systematically investigated, including delay, question format, time segment used, event duration, event repetition, and grain size estimates. We must also continue to consider what "accuracy" means and how to consider the context in which children are asked to provide this information. To better serve frontline investigators and child witnesses, we must continue to further parse out influences of each of these variables seen so often in the field. Adults bear the responsibility of questioning children in a way that best matches their abilities. To do so requires further research that promotes children's accuracy and improves the likelihood of positive outcomes when children are involved in child abuse investigations.

Author Contributions

Heather L. Price: conceptualization, investigation, funding acquisition, writing – original draft, methodology, validation, visualization, writing – review and editing, formal analysis, project administration, data curation, supervision, resources. **Rachel Cantin:** investigation, methodology, writing – review and editing. **Angela D. Evans:** conceptualization, methodology, visualization, writing – review and editing, formal analysis.

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Ethics Statement

This research was approved by the Thompson Rivers University Ethics Board.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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