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"When Did That Happen?": Developmental Shifts in Children's Interpretation and Use of Temporal Language

THESIS

submitted in partial satisfaction of requirements for the degree of

MASTER OF ARTS

in Psychological Science

by

Deborah Zonenschein Kamliot

Thesis Committee:
Associate Professor J. Zoe Klemfuss, Chair
Professor Jodi Quas
Professor Jessica Borelli

2024

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DEDICATION

To

My parents, Mom and Dad, I am deeply grateful to you both for your unwavering support throughout the years and for always believing in me and my abilities. I am forever indebted to you for your hard work before moving to this country and for providing me with the opportunity to pursue my education in the U.S. Thank you for consistently supporting my evolving passions, for instilling in me a strong work ethic, and for allowing me to follow my dreams.

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Thank you to my entire family in Brazil for your love and support throughout the years, even though you are so far away.

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ABSTRACT OF THE THESIS

"When Did That Happen?":

Developmental Shifts in Children's Interpretation and Use of Temporal Language

By

Deborah Zonenschein Kamliot

Master of Arts in Psychological Science

University of California, Irvine, 2024

Assistant Professor J. Zoe Klemfuss, Chair

Children's understanding of temporal concepts, such as "when" an event occurred, develops gradually between 4-9 years of age, playing a key role in their cognitive and linguistic growth. By age 4 children begin to comprehend basic time-related concepts but continue to struggle with understanding and appropriately using temporal terms (e.g., before, after) until middle childhood. Though children's temporal understanding has been previously examined, previous research has neglected some of the most linguistically simple but conceptually complex temporal questions, those asking "when" actions took place. "When" questions are ambiguous given that they may refer to any number of time points (before, after, or during something else, relative to now or a time in the past or future, time of day, week, month, or year, etc.). The current study examined developmental differences in children's responses to "when" questions and the use and accuracy of other temporal terms to clarify their responses across a key developmental period for children's temporal understanding.

Four-to-nine-year-old children ($N = 231$; $M_{age} = 6.41$ years, SD = 1.63 years) completed a 30-minute Zoom session with an interviewer wherein they watched pre-recorded videos of two

stories. Each story showed Character A playing with three toys in sequence. Character B played with a toy at the same time Character A played with the second toy, introducing a simultaneous event to the sequence. Following each story, the interviewer asked "when" each action in the sequence occurred (e.g., "when did [Character A] play with the X?"). Children's responses were coded for use of temporal terms (e.g., before, after, first, last, at the beginning, at the end) and each term was coded for accuracy. Children were more likely to use the term "last" (35%) and "first" (33%) to refer to sequential actions than "before" (10%), "after" (35%), or "second" (25%). Linear regression was used to examine children's use of temporal terms. The overall model was significant, $b = 0.16$, $t(228) = 4.242$, $p < 0.001$ indicating that age significantly predicted children's use of temporal terms when responding to "when" questions and the same pattern was seen when examining children's accuracy in using temporal terms $b = 0.268$, $t(228) = 6.701$, $p < 0.001$.

Results suggest that as children age, they become more accurate in using temporal terms to answer "when" questions. These findings align with existing literature indicating that although children in early childhood can respond to some sequencing questions, their comprehension of temporal terms is still developing. The current findings provide insight into the development of children's temporal understanding and their ability to answer "when" questions and suggests comprehension should not be assumed based on term use.

CHAPTER 1: INTRODUCTION

Questions asking "when" an event occurred are often syntactically basic and thus may be perceived as simple and straightforward for children. However, such questions are pragmatically ambiguous. For example, one might answer a question about when an event took place by specifying a date or a time of day or by placing the event in reference to the present moment or another event in the past or future. Further complicating matters, responses describing relative timing of two events may indicate simultaneity (a "while/during/as" interpretation of "when") or sequence (a "before/after/then/next" interpretation of "when"). Given potentially varying interpretations, it is of considerable interest to ascertain how children interpret and respond to "when" questions as their temporal understanding develops. Knowledge concerning children's response tendencies can reveal their developing sense of time and how they might answer adults' questions regarding salient events they have experienced or witnessed. Without this knowledge, miscommunication and misinterpretation could ensue. This can be particularly problematic in applied contexts such as forensic interviews and courtroom settings where children are frequently asked "when" legally relevant events took place (Saywitz et al., 2002).

The overarching purpose of the present study was to advance understanding of children's temporal knowledge development by identifying patterns in children's responses to "when" questions from early to middle childhood. More specific goals were to examine developmental change in children's use and accuracy of temporal terms in response to "when" questions.

Use and Comprehension of Temporal Terms

Children's understanding of time-related concepts develops gradually, with different temporal terms emerging at specific times in childhood. This understanding includes recognizing and interpreting event sequence, as well as distinguishing between past, present, and future time

(Friedman, 2008). As children develop, they demonstrate an increasing ability to understand and use temporal terms (Friedman, 2005). The category of temporal terms serves as an umbrella term for all words related to time (e.g., "when"), while sequencing terms specifically refer to the order of events (i.e., before, after, first, last), and simultaneous terms describe events happening concurrently (i.e., "while," "during," and "as").

Grant and Suddendorf (2011) explored preschoolers' abilities to produce and use general temporal terms such as "now," "later," and "yesterday." Their findings indicate that terms associated with the present and general time are easier for young children to use correctly, while more specific and complex terms, such as "hours," present greater challenges. This study shows the gradual nature of temporal comprehension in early childhood and demonstrates that certain terms are inherently easier for children to understand than others.

Temporal comprehension follows the ability to use temporal terms, as it involves accurately interpreting them to understand the timing and order of events. This emerging ability enables children to not only use temporal terms in their conversations but also to fully understand their meanings and apply them in everyday life.

The acquisition of temporal language and understanding of temporal concepts are closely intertwined. Temporal concepts refer to the mental framework and cognitive understanding that children develop regarding time, including their ability to understand event sequencing, temporal relationships, durations, and differentiating between past, present, and future time frames (Friedman, 2000). Young children begin developing these concepts as they experience daily routines and make sense of their everyday activities. Research shows that children's ability to use temporal terms improves significantly over time, allowing them to respond more effectively to questions related to the order of events (Clark, 1971).

Young children develop an understanding of sequences through their daily routines (Clark, 1971; Friedman, 2005). Between ages 3 and 5, they begin to grasp basic concepts of sequences and durations, enabling them to identify what happens first or last in familiar contexts (Harner, 1981). Initially, children primarily comprehend simpler, concrete terms such as "first" and "last" (Clark, 1971) because these terms directly reference the precise start and end point of events, making them visually and conceptually easier to understand (Friedman, 2005; McCormack & Hanley, 2011). For example, terms such as "yesterday," "today," and "tomorrow" allow children to describe their experiences, while sequencing terms such as "before" and "after" help children organize events chronologically (Friedman, 2003; Harner, 1980; Feagans, 1980). As their understanding of time advances, children gradually incorporate more complex temporal terms such as "before" and "after" into their vocabulary (Stevenson & Pollitt, 1987).

By the age of 4, children can respond to questions involving these terms, though children often struggle with these concepts because they require a level of cognitive flexibility to mentally reorder events (Friedman, 2005; Harner, 1980). Unlike simpler temporal terms such as "first" and "last," which align directly with the natural order of events, understanding "before" involves reversing the typical chronological order. For example, when asked, "What did you do *before* lunch?" children must not only recall the events but also rearrange them mentally to answer the question correctly. Understanding these questions requires the ability to process temporal relationships from a different perspective (Friedman, 2005; Klemfuss, 2020). Challenges with "before" and "after" are especially evident when children are asked to think backward in time, which often leads to errors in their responses.

Children's understanding of simultaneity and use of simultaneous terms (i.e., during, while, as) develop later and more gradually than their understanding of other temporal terms. Before age 4, children typically avoid using simultaneous terms (Carni & French, 1984) and instead focus on events occurring in sequence (Stevenson & Pollitt, 1987). By ages 5 and 6, children begin using "while" or "during" to describe familiar situations. However, children often need to be corrected, as they sometimes incorrectly apply simultaneous terms to sequential events rather than events happening at the same time (Munro & Wales, 1982).

By ages 6 and 7, children begin to grasp most abstract temporal concepts. Beyond familiar routines, such as brushing their teeth or getting dressed, children start using terms such as "before" and "after" extending to nonfamiliar acts such as attending new events (Friedman, 2000). At this stage, their comprehension of these terms becomes more consistent, enabling them to use them more accurately when discussing events outside their daily experiences. However, their comprehension remains limited compared to adults. Children at this age still rely on contextual cues and may struggle with complex temporal sequences involving unfamiliar events. For instance, although they can correctly use "before" and "after" terms, they may find it challenging to mentally reorder events in more cognitively demanding tasks, such as reconstructing the sequence of a story as it unfolds (Friedman, 2000; McCormack & Hanley, 2011). By age 7, children also show notable improvements in their understanding and use of simultaneous terms (Harner, 1980).

By ages 8 to 9, children's understanding of sequential terms begins to approach adult levels (Siegler et al., 1981). They can effectively reorder events and comprehend sequences they have not personally experienced (McCormack & Hoerl, 2007). At this stage, their use of terms such as "before" and "after" becomes more accurate across a broader range of contexts (Clark,

1971; Friedman 2008), although children in this age group may still struggle with more nuanced or complex questions that require advanced temporal reasoning.

Children increasingly use more simultaneous terms by the age of 9 and 10, though they grasp some terms earlier than others. For instance, Silva (1991) found that children typically comprehend and use "while" before "as." They are also capable of using simultaneous terms in novel situations, whereas younger children often apply these terms, sometimes incorrectly, only in familiar contexts. This suggests that while children's understanding of simultaneity continues to develop during middle childhood, adult-like comprehension is generally reached by age 10 (McCormack & Hoerl, 2007). The current study seeks to further explore this developmental trajectory by examining how children respond to ambiguous "when" questions and identifying patterns in using temporal terms.

Previous research has explored children's ability to sequence events using temporal terms (e.g., first, last, before, after) and their use of simultaneous terms (i.e., while, during, as). However, no prior studies have investigated children's spontaneous use of these terms when responding to "when" questions. The latter ("when") questions are particularly important in legal contexts, in which children may be required to recall and sequence events accurately. In uncontrolled environments (e.g., court rooms), it is often difficult or sometimes impossible to verify whether an event occurred. Yet, given the importance of accuracy in such settings, it is it is important to ascertain how well children can answer sequence question using a controlled design. Children's performance provides insight into how well they can answer "when" questions, insight that is directly applicable to legal settings, but also applicable to broader knowledge concerning their cognitive development and temporal abilities.

Ambiguity of "when"

"When" questions are inherently ambiguous, often eliciting more than one type of response. These questions refer to specific times, sequences, or durations (Tartas, 2001; Friedman, 2000). This ambiguity requires children to interpret the question's intent and adjust their responses accordingly, a skill that continues to develop during middle childhood (McCormack & Horel, 2007). While children as early as 4 years old can answer "when" questions (Tartas, 2001), those between ages 3 and 5 sometimes interpret these questions as "why" questions, responding with explanations of causality instead (Cairns & Hsu, 1978). Children are generally more comfortable answering "when" questions, especially when they pertain to familiar daily routines, given that temporal details are a common part of everyday conversations (McWilliams et al., 2023).

Research on children's temporal understanding has explored various aspects of how they comprehend time, but there is limited insight into how they respond to inherently ambiguous "when" questions. Understanding how and when children develop the ability to interpret and accurately answer these questions is crucial, particularly for professionals in the field (e.g., legal settings) where precise information about time and sequence is often required. Identifying the age at which children can accurately respond to "when" questions will help professionals tailor their questions to align with children's developmental stages, thereby reducing miscommunication and improving the accuracy of children's responses in various contexts.

As noted earlier, young children are still developing their temporal understanding, and asking developmentally appropriate questions is crucial for obtaining clear and accurate information. Questions that are not age-appropriate may result in vague or inaccurate answers,

which could undermine the credibility of children's responses, making it difficult for them to provide clear or accurate answers (Krähenbühl & Blades, 2005)

Present study

Study Aims and Hypotheses

The current study examined children's use of temporal terms to clarify their responses to "when" questions across a key developmental period for children's temporal understanding (4-9 years of age). Of specific interest are (a) children's relative use of temporal language across development and (b) the accuracy of children's responses. Findings will help us understand how children use temporal language and how children understand how to use temporal language when asked "when" questions in a controlled setting. Findings will also help us avoid misinterpreting children's responses to seemingly simple questions regarding the timing of events (i.e., "When did X happen?"). We hypothesized that with age, children would increasingly use more temporal terms (e.g., "before," "after," "first," "last) to clarify their responses to "when" questions. For our second aim, we expected that with age, children would be more accurate in using temporal terms.

CHAPTER 2: METHOD

Participants

The final sample consisted of 231 4- to 9-year-old children (M_{age} = 6.41, SD_{age} = 1.63) taking part in a larger longitudinal study concerning children's comprehension and memory of the timing and sequence of events. Families were primarily recruited through a database housed at the University of California, Irvine (Child Studies Collaborative), flyers distributed to local schools, and in-person recruitment at local venues (e.g., homecoming activities, parks, and daycares). The sample consisted of 50.6% girls and 49.4% boys, 13% of children were

Latinx/Hispanic, 29% were White, 6% were Black or African American, 26% were Asian, 21% indicated more than one race/ethnicity, <1% were American Indian/Alaskan Native, <1% were Native Hawaiian or Pacific Islander Caregivers, and 4% of families did not report ethnicity/race. Given the study's emphasis on children's ability to understand and answer questions posed in English, only children fluent in English were included and children with social, emotional, or cognitive disorders resulting in language delays were excluded.

Procedure

The present study was approved by the Institutional Review Board at the University of California, Irvine prior to testing (HS#: 2020-657). As the current project is part of a larger longitudinal study, demographic information, and language assessments were obtained during an initial visit to the laboratory.

The remaining variables in the present study were collected remotely via a live Zoom session with a trained interviewer. The Zoom session was completed approximately one week after the in-person laboratory visit (M = 8.6 days, SD = 2.26). Families were instructed to have a working computer or tablet, microphone, headphones, and webcam available for use during the session, and they were asked to be in a quiet, distraction-free area. Caregivers' consent and children's assent were obtained at the beginning of the study, and the researcher answered any questions they had. Caregivers were asked to sit behind the child and remain in the frame during the entire session without interrupting the study session. The interviewer encouraged the child to answer all the questions as best they could and to do so without help from their caregiver or anyone else. Following a brief rapport-building exercise, children completed the 30–45-minute session with the interviewer wherein they watched two pre-recorded narrated slide shows and answered a series of pre-recorded questions about the slide shows. The sessions were audio and

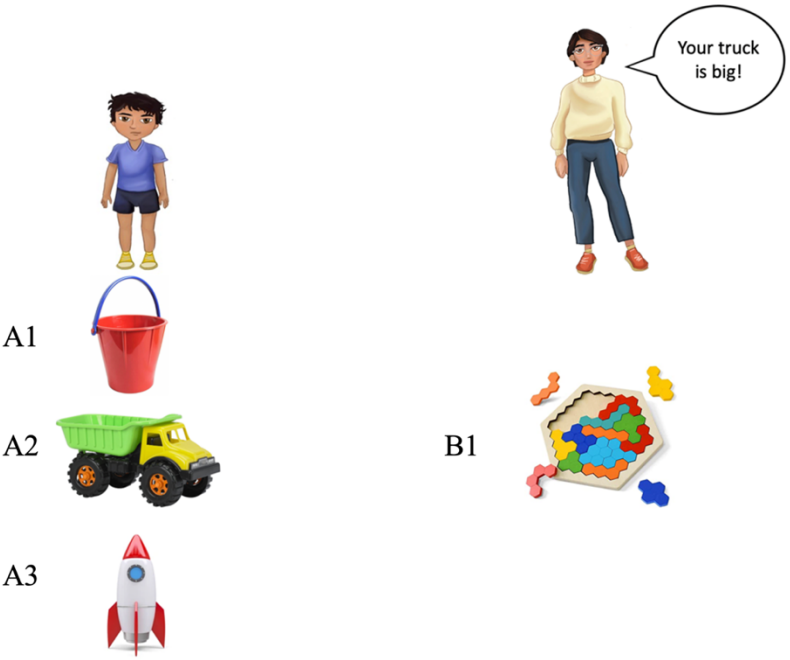
video recorded via Zoom. Caregivers completed a family demographic questionnaire on Qualtrics.

In each of the two slide shows, Character A played with three toys in sequence and Character B engaged in simultaneous play and a sequential interaction with Character A. One character was always a gender and race neutral child, and the other was always a gender and race neutral adult so that participants could easily distinguish between the two. The child and adult appeared as either Character A or Character B in the stories and they were counterbalanced across the two slideshows. In the description below, Character A is referred to as the child and B as the adult. For the example below, the slideshow first showed Character A in the upper left side of the screen and the narration stated, "A child" and then Character B appeared in the upper right side of the screen and the narration stated, "and adult were playing." First, a randomly selected image of a toy appeared on the screen beneath Character A. The narration stated, "The child played with [toy A1, e.g., the bucket]." Second, a second toy appeared beneath the child (toy A2) and a different toy appeared beneath Character B, indicating simultaneous action. The narration stated "Then, the child played with [toy A2, e.g., the truck], and the adult played with [toy B1]." Third, a speech bubble appeared on the screen above the adult, Character B. The narration stated "Then, the adult said [comment about toy A2]." Last, a third toy appeared beneath the child [Character A] and the narration stated "Then, the child played with [toy A3, e.g., the rocket]." See Figure 1 for an example of the final layout.

Following each story, a pre-recorded video was presented that asked questions about the story in a series of blocks, with question order randomized within blocks. Of interest in the current study was a set of three initial open-ended "when" questions about toy play: 1) when did [Character A] play with [toy A1, e.g., the bucket]? 2) when did [Character A] play with [toy A2,

e.g., the truck]? 3) when did [Character A] play with [toy A3, e.g., the rocket]? Images of the characters and the toys were presented on video in conjunction with the questions, and the images remained on the screen until the participant responded. If the participant stated that they did not understand or asked for clarification, the interviewer replayed the question once. If the participant was still confused, the interviewer let the video move to the next question.

Figure 1: Example of a story.



Note: The numbers on the figure indicate the sequence of events presented. The numbers on the figure are not included when the story is presented to the child.

At the end, participants and parents were thanked and provided compensation after they completed the full session.

Data Reduction and Coding

The entire Zoom session was recorded and transcribed verbatim by research assistants concurrently with data collection. All transcriptions were double-checked to ensure there were no inaccuracies. For the key questions in the current study (i.e., "When did the child/adult play

with [toy]?"), responses were coded for presence (1) versus absence (0) of each of a list of temporal terms. See Table 1 for category, descriptions, and examples of children's responses to "when" questions. The terms included: sequencing terms (e.g., before, after, first, last, then), simultaneous terms (i.e., while, during, as). For each term that was present, it was further coded for whether it was used accurately or inaccurately. Accuracy was measured by assessing if children's responses used the correct temporal term (e.g., *before* the truck, *after* the truck, first, last), depending on the question and order of toys. If children responded with a temporal term but it was incorrect in relation to the toy order, children would receive a code (1) for using a temporal term but would not receive a code for accurately using the term. Similarly to usage, children received a code (1) for accurately using temporal term and no code (0) for incorrect usage of term.

Inaudible responses and "I don't know" responses were coded as uninformative and not included in the final analyses. One graduate student coder scored all responses first. A second coder then scored a random sample of 20% of the transcripts for reliability, Cohen's d = 0.93. Discrepancies were discussed, and the primary coder implemented all final codes.

Table 1

Children's responses to "when" questions

Category	Description	Examples
Sequential term used	Type of temporal term used in response to "when" questions	"Before," "after," "first," "last," "second"
Accuracy of sequential term used	Accurate use of temporal terms in response to "When" questions	"*Before* the truck," "*after* the truck," "at the start"
Simultaneous terms used	Type of simultaneous term used in response to "when" questions	"While," "during," "as"
Accuracy of simultaneous terms	Accurate use of simultaneous terms in response to "When" questions	"*While* the adult played with the puzzle"

Analytic Plan

First, an a priori power analysis was conducted to determine the sample size. Second, descriptive analyses for the temporal term categories (i.e., temporal terms and simultaneous terms) were conducted to assess frequencies of each across each of the three "when" questions. Third, assumptions of key models and potential covariates were evaluated via preliminary analyses. Fourth, age differences in children's use of terms were examined via linear regression, followed by age differences in children's accuracy when using these terms. Of the 279 children who participated in this study, 5% of children did not complete all three questions and 2% of children had help from parents thus were excluded from the final analyses. Listwise deletion was used to handle missing data.

CHAPTER 3: RESULTS

Descriptives and Preliminary Analyses

To determine the sample size necessary to detect an effect in the current study, a power analysis was conducted via G*Power (Faul et al., 2007). The analyses indicated that to detect a moderate effect, a minimum sample size of 68 participants would be required to participate in the study. Children's normed PPVT scores were included as covariates only in models with temporal term accuracy.

Descriptive analyses were conducted via SPSS and revealed that children used temporal terms in 79% of their responses. 33% of children used "first" in their responses to "when" questions, 35.5% of children used the term "last," 10% of children used the term "before," 35% of children used the term "after," and 25% of children used the term "second." On average, 68.4% of children answered "when" questions accurately. Simultaneous terms were infrequently included (3.5%) in children's responses. Because of the low frequency of simultaneous terms, they are not included in subsequent analyses. There were no differences in the primary study outcomes by question type, therefore, the three "when" questions were collapsed for the primary analyses. Before conducting my main analyses, several assumptions were assessed. To assess the linearity assumption, the examination of the residuals was examined and indicated a linear relationship between age and temporal terms used, and between age and accuracy in temporal terms, separately. All three questions were summed up to get a sum score for temporal term use and a sum score for accuracy. The scores range from 0-3, 0 representing either no temporal term used and 3 representing temporal terms were used in response to all questions, similar scores were used for accuracy.

As this study examined children's abilities to understand and answer questions in English, preliminary analyses tested whether children's scores on the Peabody Picture Vocabulary Test (PPVT) (PPVT-3; Dunn, 2018) were related to children's temporal term use and accuracy. PPVT scores were age-normed and then explored for normality assumptions using standard values. There were no children who scored more than three standard deviations from the study mean and therefore no children were excluded from the final analyses because of PPVT. Preliminary analyses also tested whether gender and SES were related to children's temporal term use and accuracy. Results revealed that PPVT, gender, and SES were not related to children's use of temporal terms. However, PPVT positively correlated with children's accurate use of temporal terms ($r = 0.17$, $p = 0.011$). Thus, PPVT was included as a covariate only when examining children's accurate use of temporal terms.

Main Analyses

To address the first aim, age differences were examined in children's use of temporal terms to respond to "when" questions via a linear regression. The model revealed a statistically significant positive relationship between age and inclusion of temporal terms, b = 0.16, t (228) = 4.242, $p < 0.001$. The overall model was significant, F (1, 228) = 10.504, $p < 0.001$, 95% CI [0.083, 0.228], indicating that age significantly predicted children's use of temporal terms when responding to "when" questions. The model explained 7% of the variance in the use of temporal terms. To address the second aim, age differences in children's accuracy in using temporal terms to answer "when" questions were examined via a linear regression analysis, PPVT language scores were included as a covariate. See Figure 1 for children's incorrect and correct responses to "when" questions. The model revealed a significant positive relationship between age and temporal term accuracy, b = 0.268, t (228) = 6.701, $p < 0.001$. The overall model was significant,

F (1, 228) = 26.401, p < .001, 95% CI [0.189, 0.347], indicating that age significantly predicted children's accurate use of temporal terms when responding to "when" questions. The model explained 17% of the variance in the use of temporal terms.

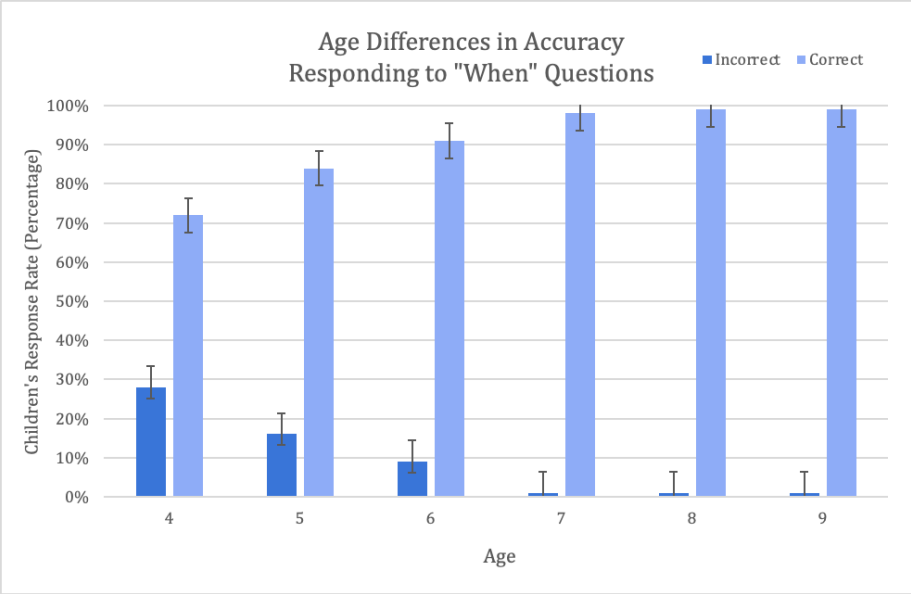


Figure 1. *Age Differences in Children's Accurate Responses to "When" Questions*

CHAPTER 4: DISCUSSION

The current study revealed that "when" questions, though they may appear simple, tap into complex temporal concepts that may be challenging for children. These questions require not only an understanding of time but also the ability to apply temporal terms in a sequential way before children have fully mastered that capacity (Friedman, 2008). Younger children often use temporal terms in responses to "when" questions, yet their incomplete mastery of these terms can lead to inaccuracies (Deker & Pathman, 2021; Grant & Suddendorf, 2011). In our study, children under the age of 7 did not reach ceiling levels of accuracy despite their frequent use of such terms, suggesting that the difficulty lies in their developing grasp of temporal language rather than the ambiguity of the questions themselves.

Children primarily relied on sequencing terms (e.g., “first,” “last,” “before”) rather than simultaneous terms (i.e., “while,” “during,” or “as”), suggesting either limited comprehension of simultaneous terms or a preference for sequencing terms as more intuitive in this context. This pattern aligns with research indicating that understanding and accurately using simultaneous terms emerges later, typically approaching adult levels around ages 9 to 10 (Harner, 1980; McCormack & Hoerl, 2007). Overall, the limited use of simultaneous terms raises questions about children’s exposure to and understanding of these concepts. The current study’s design included only one simultaneous event, potentially limited opportunities to examine their use. Future research should incorporate more simultaneous events to examine whether children’s responses remain consistent across different contexts.

It is also crucial to consider the controlled nature of this study. While it provides insights into how children interpret “when” questions in an immediate setting, real-world scenarios, such as courtroom questioning or recalling past events under stress, introduce additional complexities (Saywitz & Camparo, 2009). Future studies should explore how children use temporal terms in naturalistic and high-stress environments, such as mock interviews, to identify challenges and develop strategies to support their understanding. Using developmentally appropriate language and providing contextual scaffolding may help enhance children’s responses in such settings.

Implications

Understanding questions that ask “when” something happened is a crucial component of children’s comprehension of event sequences, with significant implications for the legal field (e.g., child interviewing). In legal settings, attorneys often need to establish a timeline of events by asking a series of “when” questions, making it essential for children to accurately interpret

and respond to these questions. This study has demonstrated that as children grow, their ability to interpret “when” questions develop with their understanding of temporal concepts.

Findings also provide novel insights into the developmental trajectory of temporal understanding and its application in responding to “when” questions. By identifying how children’s comprehension and use of temporal language evolves with age, researchers and professionals can ask developmentally appropriate questions to children. More specifically, understanding how children understand and use temporal terms is crucial in forensic settings to piece together information about events. Professionals need to evaluate children’s temporal language as it relates to their interpretation of “when” questions to ensure that children are being asked questions that they can answer correctly. By examining how children understand and use temporal terms to respond to “when” questions in a controlled setting, professionals can develop better questioning techniques that align with children’s cognitive abilities to ensure that their responses are accurate. Furthermore, this understanding can improve questioning practices, specifically in legal settings where better training for attorneys and forensic interviewers on how to ask questions in developmentally appropriate ways can lead to more accurate responses from children which will results in the correct convictions.

That is, beyond assisting legal professionals, findings can also inform professionals in other contexts, such as healthcare. In order to give the correct diagnosis and prognosis for children, such professionals often need to understand when an event happened. Practitioners often ask children “when” the pain started hurting or “when” the event took place to properly examine their injuries. If children report incorrect information, healthcare workers will be providing inaccurate diagnoses and prognoses, which in turn would result in inadequate outcomes.

Limitations and Future Directions

Despite contributions to the field of developmental psychology, this study has several limitations that are worth noting. First, the design was cross-sectional, so the findings do not provide insight into how individual children's temporal knowledge develops over time. Future work should employ a longitudinal research design to understand the trajectory in which children can use temporal terms to clarify their responses to "when" questions as well as understand how their accuracy develops in response to these questions. Second, the study assessed children's temporal understanding for an innocuous video comprised of brief actions by a child and adult character. The experience was not personally meaningful and did not involve children's own actions. Nor was the experience emotionally arousing or salient. Future studies should assess whether children's responses to "when" questions vary as a function of personal involvement, stress, or salience, given that these factors are widely known to influence children's memory more broadly. Findings would complement those reported here and contribute new knowledge about nuances in the development of children's temporal understanding.

Conclusion

The current study highlights the complexities inherent in children's responses to "when" questions, which, despite their syntactic simplicity, tap into developing temporal concepts and language skills. Although children are often expected to answer such questions accurately, the pragmatic ambiguity of "when" questions present significant challenges, requiring children to interpret and apply temporal terms they may not fully grasp. Findings indicate that children predominantly rely on sequencing terms such as "before" and "after," while their use of simultaneous terms like "while" or "during" is limited (Friedman, 2003; Harner, 1980). This suggests that sequencing terms are either more intuitive or developmentally more accessible,

while simultaneous terms require more advanced cognitive and linguistic abilities that typically emerge later in childhood (McCormack & Hoerl, 2007). Furthermore, younger children's inaccuracies in response were not solely due to the ambiguity of "when" questions but also to their incomplete mastery of temporal terms (Grant & Suddendorf, 2011).

Findings have important implications for applied settings, particularly forensic interviews and legal proceedings, but also healthcare settings, where understanding and accurately interpreting children's temporal language is critical (Saywitz & Camparo, 2009). By identifying developmental patterns in children's comprehension and use of temporal terms, researchers and professionals can create age-appropriate questioning techniques that reduce ambiguity and align with children's cognitive abilities (Tartas, 2001). This can improve the reliability of children's testimony and ensure their responses are better understood. Future research should explore how contextual factors, such as stress or unfamiliar events, affect children's temporal reasoning and language use in real-world settings. This research could offer valuable insights into professionals in education, clinical practice, and legal contexts.

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