DOES MOTHER'S EARLY TALK IMPACT CHILDREN'S INCLUSION OF TIME AND SPACE DETAILS IN THEIR AUTOBIOGRAPHICAL NARRATIVES? A 12-YEAR LONGITUDINAL STUDY

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Abstract

In this longitudinal study we examined the developmental trajectory of children's inclusion of WHEN (temporal) and WHERE (spatial) details in their autobiographical memory narratives from early childhood into adolescence and investigated the factors that led to this development. Children (*n* = 36) and their mothers engaged in conversations about unique past autobiographical events when children were 25-months, 40-months, and then again at 65-months. Then, when children were 12 years old, they were asked to talk with an experimenter about life changing events. Child talk during all timepoints (25-month, 40-months, 65-months, 12-years) and mother talk during early childhood timepoints (25-, 40-, 65-months) were transcribed and then coded for the speaker's inclusion of various WH-details (e.g., WHEN, WHERE; other details like WHO, WHAT, etc.). We analyzed how children's inclusion of WHEN and WHERE details in narratives changes across timepoints, how mother's inclusion of WHEN and WHERE details changed as children grew older, and whether factors such as early mother talk (WHEN and WHERE details; questions posed to children about WHEN or WHERE information) and children's conventional time knowledge was related to children's future inclusion of WHEN and WHERE details in independent conversations with the experimenter at 12-years. Results showed that (1) children's inclusion of time and space details were statistically significant over time, with time details significantly increasing across all timepoints, but space increasing significantly over longer periods. (2) Mother's inclusions of time, but not space, details were significant over the early childhood period, although mother's frequency of space details in their narratives was higher than their frequency of time details. (3) Mother's early inclusions of time, but not space, details were a predictor of children's future talk for time. (4) Conventional time knowledge task performance was also found to be correlated with children's future inclusions of time information. This is the first longitudinal study to examine children's inclusion of time and space details across childhood and into adolescence and the first to examine how factors such as early experiences in childhood could predict future narrative behaviour. This work has implications for and adds to our understanding of children’s autobiographical memory development.

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Does Mother's Early Talk Impact Children's Inclusion of Time and Space Details in their Autobiographical Narratives? A 12-year Longitudinal Study

When a child comes home from school and is asked by their mother to recount how their big show-and-tell presentation went, the child and their mother will engage in conversation that may elicit details from the child about the event, including who was there, what happened, when it happened, where things happened, and how they felt about it. The personal memories for past events and experiences that make up one's self and one's life story are known as autobiographical memories (AMs) (Bauer, 2007). AM, such as in the case of the mother and child, is often assessed by examining memory narratives, or verbal accounts or conversations about specific past experiences. Memory for the temporal details associated with past events, indicating when an event took place and the ability to temporally order and express past event information into a narrative structure, is a critical feature of AM (Pathman & Ghetti, 2014; Fivush & Nelson, 2006). However, relatively little is known about AM narrative development over time in the realm of temporal information (Pathman & Ghetti, 2014).

There are fewer studies on the development of children's temporal memory (TM; memory for 'when' information), especially compared to other types of memory (memory for 'what' information, e.g., item recognition; see Bauer, 2007; memory for 'where' information; see Bauer, Doydum, Pathman, Larkina, Guler & Burch, 2012). The majority of TM research and development in children is based on cross-sectional, rather than longitudinal studies, which cannot allow us to build a natural developmental trajectory. Moreover, most studies assessing for children's TM performance utilize lab-based event tasks (e.g., words or pictures on a computer screen), rather than autobiographical event tasks, which are unable to account for a more naturalistic occurrence of children's use of temporal information in everyday life, such as would be the case through narratives. Furthermore, presentations of stimuli and resulting performance in lab-based tasks may not always present an accurate depiction of what types of information children know and would naturally provide on their own. Longitudinal research that follows the same children's AM narratives over time would allow us to build a more ecologically valid developmental trajectory and could, in addition, allow us to explore the early experiences that may influence later memory performance.

As a preview, this MA thesis will use data from the Reese (1993) Origins of Autobiographical Memory project in which the same children were followed longitudinally from infancy to early adolescence (see Harley & Reese, 1999; Reese, 1999; Farrant & Reese, 2000; Newcombe & Reese, 2004, Cleveland & Reese, 2005, Reese & Cleveland, 2006). The data includes mother-child and experimenter-child transcripts of children's AM narratives collected over four timepoints ranging from when participants were 25 months old, to 12 years old. This thesis will examine the trajectory of children's AM development and TM development through their past autobiographic narratives during mother-child and later experimenter-child conversations. To examine this trajectory, this thesis will look to factors that support that development by examining (a) the change in narratives over timepoints, (b) children's concurrent and subsequent use of these details over time, (c) early mother-dialogue and their inclusions of temporal information during conversations with their child, and (d) children's temporal knowledge through performance of a conventional time knowledge task at the final timepoint.

What is Known About Temporal Memory Development?

Examining Accuracy of Children's Temporal Memory

Lab-based studies on children's memory development for temporal information typically involves testing their accuracy for temporal order (e.g., judging order for two events; see

Friedman 1991, 1992) and temporal context (e.g., placing events on a conventional time scale such as for season or month; see Friedman, Reese & Dai, 2011; Bauer et al., 2007) (Pathman & Ghetti, 2014). Past studies have found age-related improvements in the accuracy of these lab-based tasks across childhood (Scales & Pathman, 2021; Picard, Cousin, Guillery-Girard, Eustache & Piolino, 2012; Lee, Wendelken, Bunge & Ghetti, 2016; Pathman & Ghetti, 2014; Deker & Pathman, 2021). For example, one study examined 4- and 6-year-old children's memory accuracy for temporal order and temporal context using a story-based task (Scales & Pathman, 2021). Temporal information was tested by asking questions for temporal order (e.g., X happened before Y) and temporal context or association (e.g., X happened in the 'afternoon') (Scales & Pathman, 2021). Researchers found age-related improvements in young children, aged 4- to 6-years, in their recognition of item spatial location, and in their accuracy of temporal associations for those events (Scales & Pathman, 2021). However, the groups at each age, did not differ from each other for their temporal order and spatial association questions, suggesting that temporal and spatial accuracy differences are not present until later in development, which is made apparent when evaluating the study below.

Another study, assessing children's (ages 7-11) ability to remember an items' spatial location and temporal order, in comparison to their adult counterparts, found that memory for space developed before memory for time (Lee et al., 2016). A triplet binding task was administered, where participants saw a triplet of images on a computer screen during an initial encoding phase and were later asked questions about the image during a recognition phase. Memory for an item's location, reached adult performance by 9 ½ years, while memory for the sequence of items improved in adulthood. Plainly put, spatial accuracy reached adult performance levels by 9½ years, while TM accuracy improved into adulthood (Lee et al., 2016).

Both of the above studies and findings, comparing memory for time and space details in these lab-based studies, suggest that TM development may be protracted during childhood, where memory for space appears to develop faster than memory for time.

As with the examples above, the vast majority of children's memory studies are cross-sectional and tend to test for memory for temporal order and associations of past events through lab-based tasks (e.g., ordering pictures on a computer screen or events in time and space; Pathman & Ghetti, 2014; Picard et al., 2012; Scales & Pathman, 2021). However, greater research is needed to better understand the emergence of TM and the factors that lead to these age-related improvements.

Cross-sectional Studies on Children's Autobiographical Narrative Development

Autobiographical narrative studies could assist in unraveling the quandary of determining how children's TM capabilities develop. Examining AM narratives allow us to build an ecologically valid development for children's understanding of time and space details, by allowing us to examine natural conversations about past events. Moreover, lab-based stimuli and findings may in fact underestimate children's memory abilities (see Pathman, Samson, Dugas, Cabeza, & Bauer, 2011). AM narratives could present children with more naturalistic opportunities to display a more candid and accurate portrayal of their TM retrieval capabilities.

In cross-sectional studies, children are asked to discuss a past event with either a parent or experimenter, and then children's narratives are transcribed and coded (e.g., number and type of details, length, etc.). Cross-sectional studies have found that not only are age-related improvements seen in older children's performance for memory retrieval of temporal associations and for accounts of autobiographical events, but as children develop, they also improve on the narrative quality of their autobiographical accounts (Bauer, 2007). Older children's narratives tend to be longer, become more event-specific, and older children in their narratives are known to include more and provide more emphasis on WH-details (e.g., who, what, where, when, why, and how information) such as for *what* and *where* details (Bauer, 2007; Bauer et al., 2007). For example, one study investigated the details children (7- to 10-year-olds) provided in their narratives when describing AMs elicited by cue words, through their inclusion of WH-details (Bauer et al., 2007). Children used cue words as presented by experimenters and generated and dated memories for past events aided by pictures provided by their mothers (Bauer et al., 2007). The elements children typically included in their narratives included information for *who, what*, *when* and *where,* but not *why* information (Bauer et al., 2007). Results also showed that half (or more) of all reported events indicated information for *where* and *when* an event occurred, as well, children were more likely to provide both *where* and *when* information, but more likely to provide *where* over *when* information, when events were more than 11 months in the past (Bauer et al., 2007).

Another study by Kian and colleagues (2021), which also evaluated children's inclusion of WH-details in their AM narratives, looked at 4- to 10-year-old's abilities to remember event details retained for informal learning events, such as a past trip to the zoo. School-aged children participated in a week-long summer camp, during which they engaged in visits to zoo animal exhibits (Kian et al., 2021). On the last day of the camp, experimenters elicited autobiographical event narratives for two types of experiences inclusive of a child-selected animal event (visit to your favourite animal) and an experimenter-selected event (Kian et al., 2021). Researchers found age-related differences in the narratives produced by children, where narratives from 8- to 10-year-old children were longer than both 4- to 5-year-old and 6- to 7-year-old children (Kian et al., 2021). Additionally, age-related differences were found for children's provision of WH-details, and more specifically for *when* and *where* information, where for both types of details, 4- to 5-year-olds provided less of these details compared to their 6- to 7-year-old and 8- to 10-year-old counterparts (Kian et al., 2021). Age-related developments have been found for the inclusion TM and spatial memory (SM; memory for location of an event, or *where* information) information in AM narrative studies, yet these cross-sectional studies do not compare the patterns of development for temporal details and spatial details (Bauer et al., 2012).

Do Patterns for Temporal and Spatial Memory Differ?

SM and children's understanding of spatial or location knowledge as translated through their use of '*where'* details in narrative conversations, may develop at a steadier trajectory, while TM and children's understanding and use of temporal or '*when'* information, may be protracted in development (see Bauer et al., 2012, Lee et al., 2016; Canada et al., 2020). SM, through cross-sectional lab-based and longitudinal research as presented above, appears to develop at a steadier pace, reaches adult levels of performance earlier, and is included by children in their narratives more frequently than are temporal details. Like in the case of the mother asking her child about their presentation at school, the prerequisite for AM requires that the individual, and in this case the child, experience an event that must have occurred at some time in the past and in some previous physically defined space. AMs require both relational details of the person's personal past. Time and space are both imperative in locating an event in a person's past, however, space seems to be a more robust feature in the generation of autobiographic narratives compared to temporal features and will therefore be used to evaluate and compare the development of children's use and emerging understanding for time. We will focus on TM development throughout this project. We will also run parallel analyses with SM to see if patterns in development are similar or differ.

The study by Scales and Pathman (2021) as described earlier on, does find improvements in children's temporal association and spatial location accuracy (over 4- and 6-years of age) in a lab-based task. However, the individual age groups did not differ from themselves in their temporal order or spatial association accuracy – 4-year-olds were no different in their temporal order and spatial association performance, and neither were 6-year-olds. Lee and colleagues (2016) found that children reach adult levels of spatial memory performance by 9½ years, while children's TM performance continues to develop into adulthood, implying that TM development is protracted in development comparative to spatial memory performance. Although a lot can be assumed about temporal and spatial memory development from these studies, those very assumptions cannot be substantiated without further research. The ecological validity of these results also comes into question as these are lab-based studies that cannot naturally reflect what time and space contributions the child is making in their everyday life, such as with AM narratives. More information is needed on the patterns of temporal and spatial development, and patterns of comparison, in the context of a naturalistic AM study.

Another study looking at mother-child conversations from as early as 19-months to 51-months, found children's *orientation* details (person and spatial-temporal details) to be correlated to their mother's use of *orientation* details as early as 40-months, and that mother's use of *orientation* details at 19-months was relatively predictive of child's use of those details from as early as 25-months onwards (Newcombe & Reese, 2004). Results found earlier mother-child conversations for specific narrative details to be related to children's later conversation details (Newcombe & Reese, 2004). The distinction cannot be made however, as to what factor is instigating this increase in orientation use over time, as it is category umbrellaing other categories. Whether the leading factor is either temporal or spatial information, or whether it is neither, is not made clear. Current research leaves room to further examine and define time and space as narrative factors in children's narrative autobiographies, and the patterns surrounding either factor's development.

Autobiographical narrative research, as seen in the above studies, provide insight into the fact that as children age, from as early a 25-months and into adolescence, they are capable of using an increased amount of time details in their narratives, yet these developments may not be due to direct training. Indirect forms of development, such as through AM research where mothers indirectly scaffold their children through conversational nuances, is not always accounted for in lab-based research. Furthermore, these indirect developments, even in lab-based studies, do not consider the conjoint aspect of location or the physical spaces in which an event has taken place when a narrator is recounting a life event. Developments for time, and developments for space, have been examined and have been found to have age-related improvements, but these factors are usually examined under a collapsed category, conjoined with other factors. A more critical analysis on the independent developmental trajectory for *when* and *where* details in younger children, into adolescence, is still needed, especially considering spatial details tend to be completely disregarded or subsumed into a larger narrative category, making pattern comparisons for *when* and *where* details impossible.

Current AM studies do provide insight into children's AM and TM development. However, cross-sectional lab-based studies for AM research, cannot directly assess the emergence, or the age-related improvements present in children's AM narrative contexts for time. More research is needed to track age-related improvements longitudinally in children, especially to understand how immediate factors, such as a primary caregiver's narrative structure, may influence these abilities, and why children's TM development, compared to SM, appears to be delayed. The following studies discuss some of the parent-child longitudinal research that has been evaluated for autobiographical narratives.

Factors Supporting Children's Longitudinal Developments in Recalling Temporal Details

Although cross-sectional studies have enriched our knowledge of children's TM development, these studies are limited in their ability to make claims about timepoint differences and children's developments in natural contexts, such as through their everyday parent-conversations. For example, a longitudinal lab-based study by Canada and colleagues (2020) found that young children were able to perform above chance and improve on a task assessing temporal order memory (from ages 4 to 8). This study suggests improvements in TM are observable at earlier ages. However, this lab-based study (involving memory for the order of pictures presented on cards) is one of the only longitudinal studies that looked at TM over time, and it is not able to account for how children's autobiographical narrative details for time and space develop with age. Protracted developments of TM from cross-sectional studies parallel the only longitudinal study that shows age-related improvements for children's TM accuracy. More information is still needed to assess for both time and space in autobiographical narrative contexts.

Influences of Primary Caregiver's Talk for Event Details on Children's Narratives

Parent's talk has been shown to influence children's conversational details in their narratives. One longitudinal study by Haden and colleagues (1997) looked at children's memory to recount past events and their narrative developments over time (see also Fivush, Haden &

Adam, 1995; Kuebli, Butler & Fivush, 1995). Preschool children's narratives for autobiographical events were assessed longitudinally at 40-, 46-, 58-, and 70-months of age, with a parent or experimenter engaging the child in conversation about shared or novel past events, respectively (Fivush et al., 1995; Haden, Haine & Fivush, 1997). Narratives were coded categorically for *actions, descriptions, orientations* (spatial-temporal details that place events in space (where) or time (when), and person details that provide names of persons present during events), or *evaluations* (Haden et al., 1997). Findings show that joint retellings of the past by parents who constructed richly elaborative descriptions at 40-months, had children who recalled more memory information during parent-child conversations at 58- and 70-months (Haden et al., 1997; Haden & Fivush, 1996). Additionally, after a one-year delay, maternal elaborations were associated with pre-schooler's longer and more elaborative unguided narratives elicited by the researcher (Haden et al., 1997). Parents' use of WH-context details was also positively related to children's use of *where* information in experimenter-guided narratives six months to a year later (Haden e al., 1997). Children also included more *when* information in their narratives with an experimenter at 38- to 43-months (Haden et al., 1997). Additionally, parents who frequently requested *orientation* details, had children who came to give much more spatial-temporal details in later independent narratives (Haden et al., 1997).

Another study by Peterson and McCabe (1994) elicited mother-child narratives monthly, for 18 months (from 26-43 months old). Unlike the study by Haden and colleagues, that evaluated spatial-temporal and person details as a single category, this study evaluated details either *when* and *where* individually, giving greater weight to the *when* and *where* information provided by the child. Parental orientations were additionally categorized as *wh*-context questions (e.g., "Where did we go?", "When did we go?", "What did you play?") or yes/no context questions (e.g., "Did we go to McDonald's?") (Haden et al., 1997; Peterson & McCabe, 1994). Children's ability to independently provide *when* and *where* contextual details was correlated with their mothers' frequency in their earlier narrative elicitations and orientations. Time-lagged correlations also looked at mother's early frequency of these details with their child's later stand-alone narratives at 3 years of age (Peterson & McCabe, 1994). Time-lag correlations in this study found the number of parental context questions at 26-31 months, to be predictive of children's skills to talk about *when* something happened a year later (Peterson & McCabe, 1994). Additionally, these context questions at 32-37 months were predictive of children's abilities in providing *when* information 6 months later, at 3 years old (Peterson & McCabe, 1994). Children's frequency of providing *when* orientation details was related to their parent's earlier questions prompting for contextual details (Peterson & McCabe, 1994). A positive correlation was also found between the number of questions posed by the mother that dealt with orientating information when their children were 2½ years old, and the children's contributions of orientating information to a different adult, a year later (Peterson & McCabe, 1994). This study provides insight into the fact that there are developments for *when* and *where* details in children's developing narratives as a function of their mother's earlier conversations. Despite the adequacies of this research in its inspections of children's longitudinal narratives as a function of their mother's conversations and its focus on temporal and spatial conversational details, the small age range (a year and a half) leaves room for further research to be desired especially for older ages in childhood.

Only one longitudinal narrative study by Newcombe and Reese (2004) focused on how early mother-child conversations were related to children's later conversations over a larger time span. This study included a code authors termed *orientations* (narrative category consisting of spatial-temporal details such as “Remember the *day in Nelson*?”, or person details such as “What did *Uncle Russell* give you a ride on?”) (Newcombe & Reese, 2004). This code collapsed space and time, and person details under a single coding category. Fifty-six children, who were followed at 19-, 25-, 32-, 40-, and 51-months, and their mothers, engaged in conversations for shared past autobiographical experiences in order to examine children’s narrative details as a function of their attachment security with their mother (Newcombe & Reese, 2004). Results found that with age children increased their use of *orientation* information in mother-child autobiographical conversations (Newcombe & Reese, 2004). Over time children and their mothers increased their use of *orientations*, even more than for *evaluations*, suggesting that children’s developments for time and space details are present and become more pronounced over time, even more so than for other details (Newcombe & Reese, 2004). Consistency analyses showed that children are consistent with themselves in their use of *orientation* details from 25-months onwards, while mothers are consistent with themselves from as early as 19-months. Bidirectional analyses also showed that mother-child *orientation* use was concurrently associated from 25-months onwards, suggesting that children were internalising their mothers’ conversational narrative style (Newcombe & Reese, 2004). Mothers who used more *orientations* had children who used more *orientations* in the same conversations (Newcombe & Reese, 2004). Children, as early as 2 years old (25-months), appeared to mirror their mother’s use of conversational styles, especially for spatial-temporal and person details (Newcombe & Reese, 2004). Additionally, mother-child reminiscing at 40-months “uniquely predicted children’s later use of those elements 1½ years later, over and above earlier independent narrative use” (Newcombe & Reese, 2004, p. 231). Mother’s use of *orientations*, even more than other details, appears to influence what type of information the child tends to provide in later independent conversations. Through past longitudinal research, we become cognizant of the fact that not only do children augment their use of narrative details and information in conversations, but we also see that children's AM development is influenced by maternal narrative styles, especially when encountering instances where children provide spatial-temporal contexts.

Despite the research available that has looked at memory for space and time in autobiographical narratives, more information is still necessary to analyze the relationship between mother's explicit use and understanding of time details versus space details over time. There is evidence that early parent-talk could influence children's later inclusion of temporal details in memory narratives, but more work is needed. Studies by Haden and colleagues (1997) and Newcombe and Reese (2004) lump spatial and temporal details together in coding and analyses, and by doing so they cannot provide insight into the individual effects of each factor on children's developing AM or TM development, nor do they compare the developments of TM to SM, where SM is a comparable factor to TM yet develops faster. Alternatively, Peterson and McCabe (1994) do diverge their *orientation* category into separate *when* and *where* sub-categories that can tell us, to an extent, the developments that transpire for children's use of time and space information, and the types of prompting by the mother that elicits such details, however, they do this through a short time span (of 18 months).

Consistency and bidirectional analyses from Newcombe and Reese (2004), motivates parallel analyses this project will conduct in order to determine more focused relations between children's inclusions of time and space details over time, and their inclusions in the presence of their mother. This project will aim to extend the current research in this study by analyzing these specific details as independent categories in these analyses instead of as a collapsed category and will longitudinally examine these differences over a larger time period. Where previous literature has a propensity to look at either younger children (Newcombe & Reese, 2004; Peterson & McCabe, 1994) or older children (Habermas & de Silveira, 2008; Bauer et al., 2007), this project will be the first to examine children's development from early childhood (25-months) into adolescence (12-years). This project will be the first to fill these gaps in research by (a) focusing on SM and TM specifically, (b) looking at it through a greater time span (roughly 11 years).

Conventional Time Knowledge Task

Another factor that has been examined in relation to TM performance is time knowledge. Conventional time knowledge (CTK) refers to the retrieval of content or contextual information remembered about an event, "combined with knowledge about personal, natural and conventional time patterns to infer when the event had taken place" (Friedman, Reese, & Dai, 2011, p. 156). In essence, it is the ability to understand conventional time scales (e.g., years, months, weeks, etc.) (Friedman et al., 2011). This type of knowledge has implications in TM. As suggested by past research, greater accuracy for time knowledge can reflect children's abilities to accurately provide temporal details about their autobiographical past in their later conversations, indicating a conversation style that may be relational to their mother's earlier conversations.

A cross-sectional study by Friedman, Reese, and Dai (2011) imparts wisdom into children's development and ability to contextualize temporal details by investigating children's abilities to place autobiographical events on conventional time scales. This lab-based study looked at TM accuracy using children's autobiographical events. This task tested 8–12-year-olds' ability to localize parent-reported events in time from four different time points ranging from 6 months to 4 years in the past (Friedman et al., 2011). Accuracy in the task increased with age, where there were significant improvements in CTK performance, and scores for the CTK task were positively correlated with children's time estimates for personal past events as corroborated by their parents (Friedman et al., 2011; see review Pathman & St Jacques, 2014). Results showed that CTK performance was indicative of children's accuracy in locating events in time for long time scales (Friedman et al., 2011). This connection suggests that CTK results reflect a child's subjective temporal ability to understand their existence in the past. CTK results could be a predictive factor for children's temporal narrative abilities, their overall use of temporal details, and in their accuracy of recounting autobiographical events.

In the study by Scales and Pathman (2021) as previously described above, the CTK was adapted for younger children. The Children's Conventional Time (CCT) task was adapted for this study from a section of the CTK task (Scales & Pathman, 2021; see Friedman et al., 2011; Pathman & Ghetti, 2014; Friedman, 1986). In this study, the CCT task (coloured images on laminated cards presented on a white background) was utilized as a comparison to assess for how conventional time knowledge and flexible retrieval of that knowledge may develop over time (Scales & Pathman, 2021). Researchers found age-related improvements on the CCT subtasks, where 6-year-olds were more accurate than their 4-year-old counterparts in ordering timescales using visual cues and when answering flexible retrieval questions that required them to flexibly move both backwards and forward in time (Scales & Pathman, 2021). All tasks (Friedman, Reese & Dai, 2011; Pathman & Ghetti, 2014; Scales & Pathman, 2021) found that flexible retrieval of conventional time knowledge (e.g., CTK task) was positively correlated with individual differences in accurately remembering when past events occurred. Yet no study has examined whether flexible retrieval of CTK is related to inclusion of time details in narratives.

Past studies have shown that CTK is related to TM for past events and will therefore be used in this study as well as a factor supporting TM development. As made apparent through the CCT task, CCT flexible retrieval was a significant predictor of younger children's accuracy for temporal associations (temporal order and temporal context results) and whether children could remember and understand the order of past events (Scales & Pathman, 2021). As with the CTK as administered in the above example, the CCT subtask was also able to predict individual children's TM abilities in relation to their abilities to flexibly retrieve past event information even at a younger age range (Scales & Pathman, 2021). For our purposes, we aim to determine whether older children's CTK task results, relate to their incorporation of temporal information in the same timepoint. In the context of older children, we expect TM accuracy to be reflected in their CTK results.

Present Study

This project aims to build a developmental trajectory for children's TM performance and aims to examine the factors that support that development. This project investigates the emergence and continued developments of children's AM narratives as evaluated through mother-child and children's independent conversations for past events, with a focus on children's use of temporal details over time. By looking at children's conversations within the early childhood time period (25-, 40-, and 65-months old), and how those conversations change later into adolescence (12-years old) with influences from their mother's conversations (particularly for temporal details, and their WH-questions for time and space information), we will examine the age-related improvements and examine the factors that help to build this observed trajectory. This MA thesis uses data from a longitudinal study of children followed from 25-months-old, 40 months, 65 months, to 12 years old. Data is coded for various event details, inclusive of temporal and spatial event details, and at the 12-year timepoint, the CTK task was administered. This project has been the first to look at such an extensive breadth of longitudinal narrative data in reference to both the age-range of focus and in the total number of participants, with the purpose of assessing for time knowledge development through maternal conversations.

Lab-based cross-sectional studies show age-related improvements for TM in children. Longitudinal narrative AM studies show children's inclusion of time details increase through their development. However, a longitudinal study that looks at TM development through mother-child AM narratives, while also assessing for SM details and development as a comparison point, has not yet been done. This project will be the first to look at how mother's use of temporal details over time, as presented in a longitudinal narrative study, influences children's use of temporal details over time. Previous studies were either cross-sectional, or cohort-sequential (see Scales & Pathman, 2021; Bauer et al., 2017, respectively), and none focused on both time and space details. Although, as described above, Newcombe and Reese (2004) do analyze children's longitudinal trajectory for time and space details, they collapse these details under a single category which does not provide clarity into either factor's true development, as their study only looked at developments up to 51 months. For these reasons, gaps in the current literature need to be filled to build a true developmental trajectory over a larger period of time, particularly from early to late childhood, which this project aims to do. This project will fill gaps in the present literature by determining a developmental trajectory for children's time and space details in autobiographical narratives. This study will aim to study this developmental trajectory by longitudinally examining the narrative contributions for the same cohort of children from childhood into adolescence, along with their mothers' narrative contributions during childhood.

To assess the proposed developmental trajectory in children, we will break the research down into the following six components. (1) Provide an overview of the narratives, coding, and descriptions of all WH-details, and will analyze narrative breadth and narrative length scores. (2)

Examine each child's inclusion of WHEN and WHERE details in their narratives and how those details change as the child ages. We will also examine mother's contribution in their conversations and how mother's inclusion of WHEN and WHERE details in conversations changes as the child ages. (3) Next, over the first three timepoints, we will correlate children's and mother's use of WHEN and WHERE information in the same and in cross-lagged conversation to determine a relationship between children's and mother's inclusion of these details. As done with previous literature (Newcombe & Reese, 2004), we aim to determine how consistent children are with themselves as they age in including time and space details, and to determine how mother's inclusions of these details relate to their child's use of these details within conversations. (4) We will examine whether early mother talk (including questions about WHEN/WHERE) predict children's inclusion of WHEN and WHERE at 12-years-old (during experimenter-child conversations). We will determine whether mothers who ask more WHEN/WHERE questions, have children who include more WHEN/WHERE details on their own at 12-years. (5) After accounting for children's linguistic skills, we determine whether previous child and mother's inclusions of WHEN or WHERE details during conversations predict children's future inclusion of WHEN and WHERE details. We examined this in early childhood (does child's/mother's contributions at 40 months predict the child's contributions at 65 months) and in crossing the early child late child boundary (does child's/mother's contributions at 65 months predict child's contributions at 12-years). (6) Finally, we report whether children's CTK task performance at 12-years is correlated with their use of WHEN and WHERE details at the same timepoint. Previous studies examined temporal accuracy and found relations with CTK performance, however, it is not clear whether the same relation would be found for inclusion of children's temporal details in their narratives. This project will make strides in building a developmental trajectory in examining the factors that support this development.

Method

Participants

The present study is based on data collected as a part of the Origins of Autobiographical Memory project developed by Elaine Reese (1993) at the University of Otago in New Zealand, investigating children's origins of memory and autobiographical memory development (see Reese, 1999; Harley & Reese, 1999; Newcombe & Reese, 2004; Cleveland & Reese, 2005; Reese & Cleveland, 2006). The timepoints of interest for this study were chosen a prior. A total of 68 families participated in this longitudinal project. The present study focused on the 36 mother-child dyads that were present throughout the following timepoints, selected a priori; 25 months (*M* = 2.20 years; *SD* = .03 days), 40 months (*M* = 3.32 years; *SD* = .15 days), 65 months (*M* = 5.45 years; *SD* = .05 days), and 12 years old (*M* = 12.47 years; *SD* = .21 days).

Families were recruited through advertisements and public birth records placed in the local community of Dunedin, New Zealand. The majority of the sample consisted of children who were of New Zealand European descent, and the rest of the sample consisted of children who had one or both parents who were of New Zealand Māori, or Asian descent. There were 16 boys and 20 girls in the sample. English was the primary language spoken in all homes. Data collection for the 25-month timepoint occurred from 1996 to 1997. Children were on average of middle socio-economic status, according to Elley and Irving's (1976) scale of fathers' occupational status. Maternal education at the very beginning of the study averaged 13.3 years (*SD* = 2.33). At the beginning of the study, all mothers identified themselves as the child's primary caregiver.

Procedure

Two experimenters visited the children and their mothers in their homes at the 25-month to 65-month time point. Three separate sessions occurred within the span of 2 weeks at the 25-month and 40-month time points, and two separate sessions occurred within the span of one week at the 65-month time point (Newcombe & Reese, 2004; Cleveland & Reese, 2005). At each session, one experimenter was the primary experimenter, who was responsible for conducting the majority of the tasks with the child. The second experimenter operated the audio and video equipment and was responsible for conducting tasks and administering measures with the mother. Mothers completed consent and demographic forms at the start of the first session at each time point.

One experimenter assessed children's memory for past autobiographical events in the absence of their mothers at the 12-year timepoint during a single session that lasted approximately 1½ hours (Reese et al., 2010). Dyads were visited at a university laboratory or were visited at home. Each adolescent completed an audiotaped memory interview, a family history questionnaire, and a language task in one room with an experimenter, while the mother provided demographic information and performed accuracy checks with another experimenter in a separate rom (Reese et al., 2010).

Mother-Child Memory Conversations

Mothers were asked to discuss unique events with their child at each timepoint. Mother-selected events were to be one-time, shared, past events that occurred within the span of a day (Newcombe & Reese, 2004). Events that were selected to be discussed at each timepoint were all different across timepoints. Out of ear shot from the child, mothers first selected unique events that the children had experienced only once in their lifetime, to then be discussed with their child (Newcombe & Reese, 2004). Events that were based on scripts or routines were avoided. At 25-months and at 40-months, mothers were asked to discuss three shared past events. At 65-months, mothers were asked to discuss three shared events, and one unshared event where the child had experienced a unique event independent of the mother's presence. Mothers were asked to converse with their child in a natural, spontaneous format during conversations for shared event details at the 25-month, 40-month, and 65-month timepoints, and for unshared event details at the 65-month timepoint (Newcombe & Reese, 2004). There were no time restrictions, and the conversations were audio- and videorecorded for later transcription and analysis (Newcombe & Reese, 2004). For purposes of this thesis, only the first two shared events at 25-, 40-, and 65-months, are of focus (see Data Processing section below).

Experimenter-Child Memory Interview

At 12-years old, the experimenter began by engaging the adolescent in the Emerging Life Story Interview (ELSI; Reese, Chen, Jack & Hayne. 2010). In the first part of the ELSI, the adolescent talks about the chapters in their life as if it were a story in a book (Reese et al., 2010). The chapter task served as a warmup to the subsequent part of the ELSI which assessed the adolescent's insight into life changing events (Reese et al., 2010). The experimenter prompted the adolescent to think of two life-changing events from any period of their life, and the experimenter then asked the adolescent questions about what happened, who was there, how everyone felt, and finally how the event changed their life (see Reese et al., 2010 for details). Their conversations were audio- and videorecorded for later transcription and analysis.

For this 12-year timepoint, the experimenter began by eliciting AM narratives about two life changing events from the child. The event was selected by the child. The experimenter began by requesting the child to choose and then talk about an event from their life that changed what their life is like now (e.g., “I’d like you to try and think of a specific event that happened in one of the earlier chapters that somehow changed what your life is like now”). The experimenter would then have the child freely elaborate on the event and share as much as they could remember about the event. The experimenter would only interject in this first portion of the interview with words or sounds of affirmation (“cool”, “umm hmm”, “yeah”). The experimenter would conclude the free recall portion of the interview by confirming the child had exhausted their memory for the event and could no longer recall anything else about the event (e.g., “Is there anything else you remember about that day?”). Once the experimenter confirmed the child could no longer remember any other details (when the child answered “No” to the above question), the experimenter followed this free-recall portion of the interview by asking specific WH-questions about event details (e.g., “Who else was there?”, “Where were you?”, “When did that happen?”, “How did you feel?”, “How did the other people feel?”, and “How did this event change your life?”). As the experimenter was following the ELSI script, if the child had already provided certain details that answered pre-determined WH-questions in the open-ended portion of the interview, the experimenter asked them to repeat their responses (i.e., “I’ve got some specific questions that I’d like to ask you about that event. If you have already mentioned some of these things, if you could just tell me briefly again that would be really cool”).

To account for the free recall period by the child, in addition to the entirety of the conversations where children are also being prompted by the experimenter, the 12-year timepoint was split into two categories when conducting analyses. This included the open-ended, or free recall (12_{FR}) portion of the conversations, where the child independently recalled event information without questioning from the experimenter, and the total (12_{T}) conversation at 12-

years-old, inclusive of both the free recall portion of the conversations and all additional cuing by the experimenter's WH-questions.

Data Processing

WH Coding

For each time point, past event conversations were transcribed verbatim from the recorded audiotapes (Newcombe & Reese, 2004). Mother-child narratives at the 25-, 40- and 65-month timepoints were coded for the first two shared events for each transcript. Experimenter-child narratives at the 12-year time point, where only the child's dialogue was of interest and coded, were coded for two life changing events. For all participants, all codes and scores were averaged across two events. Three participants at the 12-year timepoint had their scores based on only one event, as only one life changing event narrative was obtained. All coding was done separately for both the child's contribution to the conversations, and for the mother's contributions.

The coding scheme is referred to as "narrative coding" to describe the coding scheme, and "narrative categories" to refer to the individual codes. Main narrative categories were; WHO, WHAT-ACT, WHAT-OBJ, WHEN, WHERE, WHY, HOW-EVAL, and HOW-DESC. For each conversational participant during each respective event, the number of codes in each narrative category was summed. Autobiographical memory narratives were coded in accordance with the coding schemes of the WH coding manual as developed by Bauer and colleagues (see Table B in Appendix; e.g., Bauer & Larkina, 2014, Kian et al., 2021).

For purposes of this thesis, we extended the previously used narrative categories "WHEN" and "WHERE" and created sub-categories to include and account for the more specific types of time and space details present in narratives. We added 5 temporal sub-codes in addition to the total “WHEN” category code and added 5 location sub-codes in place of the total “WHERE” coding category. The “WHEN” category code was expanded to include specific instances of “T” time information, “TR” repeated time information, “TV” vague time information, “TC” cases of temporal connections, and periods of “D” duration. The “WHERE” category code was divided into “LS” specific location information, “LG” general location information, “LV” vague location information, “GEO” geographic information, and “DL” directionality or distance information (see Table B in Appendix for further explanation).

In addition to the expanded WHEN and WHERE sub-categories, we added an entirely new narrative category to the coding scheme. A category for the question mothers asked during the conversations was added. This question category code accounted for all variations of WH information (i.e., questions for *who, what, where, when, why,* and *how* information) posed as open-ended or closed-ended questions (Q-O-WH__; Q-C-WH__), or whether the open-ended prompts or closed-ended questions were posed by the mother in the absence of WH words (Q-O; Q-C; see Table B in Appendix for all specific coding categories and further explanation of the individual categories). Despite having a category for mother’s inclusion of closed-ended WH-information questions (Q-C-WH__), no such questions were asked by the mother at any of the timepoints.

For example, the question a mother asked her child, “What do you remember about going to the beach last summer?” would receive the codes [Q-O-WHAT], [WHAT-ACT], [LG], [TC], [T]. The question code that this sentence would be different had the mother asked, “Can you tell me more about going to the beach last summer?”, which would receive the codes [Q-O], [WHAT-ACT], [LG], [TC], [T]. The question posed in the absence of WH question to start, are given general Q-O, or Q-C, codes. The codes given to questions are mutually exclusive, meaning that only one question code is given to a mother's specific type of question. Even when WH-details are provided in the questions (e.g., "going" would reference *what* or WHAT-ACT information in the mother's question "Can you tell me more about *going* to the beach…?"), if the explicit WH-term is not used, it would not receive a WH-specific question code. Rationale for this, as was done with previous research (see Peterson & McCabe, 1994) came from wanting to account for all specific details, and specific details when present in the mother's WH-questions.

Overview Coding: Narrative Breadth and Narrative Length

Two other often used scores, that give an overview of the narratives, were calculated. The two other scores include a narrative breadth score, and a narrative length score. Both of these scores, like all other scores, were averaged across two events, separately for both the child and the mother. A narrative breadth score was calculated and was used to assess narrative completeness (see Bauer et al., 2007; Bauer & Larkina, 2019; Kian et al., 2021). Completeness of a narrative event included dividing the WH codes into 8 main categories, as used in past work (WHO, WHAT-OBJ, WHAT-ACT; WHERE, WHEN, WHY, HOW-DESC, HOW-EVAL; see Table B in Appendix). For each event, children received one point for a code reflective of the category, regardless of the number of times a code was used (maximum narrative breadth score = 8). A narrative length score was also calculated and was used to assess the unique information provided by the child and the mother throughout conversations.

Narrative length referred to "units of meaning that included subject-verb construction" (Bauer & Larkina, 2019, p. 66). In other words, narrative length refers to the number of unique bits of propositional information provided by either the child or the mother in a narrative event. For this project, propositional coding (coding for a unit of meaning centered around a verb, verb phrase, or implied verb) was first completed by a propositional coder for the purposes of splitting up phrases into segments of unique information to code for WH details in relation to the verbs and to sift for off-topic statements (see Table A in Appendix). Propositional coding was conducted to account for speaker's total narrative length (i.e., for their total parsed on-task narrative contributions that were coded as propositional units) (Bauer & Larkina, 2019). For example, a child could say "Kelsey watched me swim in the pool", which would be parsed as [Kelsey watched me] [swim in the pool] (2 propositional units). Only unique and non-repeated information was counted in the narrative length score as a propositional unit. To account for repeated information by either conversational partner, repeated dialogue in transcripts by the speaker were given codes of either 'REP' self-repeated dialogue, or 'REP-P' partner-repeated dialogue. Unique propositional units for both the mother and the child were summed to come up with a total number of propositional units and provided us with a "narrative length" score (Kian et al., 2021). Repeated propositional units were not counted as part of the narrative length score but were counted as part of the repetition codes. In later analyses, narrative length was averaged across the child's 4 time points (25-months, 40-months, 65-months, and 12-years), and averaged across the mother's 3 timepoints (25-months, 40-months and 65-months). Averaged scores were later used in analyses to control for their general talkativeness over and above variance.

Narrative Coding Processes and Reliability

Participants at the earlier timepoints, at 25-, 40-, and 65-months, had two types of ID numbers: an initial participant ID created prior to the coding process for identification purposes which was used to account for the participant across time, and a coding ID, which was used while coding all narrative transcripts at the earlier timepoints to minimize coder bias for coding based on the child's age. Participants at the 12-year timepoint were assessed based on their participant ID alone. As both the experimenter and the child were explicitly talking about life-changing events, and as the experimenter was following a script, coders would know this was a 12-year-old child, so a coding ID was not designated to children's transcripts at the 12-year timepoint as age could not be blinded from the transcript.

For WH coding and narrative length coding, there were primary coders (two different coders for each), and reliability coders (two different coders for each) (four different coders in total; see Appendix, Table A). WH coding (coding using the WH-coding manual as described above) was completed by both the primary coder and the reliability coder and was done to determine what WH codes were being provided at each time point and at each event. Primary coder's codes were used as data, and reliability coders coded approximately 25% of the transcripts for reliability purposes. Coding of transcripts and the selected events incorporated three steps. As described above, propositional coding to obtain narrative length scores was first completed. Next, WH coding (Appendix, Table B) to obtain the number of individual WH codes found (and to calculate those categories to attain narrative breadth scores) was completed. Lastly, reliability coding (for 25%) of all propositionally coded and primary coded transcripts was completed.

The intraclass correlation coefficients (ICC) reported for reliability analysis throughout this paper meet or exceed recommendation by Haden and Hoffman (2013). All ICC values for both the child and the mother for all timepoints were above 0.80, with a few exceptions for the child's scores at 25-months, as indicated below. As mentioned, one primary coder coded all the transcripts, and a reliability coder coded 25% of all transcripts (mother-child and experimenter-child events). ICC scores for WHEN total details for both the child and the mother over all timepoints was above 0.95 (range: 0.954 to 0.986). There was no ICC score for the child at the

25-month timepoint, as no details were provided by the child at that time. ICC scores for WHERE total details for both the child and the mother over all timepoints were above 0.9 (range: 0.926 to 0.981), except for the child's WHERE ICC score at 25-months, 0.638. The ICC scores for narrative breadth for both the child and the mother over all timepoints was above 0.9 (range: 0.907 to 1.00), apart from the child's narrative breadth score at 25-months, 0.763. ICC scores for narrative length for both the child and the mother was above 0.8 for all timepoints (range: 0.846 to 0.982).

Conventional Time Knowledge (CTK) Task

The conventional time knowledge (CTK) task was administered to the 12-year age group. The CTK test consisted of three sections, each containing a series of questions that were read to the adolescent. However, for purposes of this study only the first task was included to assess adolescent's flexible retrieval of time information (Friedman et al., 2011). This task was made up of up of eight problems, asking participants to judge the backward order of months from a reference point (e.g., "If you're going backward and you start in May, which would you come to first, September or January?") (see Friedman, 1986; Friedman et al., 2011). The task was designed to have participants flexibly use time-relevant semantic knowledge, through the use of conventional time scales. It was found to be significantly related to temporal memory accuracy (memory for when past events have occurred) (Friedman et al., 2010; Pathman & Ghetti, 2014; Pathman et al., 2022).

Language Assessment

Children's receptive and expressive language ability was measured at 40 months, 65 months, and at 12-years old. The Peabody Picture Vocabulary Test III (PPVT-III; Dunn & Dunn,

1997) was used to measure the receptive language ability of children at these timepoints. Additionally, mothers also completed the PPVT-III, Form B at 40 months in order to attain a measure of their receptive language ability. For our purposes, only children's PPVT-III scores at 65-months, and at 12-years, were used. All language measures used were adapted for use with a New Zealand sample (see Reese & Read, 2000; Newcombe & Reese, 2004).

Results

First, we report an overview of narratives obtained. Specifically, we report descriptive data on the number and types of all narrative categories provided by children for all four timepoints (mother-child conversations at 25, 40 and 65-months, all shared events; experimenter-child conversation at 12 years, life-changing events) and by their mothers for the first three timepoints (when the child was 25, 40 and 65-months; all mother-child shared events). We then examine children's and mother's narrative breadth (completeness of narratives) and narrative length (total instances of unique, on-task information) across timepoints to give us an overall understanding of the narratives and how they changed as children grew older. Second, we begin our primary analyses, focusing on the 'WHEN' and 'WHERE' codes. We assess children's and mother's inclusion of WHEN and WHERE detail changes across timepoints, both before and after adjusting for individual differences in narrative length (see below). Third, we examine how consistent children (and mothers) were with themselves across timepoints (longitudinal correlations) and examine the bidirectional relations between children and mothers during conversations (concurrent and cross-lagged correlations). Fourth, we investigate whether mothers who signal the importance of WHEN or WHERE details (by asking more questions about WHEN/WHERE) in early childhood influence the likelihood of their children's inclusions of WHEN and WHERE details in their free recall at 12-years. Fifth, after taking into account linguistic ability, we determine whether early experience (assessed via mother-child conversations at earlier timepoints) predicts inclusion of WHEN and WHERE details in 12-year-olds' independent AM narratives. We will predict inclusions at the 12-year timepoint as the endpoint (crossing the early childhood to late childhood boundary) and will additionally predict for children's inclusion of WHEN and WHERE details at 65-months (as a within early childhood boundary). Last, we report whether CTK accuracy, assessed at 12-years-old, was correlated with children's use of WHEN and WHERE details at the same timepoint.

To best understand the 12-year timepoint, we report analyses separately using the free recall portion of the narrative ($12_{FR;}$ an assessment of what the child naturally produces without experimenter cueing/intervention) and for the child's full narrative (12_{T}). All post hoc analyses as reported in the manuscript were conducted with a Bonferroni correction. All analyses of variance (ANOVAs) will be reported with a Bonferroni correction. Additionally, Mauchly's test of sphericity was used. When the assumption of sphericity was not met, Greenhouse-Geisser estimates were reported.

1.1 Narrative Overview

Below we describe results showing how narrative breadth and narrative length changed across timepoints for both mother and child. This allows us to get an overview of the narratives, before focusing on our primary analyses examining the 'WHEN' and 'WHERE' codes. Means and standard deviations for all codes are presented in Appendix, **Table C** (mother's questions codes, are presented in Appendix, Table **D).**

1.1.1. Narrative breadth

Narrative breadth, or the measure of narrative completeness (out of 8 category codes inclusive of WHO, WHAT-ACT, WHAT-OBJ, WHERE, WHEN, WHY, HOW-EVAL, and HOW-DESC; see Bauer & Larkina, 2014; 2019), was calculated over all events and timepoints for both the child and the mother (Bauer et al., 2007; Bauer & Larkina, 2019; Kian et al., 2021). A one-way repeated measures ANOVA was run for both children and mothers to determine any timepoint differences in narrative breadth.

We present descriptive statistics and analysis statistics in Table 1. We first conducted ANOVAs using all timepoints, where for the 12-year timepoint the free recall portion (12_{FR}) was first used. We found children's narrative breadth scores at all timepoints to be significantly different from each other, $F(3, 105) = 60.53$, $p < .001$, $\eta^2 = 0.63$, with narrative breadth increasing significantly from 25-months to 40-months (95% CI [0.27, 2.06]), from 40-months to 65-months (95% CI [0.30, 1.86]), and from 65-months to 12_{FR}-years old (CI [1.96, 3.45]). The same results were found in a parallel analysis using the 12_T data, $F(3, 105) = 120.60$, $p < .001$, $\eta^2 = 0.78$.

Next, an ANOVA was conducted to examine mother's narrative breadth score over the 25-, 40-, and 65-month timepoints (see Table 1). We found significant changes in mother's narrative breadth scores over time, $F(2, 70) = 76.73$, $p < .001$, $\eta^2 = 0.69$. Mother's narrative breadth scores were higher at the 65-month timepoint compared to both the 25-month and 40-month timepoints. Mothers' narrative breadth scores significantly increased from 25-months to 65-months (95% CI [0.08, 1.05]). No other differences were found (ps > .05). In other words, mothers' contributions to the conversations were more complete, and included more different types of WH details, when their children were 65-months than when their children were younger. Results found significant increases in narratives breadth scores over time, where children's narrative breadth scores increased between each timepoint, and mother's narrative breath scores significantly increased over time. From young childhood into early adolescence, children and their mothers are providing more complete conversational narratives.

Table 1

Mean, standard deviations, and timepoint difference of children's and mother's narrative breadth and narrative length scores

	Timepoints				
	25 months M *(SD)*	***40 months*** M *(SD)*	***65 months*** M *(SD)*	***12_{FR} years*** M *(SD)*	***12_{T} years*** M *(SD)*
Children					
Narrative breadth	2.49 *(1.44)*	3.65 *(1.35)*	4.74 *(1.38)*	6.32 *(1.42)*	7.44 *(0.99)*
Narrative length	5.15 *(4.03)*	8.11 *(4.68)*	10.36 *(5.66)*	16.57 *(10.96)*	30.88 *(18.10)*
Mothers					
Narrative breadth	5.67 *(1.16)*	5.85 *(1.13)*	6.19 *(1.23)*		
Narrative length	15.26 *(7.68)*	14.56 *(7.37)*	16.17 *(7.92)*		

1.1.2. Narrative length

As a reminder, narrative length refers to the number of unique propositional units produced by either the child or mother averaged across the two events for each timepoint (Bauer et al., 2007; Bauer & Larkina, 2019; Kian et al., 2021). Narrative length scores were calculated at all events and timepoints for both the child and the mother in order to account for the overall number of unique propositions naturally provided by the speaker at a given timepoint.

To test for timepoint differences in the length of children's narratives, an ANOVA was run with age group as a within-subjects factor. We first analyzed changes over time using 12_{FR}-year-old data and found a significant increase in children's narrative length over time, $F(1.79, 62.59) = 19.96$, $p < .001$, $\eta^2 = 0.36$. Pairwise comparisons showed narratives produced at 65-months, and at 12_{FR}-years-old, to be longer than 25-month-olds. Additionally, children's narratives at the 12_{FR}-years timepoint were longer than those produced at 40-months, and at 65-months-old. Narratives produced at the two youngest age groups did not differ ($p = .056$). Post hoc analysis revealed that narrative length significantly increased between 25-months to 65-months (95% CI [2.84, 7.58]), between 25-months to 12_{FR}-years-old (95% CI [5.99, 16.85]), between 40-months to 12_{FR}-years-old (95% CI [3.09, 3.83]), and between 65-months to 12_{FR}-years-old (95% CI [0.86, 11.56]). A parallel analysis using 12_{T}-year data found the exact same results, $F(1.31, 45.89) = 55.20$, $p < .001$, $\eta^2 = 0.61$.

An ANOVA was also run for the mother to determine whether there were statistically significant differences in mother's narrative length over the three age groups. No significant change in mother's narrative length over time was found, $F(1.64, 57.45) = 0.78$, $p = .44$, $\eta^2 = 0.02$. Results revealed significant increases in children's number of propositional units over time, but no difference in mother's use of propositional units over time. When considering both mother's narrative breadth scores and their narrative length, one could argue that although the length of mother's narrative contributions are not changing significantly over time, the number, and types of event details they are using in conversations, are changing over larger time spans.

1.2. Children's and mother's inclusion of time and space details across timepoints

To examine the developmental trajectory of children's and mother's inclusion of time and space details as children aged, we conducted separate repeated measures ANOVAs. The independent variable was the timepoint (age of child when event narratives were obtained) and the dependent variables were the WHEN and WHERE total category codes and sub-category codes.

Subsequent analyses for children's and mother's WHEN and WHERE details are reported with and without narrative length controlled, mirroring the rationale by Bauer and colleagues (2017). Not controlling for narrative length allows us to determine the number and types of AM details naturally recalled in conversations, while controlling for narrative length allows us to determine potential timepoint differences above and beyond variance that could be explained by talkativeness. To control for children's narrative length across time, children's narrative length scores over all 4 timepoints (25-months, 40-months, 65-months, and 12-years) were averaged, and were used to account for any timepoint differences as a function of their talkativeness. To control for mother's narrative length across time, their narrative length scores over all 3 timepoints (25-months, 40-months, and 65-months) were averaged, and will account for any timepoint differences as a function of their talkativeness. Thus, as with past research (Bauer et al., 2017; Kian et al., 2021) we analyze both ANOVA findings, and ANCOVA (analysis of covariance) findings by controlling for narrative length.

1.2.1. Timepoint changes in children's narrative inclusions of WHEN information

Refer to Table 2 for descriptive statistics and analysis statistics. The repeated measures ANOVA, using data from timepoints 25-months, 40-months, 65-months and 12_{FR}-years, found a main effect of children's total use of WHEN codes, $F(1.19, 41.74) = 47.94$, $p < .001$, $\eta^2 = 0.58$. Pairwise comparisons revealed that inclusion of WHEN details significantly increased from 25-months to 40-months (95% CI [0.01, 0.43]), from 25-months to 65-months (95% CI [0.27, 1.37]), from 25-months to 12_{FR}-years-old (95% CI [2.83, 6.17]), from 40-months to 65-months (95% CI [0.07, 1.13]), 40-months to 12_{FR}-years-old (95% CI [2.59, 5.97]), and from 65-months to 12_{FR}-years-old (95% CI [2.13, 5.23]). The same pattern of results was found when using the total narrative data from the 12-year timepoint (12_T), $F(1.31, 45.89) = 55.20$, $p < .001$, $\eta^2 = 0.61$.

Refer to Table G in Appendix for descriptive statistics and analysis statistics of all ANCOVAs. An ANCOVA was first run using the 25-month, 40-month, 65-months and 12_{FR}-year data, and was then run using 25-month, 40-month, 65-months and 12_T-year data, to determine the effect of children's use of WHEN information over time after controlling for children's averaged narrative length. We found statistically significant differences in the use of total WHEN information across time. The patterns remained the same as with the ANOVAs conducted for the children's WHEN details for both the 12_{FR}-year, $F(1.50, 51.03) = 50.04$, $p < .001$, $\eta^2 = 0.59$), and the 12_T-year data, $F(1.18, 40.04) = 69.13$, $p < .001$, $\eta^2 = 0.67$. Results reveal that children significantly increase in their use of temporal details in narrative conversations over time, even when their conversations are controlled for by their general talkativeness.

1.2.2. Timepoint changes in children's narrative inclusions of WHERE information

An ANOVA, by first using the 25-month, 40-month, 65-month and 12_{FR}-year data, F(1.86, 65.07= 13.47, $p < .001$, $\eta^2 = 0.28$, also found a similar main effect for children's use of WHERE codes over time. Post hoc analyses revealed that inclusion of WHERE details significantly increased from 25-months to 40-months (95% CI [0.11, 1.39]), from 25-months to 65-months (95% CI [0.54, 2.49]), from 25-months to 12_{FR}-years-old (95% CI [1.32, 4.24]), and from 40-months to 12_{FR}-years old (95% CI [0.43, 3.62]). Thus, unlike the developments found in children's use of time details that increase between all timepoints, the use of location details did not vary between ages 40-months and 65-months, or between ages 65-months and 12-years. An ANOVA run using the 12_{T}-year data reveals the same findings, $F(1.38, 48.33) = 37.70$, $p < .001$, $\eta^2 = 0.48$, with the exception of a significant difference found between 65-months and 12_{T}-years (95% CI [1.89, 6.67]).

Next, ANCOVAs were run by first using the 12_{FR}-year data, $F(1.91, 64.87) = 9.98$, $p < .001$, $\eta^2 = 0.23$, and were then run using the 12_{T}-year data, $F(1.58, 53.81) = 23.63$, $p < .001$, $\eta^2 = 0.41$, to determine the effect of children's use of WHERE information over time after controlling for their averaged narrative length over the four timepoints. By adjusting for narrative length, we found a statistically significant differences in the use of total WHERE information over time. Patterns remained the same as with the ANOVAs conducted above. Results reveal that unlike with WHEN information, where children significantly increase their use of temporal details over all time points, even when controlling for narrative length, WHERE information does not change over all timepoints. Children's contributions of WHERE details remain the same between 40- and 65-months. Their WHERE contributions also do not significantly increase between 65-

months and 12-years, when they are freely recalling event information, but do significantly increase when prompted for spatial information.

As per descriptive and statistical analyses, results reveal that when looking at children's inclusion of total WHEN information, every single timepoint is different from each other. Children significantly increase their use of temporal details across all time points, regardless of controlling for their narrative length. Between 40- and 65-months, and 65-months and 12_{FR}-years, there is no differentiation in children's use of WHERE information, but there are differences from early childhood into adolescence.

Without controlling for narrative length (see Table 2), findings show that narrative details used between 25-months and 12-years old, and between 40-months and 12-years old (except subcodes *directionality* between 40-months and 12_{FR}-years, and sub-codes *time-repeated*, and *directionality* between 40-months and 12_{T}-years) significantly differ for all sub-codes and total category codes for WHEN and WHERE information. When controlling for narrative length (see Table G in Appendix) for all time and space narrative codes, we are seeing the same patterns across time. However, in addition, we are also seeing sub-codes that do not significantly differ across any timepoints (12_{FR}-year data: sub-codes *time-repeated, location specific, geographic location, directionality*; 12_{T}-year data: sub-codes *geographic location, directionality*). Overall, we are seeing the greatest differences in narrative details between ages 25-months and 12-years old. When controlling for narrative length, we are seeing less statistically significant increases in WHEN and WHERE sub-code detail use, whereas when not controlling we are seeing timepoint differences for all total code and sub-code details.

1.2.3. Timepoint changes in mother's narrative inclusions of WHEN and WHERE information

A repeated measures ANOVA found effects for mother's inclusion of temporal information over time, $F(1.66, 58.18) = 5.99$, $p = .007$, $\eta^2 = 0.15$. Refer to Table 3 for descriptives and analyses. Mother's pairwise comparisons showed an increased use of WHEN category details between 40-months and 65-months (95% CI [0.29, 2.40]). No other differences were found among timepoints.

A repeated measures ANOVA found no significant change over time in mother's use of overall WHERE information, $F(2, 70) = 0.49$, $p = .610$, $\eta^2 = 0.01$. However, post hoc analysis did reveal that mother's inclusion of geographic information, a sub-category code for WHERE information, did significantly increase over time between ages 25-months and 65-months (95% CI [17.24, 34.20]).

ANCOVAs adjusting for mother's averaged narrative length over the first three timepoints, did not reach significance at any timepoint for mother's use of total WHEN details, $F(1.67, 56.83) = 0.59$, $p = .524$, $\eta^2 = 0.02$, or in their use of total WHERE details, $F(2, 68) = 0.29$, $p = .745$, $\eta^2 = 0.01$. Thus, when controlling for these details with narrative length over time, we do not find significant timepoint differences in mother's use of time or space details.

ANCOVAs were run at each timepoint for both the child and the mother. Narrative length was controlled to determine the frequency of AM codes naturally recalled in a narrative over time. We tested for potential timepoint differences above and beyond variance that could have been explained by talkativeness. When not controlling for talkativeness, we found that children significantly increase their use of all temporal and spatial narrative details over time, their mothers were found to only increase their use of temporal details. While controlling for talkativeness, we found that children are still providing more temporal and spatial details over time, however, their mothers are not.

Table 2

Mean, standard deviation, and timepoint differences of children's use of WHEN and WHERE codes.

	Timepoints				
	25 months	***40 months***	***65 months***	***12_{FR} years***	***12_{T} years***
	M *(SD)*	**M *(SD)***	**M *(SD)***	**M *(SD)***	**M *(SD)***
Children					
TOTAL WHEN	0.03 *(0.12)*	0.25 *(0.42)*	0.85 *(1.16)*	4.53 *(3.57)*	8.53 *(6.33)*
Time	0.01 *(0.08)*	0.03 *(0.12)*	0.15 *(0.46)*	0.76 *(1.08)*	2.28 *(1.49)*
Time repeated	0 *(0)*	0 *(0)*	0.03 *(0.12)*	0.13 *(0.35)*	0.15 *(0.39)*
Time vague	0.01 *(0.08)*	0.1 *(0.23)*	0.15 *(0.29)*	1.22 *(1.16)*	2.13 *(2.05)*
Temporal connection	0 *(0)*	0.1 *(0.23)*	0.49 *(0.81)*	2.22 *(1.89)*	3.71 *(3.27)*
Duration	0 *(0)*	0 (0)	0.03 *(0.17)*	0.19 *(0.45)*	0.26 *(0.49)*
TOTAL WHERE	0.38 *(0.60)*	1.13 *(1.24)*	1.89 *(2.12)*	3.15 *(3.14)*	6.17 *(5.03)*
Location specific	0.08 *(0.19)*	0.1 *(0.23)*	0.08 *(0.22)*	0.64 *(1.07)*	1.35 *(1.72)*
Location general	0.07 *(0.18)*	0.4 *(0.58)*	0.53 *(0.68)*	0.93 *(1.02)*	2.1 *(1.8)*
Location vague	0.11 *(0.24)*	0.22 *(0.35)*	0.39 *(0.62)*	0.86 *(1.32)*	1.35 *(1.97)*
Geographic location	0.03 *(0.17)*	0.03 *(0.12)*	0.11 *(0.36)*	0.43 *(0.66)*	0.85 *(1.13)*
Directionality/ distance	0.08 *(0.25)*	0.38 *(0.55)*	0.78 *(1.08)*	0.29 *(0.58*	0.53 *(0.86)*

Table 3

Mean, standard deviation, and age-group differences of mothers' use of WHEN and WHERE codes

	Timepoints		
	25 months	***40 months***	***65 months***
	M *(SD)*	**M *(SD)***	**M *(SD)***
Mothers			
Total WHEN	2.33 *(1.90)*	1.86 *(1.42)*	3.21 *(2.37)*
Time	0.58 *(1.11)*	0.28 *(0.51)*	0.31 *(0.55)*
Time repeated	0.01 *(0.08)*	0.00 *(0.00)*	0.01 *(0.08)*
Time vague	0.53 *(0.73)*	0.63 *(0.69)*	0.83 *(0.91)*
Temporal connection	1.21 *(1.49)*	0.96 *(1.03)*	2.01 *(2.05)*
Duration	0.00 *(0.00)*	0.00 *(0.00)*	0.04 *(0.18)*
Total WHERE	4.06 *(2.79)*	4.18 *(2.61)*	4.54 *(2.94)*
Location specific	0.68 *(1.26)*	0.60 *(0.71)*	0.56 *(0.68)*
Location general	1.40 *(1.47)*	1.42 *(1.61)*	1.39 *(1.45)*
Location vague	0.93 *(1.09)*	1.13 *(0.87)*	1.14 *(1.05)*
Geographic location	0.14 *(0.39)*	0.17 *(0.36)*	0.50 *(0.81)*
Directionality/distance	0.90 *(1.12)*	0.88 *(0.99)*	0.96 *(0.96)*

1.3. Consistency and bidirectionality between mother and children's inclusions of time/space details across time

Pearson product-moment correlations (refer to Table 4) were computed to determine how consistent children and mothers were in their use of WHEN and WHERE details over time and to examine bidirectional relations between conversation partners within conversation across time. Children's variables consisted of their 4 timepoints (5 variables in total; 25-months, 40-months, 65-months, and the 12-year timepoint being split between children's 12_{FR} and 12_{T} variables). While mother's variables consisted of their 3 timepoints, as they were not present during the last time period (3 variables; 25-months, 40-months and 65-months).

Next, we computed correlations for mother's use of WHEN and WHERE details over time. Mothers were found to be consistent with themselves in time-lagged conversations. Mothers were found to be highly consistent with themselves in their use of total WHEN information from 25-months and 40-months, $r(36) = .46$, $p = .005$. Mothers were also found to be consistent with themselves in their use of total WHERE information over all timepoints. Mother were consistent with themselves from 25-months and 40-months, $r(36) = .34$, $p = .043$, from 25-months and 65-months, $r(36) = .46$, $p = .005$, and were highly consistent in their use of WHERE information from 40-months and 65-months, $r(36) = .42$, $p = .012$. As with previous research (see Newcombe & Reese, 2004), mothers were found to be more consistent in their narrative style over time compared to their children. Whereas children were not consistent with themselves in their use of time and space details over time.

Table 4

Consistency analyses: Longitudinal correlations within children's and mother's total WHEN and WHERE details

	Child variables					*Maternal variables*		
	WHEN25	WHEN40	WHEN65	WHEN12FR	WHEN12T	WHEN25	WHEN40	WHEN65
WHEN25	1.00	-0.15	-0.02	-0.07	-0.04	1.00	0.46^{**}	0.21
WHEN40		1.00	0.25	-0.09	-0.20		1.00	0.19
WHEN65			1.00	0.36^{*}	0.29			1.00
WHEN12FR				1.00	0.93^{**}			
WHEN12T					1.00			
	WHERE25	WHERE40	WHERE65	WHERE12FR	WHERE12T	WHERE25	WHERE40	WHERE65
WHERE25	1.00	-0.01	0.18	0.09	0.16	1.00	0.34*	0.46^{**}
WHERE40		1.00	0.32	-0.04	-0.04		1.00	0.42^{*}
WHERE65			1.00	0.11	0.16			1.00
WHERE12FR				1.00	0.95^{**}			
WHERE12T					1.00			

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

1.3.1. Mother's time-lagged inclusion of narrative details across time

Next, bidirectional correlations were utilized to determine whether relations existed between mother's and children's use of total WHEN details and total WHERE details (see Table 5 for Pearson product-moment concurrent and cross-lagged correlations). Children's and mother's use of WHEN details at 65-months, $r(36) = .35$, $p = .035$, and children's and mother's use of WHERE details at 65-months, $r(36) = .42$, $p = .011$, were both concurrently associated. That is, children who consistently used more WHEN details at 65-months, had mothers who consistently used more of these details in the same conversations. Additionally, children who used more WHERE codes at 65-months had mothers who provided more WHERE details in the concurrent conversations. Children who used more time and space details, had mothers who used more for those details in the same conversations.

Next, we found a positive association from child-to-mother directionality, with children's usage of WHEN details at 40-months correlated with mothers' usage at 65-months, $r(36) = .42$, $p = .010$. Additionally, in reference to mother-to-child directionality, we found mother's use of WHEN details at 40-months to be highly correlated with children's use at 65-months, $r(36) = .48$, $p = .004$. We also found that in mother-to-child directionality, mother's WHERE details at 25-months, was correlated children's use of WHERE details at 12-years ($12_{FR,}$ $r(36) = .39$, $p = .017$; $12_{T,}$ $r(36) = .40$, $p = .015$). There were no other statistically significant cross-lagged correlations between mothers and children at any of the other time periods (ps > .05).

The correlational analyses showed that children and mothers displayed concurrent and longitudinal relations in their use of both WHEN and WHERE details, particularly from 40 months. These findings parallel past research which has found that mothers' use of narrative elements at 40-months uniquely predicts children's later use of those elements (see Newcombe & Reese, 2004; Haden et al., 1997).

Table 5

Bidirectionality analyses: Concurrent and cross-lag correlations between children's and mother's total WHEN and WHERE codes over time

Maternal variables	*Child variables*				
	Total WHEN				
	WHEN25	WHEN40	WHEN65	WHEN12FR	WHEN12T
WHEN25	0.22	-0.19	0.19	0.32	0.30
WHEN40	0.07	0.17	0.47**	0.33	0.26
WHEN65	0.03	0.42*	0.35*	0.00	0.02
	Total WHERE				
	WHERE25	WHERE40	WHERE65	WHERE12FR	WHERE12T
WHERE25	0.28	0.12	0.21	0.39*	0.40*
WHERE40	0.01	0.29	0.18	0.29	0.24
WHERE65	0.31	0.14	0.42*	0.01	-0.04

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

1.4. Does early mother-talk predict children's later inclusion of time/space details

Simultaneous regression analyses were run to analyze the child's and mother's use of narrative details over time. Children's details at 12-years-old, which was the final timepoint of focus, were considered the dependent variables. The mother's and children's details at each of the earlier timepoints, including mother's use of questions, were considered the independent, or predictor variables. We were interested in the role of both children's and mothers' earlier use of narrative details in predicting children's use of these details into adolescence. Regression analyses were conducted to predict for children's use of time and space, or WHEN and WHERE details at the 12-year timepoint, distinguished by both the 12_{FR}-year and the 12_{T}-year data.

1.4.1. Mother's early open-ended questions for WHEN and WHERE predicting children's later inclusion of details for WHEN and WHERE

Refer to Table 6. First, we were interested in whether mothers who more often ask open-ended WHEN questions in early childhood have children who are more likely to include WHEN details in their narratives at 12 years. A regression established mother's use of open-ended WHEN questions at the earlier time points, to be statistically significant and accounted for 25.4% of the variability of the child's predicted use of WHEN details in the case of 12_{FR}-years old, $F(3, 32) = 3.64$, $p = .023$, and accounted for 21.7% of the variance in children's use of WHEN details at 12_{T}-years old, $F(3, 32) = 2.96$, $p = .047$. In this model, using the 12_{FR}-year data, only mother's open-ended WHEN questions at 65-months uniquely predicted children's 12_{FR}-year use of WHEN details, t = 2.80, p = .01. Similarly, in the model using the 12_{T}-year data, only mother's open-ended WHEN questions at 65-months uniquely predicted children's 12_{T}-year use of WHEN details, t = 2.92, p = .01. Mother's who naturally ask about WHEN details in early childhood have children who are more likely to include WHEN details in later narratives independently.

Next, we were interested in whether mothers who often used more open-ended WHERE questions in early childhood, had children who were more likely to include WHERE information in their narratives at 12 years. A regression analysis using mother's use of open-ended WHERE questions, did not find significant changes in children's use of WHERE information in response to mother's prompts (12_{FR}; p = .368; 12_{T}; p = .327). Later maternal narrative questions for temporal details, was a greater predictor of children's use of temporal information into adolescence, maternal narrative questions for location details, however, was not a significant predictor of children's later inclusions of space information.

Table 6

Simultaneous regression analyses predicting children's WHEN and WHERE use at 12-years

Variable Entry	*B*	*SE B*	*ß*	*t*(predictor)	*Sig.*	*F(model)*	R^2 (R^2 adj)
Criterion variable: Children's WHEN at 12_{FR}*-years old*							
MQWHEN25	7.15	5.32	0.23	1.34	0.19	$F(3, 32) = 3.64$, $p = .023$	0.25 (0.18)
MQWHEN40	-6.85	5.32	-0.22	-1.29	0.21		
MQWHEN65	13.72	4.70	0.45	2.92	0.01		
Criterion variable: Children's WHEN at 12_{T}*-years old*							
MQWHEN25	9.60	9.66	0.18	0.99	0.33	$F(3, 32) = 2.96$, $p = .047$	0.22 (0.14)
MQWHEN40	-7.40	9.66	-0.14	-0.77	0.45		
MQWHEN65	23.89	8.54	0.44	2.80	0.01		
Criterion variable: Children's WHERE at 12_{FR}*-years old*							
MQWHERE25	0.94	0.83	0.19	1.13	0.27	$F(3, 32) = 1.09$, $p = .368$	0.09 (0.01)
MQWHERE40	-0.26	0.52	-0.08	-0.50	0.62		
MQWHERE65	0.93	0.72	0.22	1.30	0.20		
Criterion variable: Children's WHERE at 12_{T}*-years old*							
MQWHERE25	1.47	1.33	0.19	1.11	0.28	$F(3, 32) = 1.19$, $p = .327$	0.10 (0.02)
MQWHERE40	-0.33	0.83	-0.07	-0.39	0.70		
MQWHERE65	1.69	1.14	0.25	1.48	0.15		

Note. 'MQWHEN25' reflects the mother's incorporation of open-ended WHEN questions at 25-months, whereas 'MQWHERE25' reflects mother's use for open-ended WHERE questions at 25-months.

The regression analyses revealed that children's use of WHEN and WHERE details, to some extent, reflected their mothers' earlier use of these narrative elements. Particularly, mother's incorporation of open-ended WHEN questions in their earlier shared narrative accounts about the past, predicts children's natural use of these details in their later independent conversations. These results support past findings (see Newcombe & Reese, 2004) suggesting that mother's earlier narrative use uniquely predicts children's later narrative ability for spatial-temporal information.

1.5. *Does mother's inclusion of WHEN/WHERE, after controlling for children's linguistic skill, predict children's later inclusion of WHEN/WHERE details*

Next, we conducted a series of hierarchical regressions. We wanted to determine, after controlling for children's language ability at the predicted timepoints of interest, whether children's and mother's inclusion of WHEN and WHERE details at earlier timepoints predict children's future inclusions of WHEN and WHERE details (see Table 7). The model predicting children's use of WHEN details at 65-months consisted of children's receptive language at 65-months in the first step, followed by children's and mother's use of WHEN details at 40-months. The model was statistically significant, $F(3, 29) = 3.48$, $p = .029$, adjusted $R^2 = .189$, revealing that children's use of time information was a reflection of their mother's earlier use of these narrative elements, which contributed significantly to the model ($B = .38$, $p = .014$). Mother's use of WHEN details at 40-months was a unique predictor of children's later use of WHEN details at 65-months, when their language ability is being controlled for.

A parallel model predicting children's use of WHERE details at 65-months, consisting of children's receptive language at 65-months, followed by children's and mother's use of WHERE details at 40-months, did not find significant results ($p = .297$). Further, we wanted to cross the early childhood to late childhood period, and wanted to determine, after controlling for children's language ability at 12-years, whether mother's and children's inclusion of WHEN and WHERE details at 65-months predict children's inclusions of WHEN or WHERE details at 12-years. No significant results were found. After controlling for child's language ability at 65-months, mothers' and children's earlier inclusion of WHEN and WHERE details did not predict child's future.

Table 7

Hierarchical regression analyses predicting children's narrative use at 65-months and at 12-years

Variable Entry	*B*	*SE B*	*ß*	*t* (predictor)	*Sig.*	*F(model)*	R^2 (R^2 adj)	R^2 change
Criterion variable: Children's WHEN at 65-months with mothers								
1. CPPVT65	-0.00	0.02	-0.01	-0.07	0.945	$F(3, 29) = 3.48, p = .029$	0.27 (0.19)	0.19
2. CWHEN40	0.50	0.50	0.17	0.91	0.370			
MWHEN40	0.38	0.15	0.46	2.61	0.014			
Criterion variable: Children's WHERE at 65-months with mothers								
1. CPPVT65	0.02	0.04	0.09	0.52	0.606	$F(3, 29) = 1.29, p = .297$	0.12 (0.03)	0.07
2. CWHERE40	0.45	0.33	0.26	1.34	0.190			
MWHERE40	0.07	0.15	0.08	0.43	0.670			
Criterion variable: Children's WHEN at 12_{FR}-years with mothers								
1. CPPVT12	0.03	0.04	0.14	0.79	0.437	$F(3, 31) = 2.18, p = .111$	0.17 (0.09)	0.09
2. CWHEN65	1.08	0.57	0.36	1.89	0.068			
MWHEN65	-0.15	0.26	-0.10	-0.57	0.574			
Criterion variable: Children's WHEN at 12_{T}-years with mothers								
1. CPPVT12	0.01	0.08	0.02	0.10	0.923	$F(3, 31) = 1.12, p = .356$	0.09 (0.01)	0.08
2. CWHEN65	1.73	1.07	0.32	1.62	0.116			
MWHEN65	-0.19	0.49	-0.07	-0.40	0.694			
Criterion variable: Children's WHERE at 12_{FR}-years with mothers								
1. CPPVT12	0.03	0.04	0.14	0.76	0.455	$F(3, 31) = 0.36, p = .783$	0.03 (-0.06)	0.01
2. CWHERE65	0.18	0.29	0.12	0.63	0.530			
MWHERE65	-0.04	0.21	-0.04	-0.21	0.837			
Criterion variable: Children's WHERE at 12_{T}-years with mothers								
1. CPPVT12	0.05	0.06	0.14	0.76	0.450	$F(3, 31) = 0.63, p = .600$	0.06 (-0.03)	0.04
2. CWHERE65	0.49	0.46	0.20	1.08	0.290			
MWHERE65	-0.23	0.34	-0.13	-0.70	0.492			

Note. 'CWHEN40' reflects children's incorporation of WHEN details at 40 months, while 'MWHEN40' reflects mother's incorporation of WHEN details at 40 months. 'CPPVT65' reflects children's linguistic skills at 65-months.

Table 8

Bidirectionality analyses: Correlations between children's CTK scores and total WHEN and WHERE codes

		CTK	CWHERE12FR	CWHEN12FR
CTK	R	1		
	p-value			
	N	36		
CWHERE12FR	R	0.049	1	
	p-value	0.387		
	N	36	36	
CWHEN12FR	R	.283*	.529**	1
	p-value	0.047	0.000	
	N	36	36	36
		CTK	**CWHERE12T**	**CWHEN12T**
CTK	R	1		
	p-value			
	N	36		
CWHERE12T	R	0.114	1	
	p-value	0.255		
	N	36	36	
CWHEN12T	R	0.263	.635**	1
	p-value	0.061	0.000	
	N	36	36	36

*. Correlation is significant at the 0.05 level (1-tailed).
**. Correlation is significant at the 0.01 level (1-tailed).

1.6.Does early mother-talk relate to children's later time knowledge abilities

See Table 8 for Pearson's product-moment correlations. First, we wanted to determine whether there was a relationship among children's conventional time knowledge at 12-years, and their use of WHEN and WHERE details in the recounted AM narratives during the same age. Total code categories were correlated with CTK data. CTK performance at 12-years-old was correlated with children's use of WHEN details when they were freely recalling past event information, 12_{FR}-year, $r(36) = .28$, $p = .047$, but not when taking into account their total narrative, 12_{T}-year, $r(36) = .26$, $p = .061$. Statistics did not reveal a significant correlation between CTK and children's use of WHERE information. Children's CTK performance at 12-

years is correlated with children's use of WHEN information at the same age but is not correlated with their use of WHERE information.

Discussion

The goal of the present study was to document the developmental trajectory of children's use of WHEN and WHERE details in narrative conversations while also exploring the factors that lead to this development. Children's and mother's shared narratives were obtained during conversations about past unique autobiographical events at three timepoints in early childhood. Children's independent narratives were then obtained in adolescence (12 years). In this thesis we (1) examined how narrative breadth and narrative length for both the child and their mother changed across timepoints, (2) determined how the number of WHEN and WHERE details children and mothers included in their narratives changed across timepoints, (3) examined the consistency mother and children had with themselves over time, and mother and child bidirectionality over time, (4) analyzed how mother's questions for time and space information influenced children's subsequent inclusions of these details at 12-years, (5) determined whether mother's inclusions of WHEN and WHERE narrative information, after controlling for children's linguistic skill, was predictive of children's future performance at 65-months and 12-years, and finally, (6) determined whether children's CTK performance at the final timepoint was correlated with their inclusions of WHEN and WHERE information at that age. Past research found children to increase in the frequency of their narrative contributions and increase their use of time and space details in conversational narratives about past AM events. This research supports previous outcomes by providing findings that explore children's early AM development. This longitudinal study allows us to build a developmental trajectory that is not possible to attain from cross-sectional studies. This study provides a unique perspective on the underlying factors leading to children's AM narrative developments for time and space.

Mother-child conversations and their narrative breadth and narrative length scores

We first examined children's and mothers' narrative breadth, or narrative completeness, separately in conversations over time. We examined children's narrative breadth over each age range and found significant differences across all timepoints that parallel past studies (see Bauer & Larkina, 2014, for similar findings on narrative completeness). Analyses examining children's timepoint differences found that children are increasing in the completeness of their narratives across all four timepoints of interest. Past research found similar results, where children increased their narrative breadth scores over time and into later childhood, as they included more varied WH-details (e.g., who, what, where, when, why, and how information) in their autobiographical narratives (Bauer, 2007; Bauer et al., 2007). For example, children are shown to have lower narrative breadth scores at 4- to 5-years old than 6- to 7-years-olds and 8- to 10-years-olds (Kian et al., 2021). Additionally, they are shown to have lower scores at 5- and 6-years old relative to 8- and 9-year-olds (Bauer & Larkina, 2014). Although our timepoints are different from those assessed in the given example, we are still seeing a similar trend. As children age, they tend to provide more complete narrations of their past autobiographical events.

The way mothers talk with their children about past autobiographical events has been found to be a consistent determinant of children's contributions to co-constructed narratives in early childhood (see Larkina & Bauer, 2010; Reese, Haden, & Fivush, 1993; see Fivush & Zaman, 2014, for a review; Bauer et al., 2019). However, mother's narrative completeness has not been specifically evaluated over time. Mother's narrative breadth score was a novel variable that was looked at in the present study to evaluate how the fullness of mother's reports of events changes as their conversation partners, their children, grew older. We found that mother's narrative completeness increases slowly as their child develops over time. In the present study, mothers did not appear to provide or talk about all WH-details in their conversations with their children as assessed within this sample. Mothers were found to increase in their narrative breadth scores over time when their child was 25-months to 65-months old, but no timepoint differences were found between these timepoints (i.e., no timepoint differences were found between 25- and 40-months, and between 40- and 65-months). It could be the case that mothers may not have to provide as many details in their shared mother-child conversations, because children are providing the remaining WH-details themselves, as can be seen through children's increasing narrative breadth scores over time. Mothers in the present study may be allowing their children to provide their own accounts of the autobiographical events, where their children are learning to provide more types of narrative details on their own. Mothers may then only inquire about the incomplete or undiscussed narrative details once their child has exhausted the types of narratives details, they are capable of communicating on their own. As children develop, their narrative reports were shown to increase in their completeness, as can be acknowledged from the current results, and from previous research findings.

Second, we investigated speakers' narrative length (unique propositions in conversations) scores over time. We found that children are significantly increasing how much unique information they are contributing to their narrative discussions over time. More plainly, children are found to talk more and use more unique details and more event-specific information as they get older. A difference in narrative length scores in our results was found between 25-months old and 65-month and 12-years old, and between 40- and 65-months and 12-years. However, no differences were found between the ages of 25 months (2 years) to 40 months (3 years), and between 40 months and 65 months (5½ years), suggesting that children's narrative contributions from about 2 years to 3 years, and from 3 years to 5½ years, do not significantly change, but do change greatly over longer periods of development, such as from 5½ years onwards. Past research has shown similar increases in children's narrative length scores over time. For example, narratives produced at 8- to 10-years old have been found to be longer than those produced by 4- to 5-year-olds (Kian et al., 2021). Children are found to provide more unique, non-repeated event information in their narratives as they age.

Mother's narrative length was also of interest. No differences were found in mother's length of event talk over time. Children were shown to go through significant changes in their narrative length scores over time, however, their mother's were not. Findings surrounding mother's narrative length scores do complement those found in previous research using the same cohort of children, where children's independent narrative memory did not mirror their mother's contributions until age 5 or 6, which matches the timeline that has been found for children's increase in narrative length scores in this project (see Cleveland & Reese, 2005; Newcombe & Reese, 2004; Haden et al., 1997). More interestingly, this lack of increase in mother's narrative length scores, when taking into account the increase in their narrative breadth scores over time, suggests that although mothers are not participating more in conversations with their children over time since the amount of unique talk they contribute does not significantly change as their children age, they are still continuing to provide more varied WH-details within that same amount of talk, and are adding to its completeness as shown by the mother's narrative breadth scores above. In other words, over children's early years mothers do not appear to increase in the length of their narratives, but instead appear to increase in the detailed quality, and the breadth (number of different types of narrative details) of their WH-detail provisions in their mother-child conversations.

Developmental trajectory for inclusions of WHEN/WHERE details

The present research allowed us to examine the developmental trajectories for children's inclusions of time and space details. Previous research coded spatial and temporal event details (see Newcombe & Reese, 2004; Haden, et al., 1997), however, these details were collapsed under a single category (*orientations* category which collapsed person, and spatial-temporal details). Previous studies that did separate time and space details (see Peterson & McCabe, 1994) only provided longitudinal data for a shorter time window (from 26-43 months). Thus, the trajectory for children's inclusion of temporal details across a wider timespan of childhood was still in question. This study was the first to make strides to bring clarity to this trajectory by looking at mother's narrative contributions over time and their influences on children's subsequent provisions.

Children's inclusion of WHEN details

We found that children's use of WHEN category details increased significantly across all timepoints, even when controlling for narrative length. This increase in temporal details in children's early years into early adolescence is comparable to results found in prior studies. Although temporal details were combined with spatial and person details under the *orientation* total category, previous research has found that children increase their use of *orientation* details with age, where children's *orientations* at 19-months have been related to their use at 40-months (Newcombe & Reese, 2004). Our findings also parallel past cross-sectional work (see Kian et al., 2021) that examined '*when*' narrative codes and children's age differences. This study found significant age-related differences in children's inclusions of *when* details (8- to 10-year-olds produced significantly greater amount of WHEN details compared to their 4- to 5-years-old counterparts; Kian et al., 2021). Our results complement such past literature for children's inclusions of WHEN details.

Children's inclusion of WHERE details

We found that children's development in their use of WHERE details increased over time, except between timepoints 40-months and 65-months, and between timepoint 65-months and 12_{FR}-years. Results were the same when controlling for narrative length. The trajectory for children's inclusion of space details was not as steep as the trajectory for their inclusion of time details, as children's development in their inclusion of temporal details during conversations was consistent across all timepoints, however, their use of space information was not.

These results add to previous findings suggesting that the developments of children's inclusions of WHEN and WHERE details, are different. For example, in a study by Kian and colleagues (2021) evaluating children's (4- to 10-year-olds) inclusion of WH-details in their AM narratives found that 6- to 7-year-olds and 8- to 10-year-olds provided more *when* and *where* details in the AM narratives compared to their 4- to 5-year-old counterparts. However, this past study did not find diverging patterns of development for *when* vs *where* information. It could be the case that this study by Kian and colleagues (2021) had three timepoints of interest that were different from the timepoints of the present study, and so results are not translatable to the present study's findings. However, again, this study by Kian and colleagues (2021) is not longitudinal, but cross-sectional, and a developmental trajectory for children's AM details in their narratives over time cannot be inferred.

Newcombe and Reese (2004) do evaluate *orientations* longitudinally, and significant differences were found for this category across timepoints from 25- to 51-months. Yet we know that their *orientations* category is a collapsed category housing three sub-categories, and so results may be inflated. Results are unclear when it comes to how WHERE information develops in children over time, and the findings from this study provide insight into an accurate developmental trajectory for children's spatial information and how it develops into early adolescence, which the literature does not cover.

It must also be noted, as per Table 2, when comparing the patterns between children's WHEN and WHERE results, that at all early timepoints (from 25- to 65-months) the mean frequencies in the total use of WHERE details were higher than children's total use of WHEN details. Additionally, children's mean frequency for WHEN details was higher during the final timepoint than it was for total WHERE details. These results strongly imply that although during early stages in children's narrative development, there are significant differences found in the use of time information across all time points, but not for space information, it is not because understanding of space information is not developing. It could be reasoned that children are consistently learning how to incorporate time information into their narratives, but at a lower frequency compared to space information which they have already learned to use earlier and with greater competence. Strikingly, what general descriptives have shown is that when children at 12-years of age are discussing past events, they tend to include more temporal information about the event than they do spatial information. Taken together, these findings from the ANOVAs and the descriptives, build on previous research by (1) finding complementing results of children's early developments of time and space in AM narratives, and (2) finding results suggestive of the fact that although memory for time develops slower in children than memory for space, memory for time is consistently developing at a significant trajectory comparative to the trajectory for memory for space, and by adolescence, time information may develop further and may be used more frequently than information for space. This study provides novel information by establishing an ecologically valid development for children's WHEN and WHERE information in their AM narratives over time.

Mother's inclusion of WHEN and WHERE details

We also evaluated mother's timepoint differences in their provisions of WHEN and WHERE details as their child grows older. In contrast to children's timepoint differences for WHEN information which increases across all timepoints, mother's use of WHEN information only increased between 40 months and 65 months. No other differences were found across time in their use of WHEN details. Additionally, there were no differences in mother's use of WHERE details over time. Results were the same when controlling for narrative length. Results contrast and build on previous findings. Even when controlling for narrative length, mothers are found to increase their inclusions of temporal information in conversations with their children during early childhood but are not significantly increasing their inclusions of spatial information.

Past AM literature examining mother's incorporations of time and space details, did so under the scope of *orientations* (spatial-temporal, and person details) (Newcombe & Reese, 2004; Haden et al., 1997; Peterson & McCabe, 1994). Mother's *orientations* scores were found to significantly increase over time with their young children (Newcombe & Reese, 2004; Haden et al., 1997). However, past AM literature generally does not control for mother's narrative length in their conversations, and thus variance of mother's talkativeness in relation to their temporal and spatial details in their conversations cannot be reviewed. Instead, past literature tends to examine how elaborative (unique details provided by the mother through conversations and prompted through specific questions, rather than repeated narrative content) mothers are in their conversations with their children (Haden & Fivush, 1996; Cleveland & Reese, 2005; Fivush et al, 2006). Assessing for how elaborative mothers are in their conversations does provide an extensive breadth of information on the influence maternal conversation styles have on children's later conversational abilities (when mothers have a low versus high elaborative style, see Fivush et al., 2006; Bauer & Larkina, 2014; Farrant & Reese, 2000; Cleveland & Reese 2005). However, mother's elaborative style does not provide us with exact information on the variance of WHEN and WHERE details in their conversations, and it does not tell us whether those inclusions are just a result of talkativeness. Past research contrasts our findings, as we did not find consistent significant results for mother's incorporations of WHEN details over time, we also did not find any significance in mother's WHERE scores over time. This study finds unique results that build on the current breadth of data for mother's inclusions of WH narrative details, as it has been overlooked as an influential factor into children's developments.

Children's and mother's concurrent and subsequent use of WHEN/WHERE details over time

Given this was a longitudinal study, we are able to examine the consistency and bidirectional correlations across time for children's and their mother's use of WHEN and WHERE conversational details. We conducted consistency analyses to determine if participants were consistent with themselves in their inclusions of WHEN/WHERE details over time, and examined concurrent and cross-lagged correlations to examine how children's and mothers' inclusions of these details relate to one another in the same conversations and in conversations across time.

First, we ran consistency analyses. We analyzed whether children and mothers were consistent with themselves in their use of time and space details over time. Children were not consistent with themselves in either their use of WHEN details, or in their use of WHERE details during the early childhood period. Children were consistent, however, with themselves in their use of WHEN details when crossing the early to late childhood boundary. Children were consistent with themselves in their use of total WHEN details between 65-months and at 12_{FR}-years. Mothers were found to be consistent with themselves in their use of WHEN information at 25- and 40-months. Mothers were also found to be consistent with themselves in their use of WHERE information throughout the early childhood period from 25- and 40-months, from 25- and 65-months, and from 40- and 65-months.

Newcombe and Reese (2004) found that from about 25-months onwards, children were consistent in their use of *orientation* details during the early childhood period (from 25- to 51-months). Our results contrast these findings as children were not consistent with themselves in their use of WHEN and WHERE details during the early childhood period (from 25- to 65-months) but were consistent with themselves when crossing the early childhood boundary into early adolescence in their use of WHEN details (from 65-months to 12_{FR}-years). Past findings (Newcombe & Reese, 2004) reporting significant results in their consistency analyses could be driven by the fact that their respective category code (*orientations*) summed both temporal information and spatial information together, along with person details, which may have inflated the significance found for those narrative details.

Conversely, in the present study and has been found in previous literature, maternal narrative provisions tend to be more consistent over time, compared to children's narrative provisions (Newcombe & Reese, 2004). Mirroring past findings (Newcombe & Reese, 2004), mothers are more consistent with themselves in their inclusions of *orientation* details from 25-months onwards, and their inclusions of *orientations* are also associated concurrently and in cross-lagged conversations from 25-months onwards (Newcombe & Reese, 2004).

For our purposes, we separated and individually evaluated the temporal and spatial details present in the mother-child narratives. By doing so, we found different patterns as compared to past research. This project sheds light on previous findings, and suggests that children are not consistent in their use of WHEN and WHERE details during early childhood. It also complements past findings regarding mother's consistent use of WHEN and WHERE details over time. We cannot expect consistent discussions of WHEN and WHERE details from children in early childhood but can expect to find these developments from later childhood into adolescence. Future studies could further aim to separate time and space details over a larger time period, such as in early childhood from 19-months to 51-months as done by Newcombe and Reese (2004), as well as could examine these details far after 12-years of age, in order to further clarify whether details expressed in narratives in early childhood are in anyway consistent over that early period, or whether children only become more consistent with themselves as they age into adolescence.

Next, we ran bidirectional analyses to determine whether relations existed between children's and mothers' use of WHEN and WHERE narrative contributions. To review, inclusions for WHEN and WHERE information, for both children and mothers were coded only for their unique inclusions of theses details. Narrative information was not coded if either the child or the mother repeated information (see Table B in Appendix for codes pertaining to repeated information). This study found that children's and mother's use of WHEN details at 65-months, and children's and mother's use of WHERE details at 65-months, were both concurrently associated. In other words, children and their mothers are collaborating in their discussions for both time and space details at this timepoint. The more unique information the mother provides for WHEN and WHERE information at 65-months, the more likely it is their child will also provide unique WHEN and WHERE information at that same timepoint. Additionally, children's usage of WHEN details at 40-months correlated with mothers' usage at 65-months, mother's use of WHEN details at 40-months is highly correlated with children's use at 65-months, and mother's WHERE details at 25-months is correlated with children's use of WHERE details at 12-years. These correlations illustrate that children are not just repeating what their mothers are saying in their shared conversations, but instead, children are independently providing their own unique narrative details in these cross-lagged conversations. Children are providing more unique information during the above timepoints, in both concurrent and cross-lagged conversations with their mothers, suggesting that their unique contributions of WHEN and WHERE details in their respective details, are supported by their mother's contributions in the same or in cross-lagged conversations.

These results mirror patterns found in previous research. Time-lagged correlations were found by Peterson and McCabe (1994), where children's ability to independently provide *when* and *where* contextual details at 43-months (3 years) was correlated with their mothers' frequency in their earlier narrative elicitations. Although the age of interest in this study is much younger, their results support our findings that mother's early narrative use, uniquely relates to children's future inclusions for WHEN and WHERE narrative information. It also supports the claim that children and their mothers are collaborating in their shared conversations for time and space details. Bidirectional analyses found that children and their mothers are co-constructing their narratives in such a way that mother's may be supporting their children's narrative contributions for time and space details in both concurrent and subsequent narrative conversations.

Interestingly, results also found that in cross-lagged conversations, children's inclusion of WHEN details at 40-months, and mother's inclusion of WHEN details at 25-months, was negatively correlated (R = -0.19), suggesting that while one conversational partner was contributing less temporal information, the other partner was contributing more of those in conversations at a different time. Although this was the only negative result found, it further suggests that conversational partners are working off each in a collaborative manner in their narratives and that patterns of event co-narrations may be found in how children and mothers talk about time. Children and mothers are co-constructing and collaborating in their narrative production which potentially influences the narrative style of their later conversations.

Regression analyses

Early mother WHEN/WHERE questions predicting children's later inclusion of time/space

Simultaneous regressions analyzed mother's questions for WHEN and WHERE information during the early childhood period to predict for children's respective WHEN and WHERE narrative inclusions at 12-years. Regression analyses explained that the number of open-ended WHEN questions ('Q-O-WHEN') mothers asked when speaking with their children at 5½ years uniquely predicted children's independent inclusions of WHEN information at 12-years old. A regression analysis using mother's open-ended WHERE questions ('Q-O-WHERE') did not significantly predict children's use of later WHERE information.

Children are learning what information is valuable or necessary to include in their conversations. Results found differing patterns in children's inclusion of time and space details into adolescence in relation to their mother's early time and space questions. For children's developments into adolescence, mother's early prompts for temporal information is more predictive of their children's later inclusions of temporal information, compared to their prompts for spatial information. It could be suggested that mothers who include more WHEN questions in early childhood, particularly at 5½-years, may have children who are internalizing their prompts for that information over time, and their children may then be more likely to include that information at 12-years old. Mothers inclusions of WHERE-informative questions in their conversations during early childhood, did not predict children's future conversational inclusions of WHERE details . As per previous discussions surrounding children's frequencies of WHERE details during early childhood, it could be inferred that children's use of WHERE narratives details may be more common and naturally salient, where children may already be providing that information in their conversations so mothers prompt less for this information, and in turn children's individual differences into adolescence for this information are not as prominent. Mother's inclusion of spatial questions in this study did not predict children's inclusion of spatial details when crossing the boundary between early childhood and adolescence. Mother's inclusion of temporal questions, however, does predict children's inclusions of temporal details in their narratives when crossing that boundary.

As per findings from the bidirectional analyses, and as hypothesized through these regression analyses, it could be suggested that children may be internalizing how their mothers are talking about the past predominantly for time information, in co-constructed narratives, particularly around 65-months (see Cleveland & Reese, 2005; Newcombe & Reese, 2004). These results support findings from Newcombe and Reese (2004), where mother's average use of spatial-temporal details (under the *orientations* category) from 25-months onwards, has been found to be positively associated with their children's average use of time and space details at that same timepoint and in later cross-lagged conversations. In our case, mother's contributions for WHEN informative questions, seemed to have influenced children's inclusions of WHEN details in later conversations within the early childhood period.

Moreover, Peterson and McCabe (1994), analyzed mother's use of questions under a single category (single question code category that did not distinguish the types of *wh*-questions such as for *when/where* information, but instead was inclusive of all *wh*- and *yes/no* context questions), in relation to their children's later provisions of both *when* and *where* information. Contextual questions asked by the parent at 32-37 months significantly predicted children's inclusions of *when* and *where* details 6 months later, when the children were 3 years old. In the study by Peterson and McCabe (1994), although the timeframe of this study is much smaller than the current project's timeframe, and although mother's questions were coded under a single category and do not differentiate the WH questions asked (i.e., does not differentiate questions for WHEN and questions for WHERE information), a relation was found over time between mother's earlier inclusions of questions and children's future inclusions of *when* and *where* information, over an early childhood period. Our study parallels this finding in relation to mother's inclusion of WHEN context questions but does not parallel their findings for mother's WHERE context questions. In our study, mother's WHERE questions did not predict children's later WHERE narrative inclusions. Our findings differ from this research. It could be reasoned that the all-inclusive question category used by Peterson and McCabe (1994) for all *wh*- and *yes/no* context questions, overestimates the significance found in children's subsequent provisions of *when* and *where* details, as all types of questions are being used to correlate for children's later inclusions of these details. The overarching question category does not exclusively compare parent's *when*-context questions with children's *when* information, nor does it exclusively compare parent's *where*-context questions with children's *where* information. As we did not find significant results for mother's open-ended WHERE questions in relation to children's later use of WHERE details, future work could attempt to replicate the pattern for WHEN and WHERE questions, as found by Peterson & McCabe (1994) in the early childhood period. Their overarching question category could be further broken down based on the specific *wh*-details, and parent's specific *when* and *where*-context questions could be correlated with children's respective *when* and *where* narrative incorporations to determine a true development of these narrative details during early childhood, and then later into adolescence.

Does early inclusion of time/space details predict future inclusion

Hierarchical regressions were run to determine whether children's and mothers' inclusion of WHEN and WHERE details at earlier timepoints predicted children's future inclusions of WHEN and WHERE details, after having controlled for children's language ability at 65-months. First, we wanted to examine the contributing factors that lead to the development of children's narrative inclusions for WHEN and WHERE details over the early childhood period. In this study, we found that when predicting for children's WHEN details at 65-months, mother's use of WHEN details at 40-months was a unique predictor of children's later use of WHEN details at 65-months, when their language ability is being controlled for. Next, a model predicting for children's use of WHERE details at 65-months was analyzed. Results were not significant. In the present study, it appears that mother's inclusion of temporal information is a greater predicter for children's narrative development over early childhood, compared to mother's inclusion of spatial details.

Second, we wanted to cross the early childhood to late childhood boundary and wanted to determine whether mother's early inclusions of WHEN/WHERE details predicted children's future inclusions of WHEN/WHERE details at 12-years old. No significant results were found. Developments for children's inclusion of WHEN/WHERE details in their narratives do not cross the early into later childhood boundary. Mother's inclusions of narrative details at the earlier timepoint do not relate to children's later inclusions of those details. Being mindful of the gap between development from 5½ years and 12-years it could be argued that there may be further developments that occur within the six-and-a-half-year gap that were not accounted for and that could better explain children's developments at 12-years. Future research could further evaluate mother-child conversations past the age of 65-months and prior to 12-years of age, in order to assess how children's and mother's conversations change over time, and how mother's inclusions of WHEN/WHERE details after 65-months may better predict children's narrations of these details into adolescence.

Conventional Time Knowledge Performance

We completed correlations to determine relations among children's conventional time knowledge at 12-years and their use of WHEN and WHERE details at 12-years. Children's CTK performance at 12-years-old, was significantly correlated with children's use of WHEN details at 12_{FR}-years, when they were freely recalling past event information, but was not significantly correlated when accounting for children's total narratives at 12_{T}-years. No significance was found between CTK performance and children's use of WHERE information. Children's CTK performance at 12_{FR}-years was correlated with children's use of WHEN information at the same age but children's CTK performance is not correlated with their use of WHERE information at that time.

The CTK task reflects accuracy of children's knowledge for language and their working memory abilities, not children's ability to remember and to include temporal information in conversations about the past (see Pathman et al., 2022). Children's accuracy and performance on the CTK task is based on parent's accuracy of the past, and therefore depends on whether the parent approves the accuracy for the time estimates presented by the child. Previous research found age-related improvements in young children's ability to accurately order timescales and answer flexible retrieval questions (between ages 4 and 6; see Scales & Pathman, 2021), and found adolescent's CTK performance to increase with age (between 8-12-years-old; see Friedman et al., 2011). These improvements were positively correlated with children's time estimates for personal past autobiographical events, as confirmed by their parents (Friedman et al., 2011; Pathman & St Jacques, 2014). However, these improvements were found in the context of lab-based studies that were specifically testing for temporal accuracy judgements. These studies did not test for children's narrative use for such details as time and space, nor were they looking at children's AM narrative performance.

Past research has found connections between CTK performance and temporal accuracy (see Pathman et al., 2022). For our purposes, this study aimed to determine whether children's CTK task performance at 12-years was reflective of children's memory performance and was reflective of children's inclusions of temporal details in conversations at that age. Although the CTK task uses past autobiographical events to determine children's temporal abilities, the task itself does not technically reflect the approach of a narrative study, but of a lab-based one instead. The CTK is used to test children's concepts for time, not their general abilities to use time information to construct narrative histories, which could account for the lack of predictive power found in our results.

Our findings compel additional research on the accuracy of AM narratives from early into late childhood. In follow-up studies, accuracy tests for temporal information, such as the CCT task as developed by Scales and Pathman (2021) for younger children, could be administered at each corresponding timepoint during early childhood to determine a more precise trajectory for the development of children's ability to flexibly retrieve past time information. Temporal accuracy judgements could be studied in children over time, from early into late childhood to obtain a natural trajectory for not only when children are able to accurately remember the specific temporal details about their past, but also ascertain when they are able to accurately narrate those details. This could add to current research by providing data on determining what temporal information children remember about their past, and by what age those temporal details are accurate. Accuracy for time information in children's verbal memory narratives would further aid as predictors of children's ability to accurately judge and present autobiographical memory representations in narratives.

Limitations and Conclusions

A limitation to this present study was that our project did not measure accuracy of experimenter-child discussed events at the final timepoint. This is a limitation of most AM studies that examine unique autobiographical events, as past events are not always recorded and thus accuracy checks for event information cannot be confirmed. For this reason, experimenters could not accurately confirm events or probe for correct event details from the adolescents at 12-years old, as mothers had done with their children at the earlier timepoints, as mothers would orient their children to the correct event of focus if the child had misunderstood the event being discussed. Future work would be needed to overcome this. Future work could combine the overall examination of AM narratives at 12-years old with event accuracy measures, including measures to confirm time and space details (e.g., photo taking or recording events as they occur).

The present project has enhanced our understanding of children's developing use of time and space details in early childhood into early adolescence, and the factors that influence these developments. The present research contributes to a growing body of evidence surrounding child's AM developments (Larkina & Bauer, 2010; Reese et al., 1993; Reese et al., 2010; and Larkina & Bauer, 2012; Bauer & Larkina, 2019). By longitudinally studying a young cohort of children into adolescence and the patterns that shape the development of their TM development, this research adds to this field of research and further reasons that early mother conversational factors influence children's understandings and abilities to provide temporal information in narrative conversations over time.

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Appendix

Table A

Time Points of Focus

<table>
<tr><th></th><th></th><th colspan="2">Mother-Child Conversations</th><th>Experimenter-Child Conversations</th></tr>
<tr><th></th><th></th><th colspan="2">First 2 Shared Events</th><th>First 2 Life Changing Events</th></tr>
<tr><th></th><th></th><th>Mom-Coded</th><th>Child-Coded</th><th>Child-Coded</th></tr>
<tr><td rowspan="7">Timepoints</td><td>19 months</td><td></td><td></td><td></td></tr>
<tr><td>25 months</td><td>X</td><td>X</td><td></td></tr>
<tr><td>32 months</td><td></td><td></td><td></td></tr>
<tr><td>40 months</td><td>X</td><td>X</td><td></td></tr>
<tr><td>51 months</td><td></td><td></td><td></td></tr>
<tr><td>65 months</td><td>X</td><td>X</td><td></td></tr>
<tr><td>12 years</td><td></td><td></td><td>X</td></tr>
<tr><td rowspan="7">WH Codes</td><td>WHO</td><td colspan="2">X</td><td>X</td></tr>
<tr><td>WHAT</td><td colspan="2">X</td><td>X</td></tr>
<tr><td>WHERE</td><td colspan="2">X</td><td>X</td></tr>
<tr><td>WHEN</td><td colspan="2">X</td><td>X</td></tr>
<tr><td>WHY</td><td colspan="2">X</td><td>X</td></tr>
<tr><td>HOW</td><td colspan="2">X</td><td>X</td></tr>
<tr><td>QUESTION CODES</td><td>X</td><td></td><td></td></tr>
<tr><td></td><td>CTK Data</td><td colspan="3">CTK data obtained at the 12-year timepoint</td></tr>
</table>

Note. "X" denotes timepoint and WH codes of focus. For proposition coding, Puneet Parmar was the primary coder and Yang Lin was the reliability coder. For WH-coding, Taran Virk was the primary coder and Kathleen Bettencourt was the reliability coder.

Table B

WH Coding Scheme

MAIN CODES	SUB-CATEGORY	MEANING AND WHEN TO USE
WHO*		Specific people, gender, or class of people ("*cousins," "friends")* present for or participating in the event. Includes general references to person ("*somebody"*) and references to one's role in a play ("*I was Snow White"*)
WHAT-ACT*		Actions performed by a character or an object in the narrative
WHAT-OBJ*		Specific objects or things present
WHERE*		Location of the event in place
	LS (location specific)	Explicit reference to a building, physical location, or named space *("my house")*
	LG (location general)	General reference to a building or other location or space where specific name is not mentioned *("the park")*
	LV (location vague)	The use of spatial prepositions in the absence of location or space information *("outside", "at", "on", etc.)*
	GEO (geographic location)	The explicit mention of a geographic location, including the explicit name a city, town, province, country, or any other geographic region *("England", "Toronto")*
	DL (distance)	Expression of a physical orientation, position, or distance in reference to a subject or object in space *("over", "to the left", "six feet apart")*
WHEN*		Reference to time, including indications of order
	T (time)	Pinpoints the event or sub-events in historical or narrative time
	TR (time repeated)	Reference to a repeated time point
	TV (time vague)	Describes event time in a vague way (e.g., 'earlier'; sometime that day)
	TC (temporal connection)	The explicit use of words or statements that provide information about the relative sequential order in which aspects of the event took place

	D (duration)	Indication of duration of time
WHY*		Statements of justification or causation
HOW-DESC*		Adverbs, adjectives, words, or prepositional phrases that describe the physical or observable characteristics of an object or an action, but without evaluation
HOW-EVAL*		Indication of personal evaluation of the event by the participant, including intensifiers ("*really* hot," "*biggest*"), subjective modifiers *("it was ugly"),* and terms conveying information about emotion, relative preference, or physiological state *("I was sad," "I liked it," "I was hungry")*
Q-WH		Use of a WH code by the mother or experimenter, in question form
	Q-O-WH__	Question posed using a WH code asking the child to elaborate and openly share as much event detail as they can remember (e.g., the mother asks "*Who* was there?", the WHO in this context would receive 'Q-O-WHO' code)
	Q-C-WH__	WH code question that asks the child a closed prompt, asking for either a "*yes*" or "*no*" in response to their question about an event (ex. "When we went it was nighttime, right?" would receive a 'Q-C-WHEN' code)
	Q-O	An open-ended question, that does not start with a WH word, is posed to the child prompting them to further elaborate on event information (ex. "Do you remember anything else?")
	Q-C	When a close-ended question, that does not start with a WH word, is posed to the child asking them to reply with either a "*yes*" or "*no*" (ex. Did you like the food?" or similar questions prompting the child to respond with either "*yes*" or "*no*")

Note. Table indicating the codes to be used in the WH Coding Manual for this project. All sub-category codes were not in the original WH manual but were added to the manual for purposes of this project.

*The eight codes used in the narrative breath score.

Table C

Means and standard deviations for all other codes included by children and mothers

	25 months M *(SD)*	*40 months* M *(SD)*	*Timepoints* *65 months* M *(SD)*	*12_{FR} years* M *(SD)*	*12_{T} years* M *(SD)*
Children					
WHO	1.54 *(1.45)*	1.65 *(1.57)*	1.79 *(2.04)*	3.58 *(3.60)*	8.71 *(5.96)*
WHAT-ACT	1.01 *(1.27)*	3.01 *(2.63)*	5.26 *(3.81)*	12.79 *(7.94)*	20.38 *(13.38)*
WHAT-OBJ	2.18 *(2.05)*	2.54 *(1.82)*	4.38 *(2.91)*	4.78 *(4.29)*	6.85 *(5.91)*
WHY	0.00 *(0.00)*	0.17 *(0.34)*	0.33 *(0.41)*	1.24 *(1.00)*	2.51 *(1.82)*
HOW-DESCRIPTION	0.81 *(0.96)*	1.76 *(1.74)*	3.07 *(3.14)*	3.81 *(2.79)*	7.18 *(5.32)*
HOW-EVALUATION	0.11 *(0.32)*	0.47 *(1.69)*	0.49 *(0.86)*	2.63 *(2.17)*	6.96 *(4.49)*
REP	0.26 *(0.44)*	0.17 *(0.32)*	0.04 *(0.14)*	0.01 *(0.08)*	0.01 *(0.08)*
REP-P	0.22 *(0.45)*	0.07 *(0.18)*	0.15 *(0.31)*	0.01 *(0.08)*	0.01 *(0.08)*
Mothers					
WHO	4.83 *(2.95)*	3.15 *(2.90)*	2.18 *(1.94)*		
WHAT-ACT	15.04 *(8.00)*	12.57 *(6.86)*	13.40 *(7.27)*		
WHAT-OBJ	9.50 *(6.01)*	6.25 *(3.96)*	7.11 *(5.14)*		
WHY	0.06 *(0.16)*	0.18 *(0.42)*	0.39 *(0.59)*		
HOW-DESCRIPTION	3.40 *(2.52)*	3.74 *(3.11)*	4.60 *(4.03)*		
HOW-EVALUATION	1.14 *(1.66)*	1.43 *(1.43)*	2.38 *(2.25)*		
REP	0.08 *(0.28)*	0.08 *(0.22)*	0.11 *(0.30)*		
REP-P	0.85 *(1.21)*	1.13 *(1.28)*	0.75 *(0.72)*		

Note. 'REP' codes represent self-repeated information by either participant in their narratives, and 'REP-P' codes represent information that was said by one conversational partner and repeated by the other**.**

Table D

Means and standard deviations of mother's question codes

	Timepoints		
	25 months	***40 months***	***65 months***
	M *(SD)*	**M *(SD)***	**M *(SD)***
Q-O-WHO	1.49 *(1.44)*	1.43 *(1.29)*	0.88 *(1.02)*
Q-O-WHAT	4.58 *(3.60)*	3.97 *(1.84)*	4.18 *(2.19)*
Q-O-WHERE	0.54 *(0.64)*	0.60 *(1.03)*	0.50 *(0.74)*
Q-O-WHEN	0.03 *(0.12)*	0.03 *(0.12)*	0.03 *(0.12)*
Q-O-WHY	0.06 *(0.26)*	0.06 *(0.16)*	0.18 *(0.30)*
Q-O-HOW	0.18 *(0.60)*	0.24 *(0.35)*	0.43 *(0.74)*
Q-O	2.01 *(1.48)*	2.74 *(1.82)*	3.51 *(2.07)*
Q-C	6.07 *(3.51)*	4.78 *(2.76)*	3.22 *(1.99)*
Q-REP	1.14 *(1.88)*	0.35 *(0.65)*	0.13 *(0.25)*

Note. Mothers only asked their children open-ended WH-questions across all timepoints. Although a category was created for mother's inclusion of close-ended WH-questions, mothers did not ask questions in this format. No scores were available for mother's closed-ended WH-questions and so corresponding codes are omitted from this table.

Table E

F-statistics for children's WHEN and WHERE sub-category code differences.

	ANOVAs testing for differences across timepoints	***ANOVAs testing for differences across timepoints***
Children	***Timepoints (25mo, 40mo, 65mo, & 12_{FR} years)***	***Timepoints (25mo, 40mo, 65mo, & 12_{T} years)***
Time	**$F(1.35, 47.25) = 13.03, p < .001, \eta^2 = 0.27$** [25 months, 40 months and 65 months < 12 years old]	**$F(1.19, 41.49) = 71.12, p < .001, \eta^2 = 0.67$** [25 months, 40 months and 65 months < 12 years old]
Time repeated	**$F(3, 105) = 3.74, p = .013, \eta^2 = 0.09$** [follow-up tests with correction were not significant]	**$F(3, 105) = 4.48, p = .005, \eta^2 = 0.11$** [follow-up tests with correction were not significant]
Time vague	**$F(1.19, 41.97) = 31.61, p < .001, \eta^2 = 0.48$** [25 months, 40 months and 65 months < 12 years old]	**$F(1.06, 37.19) = 34.43, p < .001, \eta^2 = 0.49$** [25 months, 40 months and 65 months < 12 years old]
Temporal connection	**$F(1.33, 46.39) = 37.98, p < .001, \eta^2 = 0.52$** [25 months and 40 months < 65 months] [25 months, 40 months and 65 months < 12 years old]	**$F(1.10, 38.71) = 71.12, p < .001, \eta^2 = 0.54$** [25 months and 40 months < 65 months] [25 months, 40 months and 65 months < 12 years old]
Duration	**$F(3, 105) = 5.35, p = .020, \eta^2 = 0.13$** [follow-up tests with correction were not significant]	**$F(3, 105) = 8.79, p < .001, \eta^2 = 0.20$** [25 months and 40 months < 12 years old]
Location specific	**$F(1.21, 42.28) = 8.41, p = .004, \eta^2 = 0.19$** [25 months, 40 months and 65 months < 12 years old]	**$F(1.08, 37.84) = 18.38, p < .001, \eta^2 = 0.34$** [25 months, 40 months and 65 months < 12 years old]
Location general	**$F(1.98, 69.45) = 10.43, p < .001, \eta^2 = 0.23$** [25 months < 40 months, 65 months and 12 years old]	**$F(1.39, 48.73) = 31.76, p < .001, \eta^2 = 0.48$** [25 months < 40 months, 65 months and 12 years old] [40 months and 65 months < 12 years old]
Location vague	**$F(1.55, 54.36) = 6.78, p = .005, \eta^2 = 0.16$** [25 months and 40 months < 12 years old]	**$F(1.26, 43.96) = 10.20, p = .001, \eta^2 = 0.23$** [25 months and 40 months < 12 years old]

Geographic location	**F(1.58, 55.22) = 9.11, p = .001, η^2 = 0.21** [25 months and 40 months < 12 years old]	**F(1.20, 42.14) = 15.80, p < .001, η^2 = 0.31** [25 months, 40 months and 65 months < 12 years old]
Directionality/ distance	**F(1.74, 60.73) = 6.39, p = .004, η^2 = 0.15** [25 months < 40 months, 65 months and 12 years old]	**F(1.99, 69.91) = 5.29, p = .007, η^2 = 0.13** [25 months < 40 months, 65 months and 12 years old]

For significant main effects of age (bolded statistics), pairwise comparison of age group differences is done with a Bonferroni correction. Square brackets summarize the age groups that were significantly different from each other.

Table F

F-statistics for mother's WHEN and WHERE sub-category code differences.

	ANOVAs testing for differences across timepoints
Mothers	
Time	$F(1.65, 57.79) = 2.47$, $p = .103$, $\eta^2 = 0.07$
Time repeated	$F(1.57, 55.05) = 0.49$, $p = .569$, $\eta^2 = 0.01$
Time vague	$F(2, 70) = 1.79$, $p = .174$, $\eta^2 = 0.05$
Temporal connection	**$F(1.53, 53.66) = 4.59$, $p = .022$, $\eta^2 = 0.12$** [40 months < 65 months]
Duration	$F(2, 70) = 1.84$, $p = .166$, $\eta^2 = 0.05$
Location specific	$F(2, 70) = 0.19$, $p = .823$, $\eta^2 = 0.005$
Location general	$F(2, 70) = 0.004$, $p = .99$ $\eta^2 = 0.000$
Location vague	$F(2, 70) = 0.52$, $p = .597$, $\eta^2 = 0.02$
Geographic location	**$F(1.46, 50.92) = 5.33$, $p = .015$, $\eta^2 = 0.13$** [25 months < 65 months]
Directionality/distance	$F(2, 70) = 0.09$, $p = .907$, $\eta^2 = 0.003$

For significant main effects of age (bolded statistics), pairwise comparison of age group differences is done with a Bonferroni correction. Square brackets summarize the age groups that were significantly different from each other.

Table G

Children's and mother's timepoint differences for WHEN and WHERE sub-category details when controlling for narrative length.

Variables	***Children's adjusted timepoint differences (12FR)***	***Children's adjusted timepoint differences (12T)***	***Mother's adjusted timepoint differences***
Time	**F(1.48, 50.44) = 11.23, p < .001, η^2 = 0.25** [25 months < 65 months] [25 months, 40 months and 65 months < 12 years old]	**F(1.31, 44.42) = 19.69, p < .001, η^2 = 0.37** [25 months, 40 months and 65 months < 12 years old]	F(1.69, 57.69) = 2.32, p = .115, η^2 = 0.06
Time repeated	F(3, 102) = 2.15, p = .098, η^2 = 0.01	**F(3, 102) = 3.18, p = .027, η^2 = 0.09** [follow-up tests with correction were not significant]	F(1.56, 53.35) = 0.18, p = .785, η^2 = 0.01
Time vague	**F(1.29, 44.09) = 16.59, p < .001, η^2 = 0.33** [25 months, 40 months and 65 months < 12 years old]	**F(1.13, 38.42) = 37.45, p < .001, η^2 = 0.52** [25 months, 40 months and 65 months < 12 years old]	F(2, 68) = 1.71, p = .188, η^2 = 0.05
Temporal connection	**F(1.38, 46.88) = 21.53, p < .001, η^2 = 0.39** [25 months < 65 months and 12 years old] [40 months < 65 months and 12 years old] [65 months < 12 years old]	**F(1.19, 40.28) = 38.58, p < .001, η^2 = 0.53** [25 months < 65 months and 12 years old] [40 months < 65 months and 12 years old] [65 months < 12 years old]	F(1.54, 52.35) = 0.39, p = .619, η^2 = 0.01
Duration	**F(2, 102) = 6.67, p < .001, η^2 = 0.16** [25 months and 40 months < 12 years old]	**F(2, 102) = 6.75, p < .001, η^2 = 0.17** [25 months, 40 months and 65 months < 12 years old]	F(2, 68) = 0.48, p = .618, η^2 = 0.01
Location specific	F(1.22, 41.56) = 3.10, p = .078, η^2 = 0.84	**F(1.09,37.18) = 5.93, p = .018, η^2 = 0.15** [25 months, 40 months and 65 months < 12 years old]	F(2, 68) = 0.42, p = .658, η^2 = 0.01
Location general	**F(1.95, 66.40) = 5.16, p = .009, η^2 = 0.13** [25 months < 40 months, 65 months and 12 years old]	**F(1.62, 55.20) = 22.78, p < .001, η^2 = 0.40** [25 months < 40 months, 65 months and 12 years old] [40 months and 65 months < 12 years old]	F(2, 68) = 0.03, p = .974, η^2 = 0.01
Location vague	**F(1.76, 59.95) = 12.26, p < .001, η^2 = 0.27** [25 months and 40 months < 12 years old]	**F(1.41, 47.89) = 19.25, p < .001, η^2 = 0.36** [25 months, 40 months and 65 months < 12 years old]	F(2, 68) = 0.08, p = .927, η^2 = 0.02

Geographic location	$F(1.59, 53.89) = 1.39$, $p = .256$, $\eta^2 = 0.04$	$F(1.20, 40.82) = 0.45$, $p = .543$, $\eta^2 = 0.01$	**$F(1.46, 49.51) = 0.21$, $p = .740$, $\eta^2 = 0.01$ [25 months < 65 months]**
Directionality/ distance	$F(1.69,57.59) = 3.16$, $p = .058$, $\eta^2 = 0.03$	$F(3, 102) = 2.93$, $p = .064$, $\eta^2 = 0.08$	$F(2, 68) = 0.57$, $p = .552$, $\eta^2 = 0.02$

For significant main effects of age (bolded statistics), pairwise comparison of age group differences is done with a Bonferroni correction. Square brackets summarize the age groups that were significantly different from each other.