ABSTRACT

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Research exploring adults’ earliest memories provides clear support for childhood amnesia, defined as a paucity of autobiographical memories for events experienced during the first years of life (e.g., Wetzler & Sweeney, 1986). Recently, researchers have begun to explore children’s earliest memories to better understand the maintenance of memories encoded early in life and the mechanisms that support their retrieval across time. The value of this past research notwithstanding, the number of studies that have been conducted is relatively limited. Further, despite the importance attached to estimates of age at encoding (AaE) for conclusions regarding the emergence of autobiographical memory (e.g., Peterson et al., 2005; Wang, 2004), few studies have evaluated the plausibility of memories of very early life events (e.g., memories of infancy) or have systematically explored implausible memory reporting in child or adult samples. This issue is particularly relevant given that the extant literature provides evidence that children may report events that occurred during infancy when prompted to recall their earliest recollections. This study addresses these issues and contributes to the growing literature by examining factors that may be related to how children engage in the task of recalling their earliest memories. Specifically, this study examined beliefs about autobiographical memory and past parent-child discussion as factors that may be related to children’s selection of implausible memories of events that occurred during the first 18 months of life. Second, this study also examined how parent-child discussion at the level of the memory may be related to children’s autobiographical remembering, particularly with regard to the narrative coherence and AaE of their previously discussed and non-
discussed earliest memories. This study examined the earliest memories of children in three age groups: prekindergarten, grade 1, and grade 3. Child participants’ parents provided feedback about their memories, including whether or not memories had been previously discussed. In addition, earliest memories reported by college students were analyzed to provide a baseline for implausible memory reporting. Findings revealed that participants in the college sample reported fewer implausible memories than children at all grade levels. Examining beliefs about the limitations of autobiographical memory, only a small proportion of children demonstrated an understanding that autobiographical memory is limited and that external sources of knowledge (e.g., photos) do not supplant these limitations. This finding suggests that beliefs about autobiographical memory continue to develop through grade 3. Although grade-level differences were evident in the accuracy of children’s beliefs about autobiographical memory, the predicted relation between these beliefs and implausible memory reporting did not reach statistical significance. Among children, implausible memories of were more likely than not to have been the topic of parent-child discussion, which may suggest that children through grade 3 do not differentiate the knowledge they acquire through discussion of the past with their parents from their own personal recollection of past experiences. The results further indicate that parent-child discussion at the level of the memory may yield benefits for children’s earliest memory recall. Compared to events that had not previously been the topic of parent-child discussion, previously discussed events occurred earlier in time and were associated with children’s memory dating accuracy. In addition, children’s memory narratives were more likely to be thematically coherent if memories had previously been the topic of parent-child discussion than if they had not been discussed. Overall, these findings align with a social cultural developmental theory of
autobiographical memory (Nelson & Fivush, 2004), which emphasizes the role of social interaction in the emergence of autobiographical memory while also acknowledging that social interaction is part of a larger constellation of biological, linguistic, cognitive, and socioemotional influences.
What Children Know about Remembering: Implications for Reports of Earliest Memories

by

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DEDICATION

I dedicate this work to the memory of my Mammaw, Ellen Townsend. Thank you for so many of my fondest childhood memories and for teaching me the value of persistence.
BIOGRAPHY

Ellen Rebekah Siceloff was born in Columbia, South Carolina where she lived with her mother, father, and two brothers. She moved to Laramie, Wyoming to attend college and earned a Bachelor of Arts degree in Psychology from the University of Wyoming in 2003 and a Bachelor of Arts degree in Criminal Justice the following year. During her time in Wyoming, Rebekah was fortunate to have numerous opportunities to be a part of the research process as an undergraduate research assistant. From those experiences, she gained an appreciation for research and understanding the human condition. She carried those interests with her when she enrolled in the Lifespan Developmental Psychology Program at North Carolina State University where she earned a master’s degree in 2007.
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What Children Know about Remembering: Implications for Reports of Earliest Memories

Research exploring adults’ earliest memories provides clear support for childhood amnesia, defined as a paucity of memories for events experienced during first years of life (Kihlstrom & Harackiewicz, 1982; Wetzler & Sweeney, 1986). Despite evidence of this phenomenon in adulthood, three-year-old children are able to recall events that happened a year in the past (Fivush, Haden, & Adam, 1995; Peterson, Moores, & White, 2001; Peterson & Rideout, 1998). Thus, there is an apparent contradiction. Whereas adults’ earliest memory reports typically describe events that occurred in their fourth year of life (Rubin, 2000; West & Bauer, 1999), a vast literature establishes that young children are able to remember everyday experiences across lengthy time intervals during the years that eventually become inaccessible in adulthood (see Peterson, 2002 for a review). Taken together, these seemingly disparate findings converge to discount an encoding deficit in early childhood as a tenable explanation for childhood amnesia. Instead, it appears that autobiographical memory emerges as children begin to encode memories in a way that supports their retrievability into adulthood (Morrison & Conway, 2010).

To better understand the maintenance of memories encoded early in life and the mechanisms that support their retrieval across time, researchers have recently begun to explore children’s earliest memories. This burgeoning line of research has made a vital contribution to the literature by providing a developmental perspective on the phenomenon of childhood amnesia and the emergence of autobiographical memory. A central contribution of this research is an attempt to index the emergence of autobiographical memory during childhood by exploring the age at which children encoded the events described in their
earliest memories (Peterson, Grant, Boland, 2005; Peterson, Wang, & Hou, 2009; Wang, 2004). Further, this temporal information, which Wang, Peterson, and Hou (2010) refer to as the “age at encoding” (AaE), offers critical information regarding how the accessibility of earliest memories shifts across time (Peterson, 2011). In addition to exploring how far in the past children can remember, studies have also explored factors that may influence children’s memory for their earliest experiences, including culture (Peterson et al., 2009; Wang, 2004) and parent-child reminiscing (Jack, McDonald, Reese, & Hayne, 2009). The value of this past research notwithstanding, the number of studies that have been conducted is relatively limited and questions remain about the retrievability of early memories across childhood and the factors that contribute to the emergence of autobiographical memory.

A particular limitation of the extant research that examines children’s earliest memories centers on children’s ability to meaningfully engage in the task of recalling their earliest memories. When prompted to recall an experience, children are “engaged in a complex social and cognitive performance that draws on many different capabilities, each with its own developmental trajectory” (Pasupathi & Wainryb, 2010). For recalled experiences to contribute to an understanding of autobiographical memory, this ‘performance’ requires children (and adults) to select memories that are based on personal recollection that is autonoetic in nature (Nelson & Fivush, 2004). In contrast to recalling knowledge of the past, autonoetic recollection involves the sense of one’s self in the experience (Tulving & Lepage, 2000). This is a critical aspect of autobiographical memory, which is defined as “declarative, explicit memory for specific points in the past, recalled from the unique perspective of the self in relation to others” (Nelson & Fivush, 2004, p. 488).
Despite the importance attached to earliest memories as evidence of the emergence of autobiographical memory, extant studies have not systematically explored children’s earliest memories to examine the frequency with which they report memories that are likely based on knowledge. Addressing this gap in the literature, a primary aim of the current study was to examine earliest memory reporting among children in prekindergarten, first grade, and third grade and among college students to identify reports that are not plausible representations of autobiographical memory.

A second aim of the current study was to contribute to the literature by exploring child-level cognitive factors and memory-level features that may be related to how children engage in the tasks of selecting and reporting their earliest memories. The social cultural developmental theory emphasizes the contributions of cognitive and social sources to the emergence of autobiographical memory, including children’s mental concepts and engagement in conversations about the past (Nelson & Fivush, 2004). Building on this theory, I examined the relationship between children’s beliefs about autobiographical memory and their selection of knowledge-based memories as their earliest recollections. Further, I explored parent-child discussion as a context through which children gather the information reported in these implausible memories. The social cultural developmental theory suggests that conversations about the past may support the emergence of autobiographical memory by supporting the development of children’s narrative skills (Nelson & Fivush, 2004). However, there is a dearth of research that explores how parent-child discussion is related to children’s independent narratives of their earliest memories. Thus, to address this gap in the literature, a third primary aim of the current study was to
examine the relationship between previous parent-child discussion and the coherence of children’s independent narratives of those events.

*Earliest Memory Research*

A common aim of earliest memory research is to contribute to a theoretical explanation of childhood amnesia. The offset of childhood amnesia coincides with the emergence of autobiographical memory as children begin to encode their experiences in a way that supports their long-term maintenance in memory (Morrison & Conway, 2010). To characterize the emergence of autobiographical memory developmentally, many studies have examined estimates of AaE associated with the events described in earliest memory reports (e.g., Peterson et al., 2005; Wang, 2004; Wang, Peterson, & Hou, 2010). This temporal information, which typically represents participants’ (or their parents’) estimates of their age at the time the events described in their earliest memory reports occurred, serves as an index of the emergence of autobiographical memory. Although AaE is known for some events (e.g., the birth of a sibling), AaE for other events may reflect reconstructions of time. In the adult literature, these estimates are remarkably consistent across studies (Courage & Howe, 2004). However, findings regarding the AaE of children’s earliest memories do not demonstrate similar consistency. Although variability in AaE is predicted across age groups in childhood and adolescence (Peterson, Grant, & Boland, 2005), extant studies fail to reveal expected consistencies in average AaE estimates across similar age groups. For example, although some studies report an AaE of about 24 months during late childhood/early adolescence (Peterson et al., 2009; Tustin & Hayne, 2010), other studies find a much later AaE of 44 months among similar-aged participants (Peterson et al., 2005). Similar variability
is also evident for eight- to nine-year-old participants, with AaE estimates ranging from about 15 months (Tustin & Hayne, 2010) to just over 24 months (Peterson et al., 2009).

A related limitation centers on how AaE estimates for children’s earliest memories may shift with time. Some studies have found evidence of diminished retrievability with increasing age (Peterson, 2011; Peterson et al., 2005), with younger children recalling earlier first memories than older children do. Complicating these finds, however, other research indicates that an increase in AaE does not occur until adolescence (Tustin & Hayne, 2010) or that despite an increase in AaE during later childhood, adolescents’ AaE is similar to that of six- to nine-year-old children (Peterson et al., 2005). There are also studies that do not find evidence of diminished retrievability across age groups, regardless of whether the study includes only children (Wang, 2004) or is inclusive of adolescents (Peterson et al., 2009). The discrepancies in AaE found within and across age groups in studies of children’s earliest memories limit the conclusions about the development of autobiographical memory that can be derived from this body of research. Therefore, further research is necessary to elucidate the nature of children’s earliest memories and the emergence of autobiographical memory.

One explanation for the variability in the findings that have emerged from studies of children’s earliest memories centers on the plausibility of the memories that are accepted as evidence of autobiographical memory. Few studies have explicitly discussed memory plausibility as a criterion for the inclusion or exclusion of memory reports from data analysis (cf., Jack et al., 2009). Although it may not be possible to confirm that a memory report represents a genuine autobiographical memory, it is possible to evaluate the plausibility that a report is based on personal recollection. In particular, I suggest that the plausibility that
reports of infancy are genuine memories is suspect given the protracted development of the neural networks that support declarative memory (Bauer 2004, 2007; Richmond & Nelson, 2007). Specifically, the functional maturity of the medial temporal lobe, which plays a key role in the conscious recollection of information, extends to at least two years of age as a result of postnatal development of the dentate gyrus and maturation of inhibitory neurons (Richmond & Nelson, 2007). Neurological evidence also implicates the prefrontal cortex as a structure that is particularly important in the retrieval of traces from long-term stores, and this structure does not reach functional maturity until close to the end of the second year of life (for a review, see Bauer, 2004, 2007).

Behavioral data regarding the development of declarative memory is consistent with neurological evidence. For example, in an elicited imitation paradigm, which is considered a nonverbal measure of declarative memory, nine-month-old infants can recall multiple sequences over a one-month delay but not over longer intervals (Carver & Bauer, 2001). Although this research indicates significant improvement by 10 months of age, when recall of multiple sequences is demonstrated over a three-month delay, long-term recall remains relatively limited in infancy. Further, research demonstrates that although 20-month-olds have better event memory across than either 13- or 16-month-olds, fewer than half of the children in the oldest age group could recall the event after a 12-month delay (Lukowsky, Garcia, & Bauer, 2011).

Research using the visual paired-comparison (VCP) procedure provides further evidence of the prolonged development of declarative memory. In this task, infants view a pair of stimuli for a fixed amount of time. Following a delay, infants view another pair of
stimuli, which includes one novel item and one previously viewed item. Memory is inferred if the infant demonstrates a novelty preference for the previously viewed item (Richmond & Nelson, 2007). Using this procedure to examine retention, one year olds only show a novelty preference if tested immediately (Hayne, 2004). Retention improves over early childhood, however, with a novelty preference evident in two year olds after a one day delay, in three year olds after a one week delay, and in four year olds after one month (Hayne, 2004). Similar evidence comes from delayed imitation tasks, which finds that 18 month olds can remember the task across a maximum of two weeks and that 24 month olds can remember for a maximum of 12 weeks (Herbert & Hayne, 2000).

Together, neurological and behavioral evidence indicates that, despite impressive evidence of memory in infancy, brain development limits recall to modest delays. Therefore, it is implausible that a as child as young as four years of age could recall an event that he or she encoded during the first or even second year of life. However, the extant literature offers evidence that, when prompted to report memories of their past experiences, children may describe memories of perinatal experiences (e.g., Jack et al., 2009) or experiences that occurred in the first year of life (e.g., Bauer, Burch, Scholin, & Güler, 2007; Jack et al., 2009; Tustin & Hayne, 2010). Despite evidence that these memories may not be plausible representations of autobiographical memory, previous studies have given little attention to such reports (cf. Jack et al., 2007). In fact, memories of infancy in the extant literature are typically only revealed in descriptive statistics that provide minimum estimates of AaE (e.g., Bauer et al., 2007) or in graphical presentations of the data (e.g., Tustin & Hayne, 2010), without any explicit discussion of their plausibility. Offering an exception to the typical
oversight of memory plausibility, Jack and colleagues (2007) defended their inclusion of a memory report of a perinatal event by noting that “it is difficult to know for certain that any given memory is a genuine autobiographical memory (as opposed to a reconstruction based on family stories and photographs)” (p. 501). Although it is certainly the case that autobiographical memories may reflect extended encoding, such as that which may occur in parent-child discussions of the past, the neurological evidence described above indicates that it is reasonable to conclude that memories of infancy are not likely to be autobiographical in nature. Regardless, however, Jack and colleagues’ explicit discussion of memory plausibility provides valuable information regarding the types of information children report and the data that inform conclusions regarding the emergence of autobiographical memory. This discussion of memory plausibility is absent in the majority of the extant literature on children’s earliest memories, which limits our understanding of the frequency of these reports and their implications for conclusions regarding the emergence of autobiographical memory.

The current study sought to overcome this limitation of previous studies that have examined children’s earliest memories by exploring the frequency of implausible memory reporting among children’s and college students’ earliest memories within the context of the source monitoring framework (Johnson, Hashtroudi, & Lindsay, 1993). Source monitoring refers to the processes involved in making judgments about the origins of memories based on average differences in the characteristics of memories from various sources in combination with judgment processes (Johnson et al., 1993). Discriminating between these sources of knowledge about one’s personal past requires that a distinction be made between
“remembering” as the conscious recollection of an experience and “knowing” as being familiar with an event but without the experience of conscious recollection (Gardiner & Java, 1993; Tulving, 1985). If an event is judged to be remembered, then the source of one’s memory for that event is personal recollection. In contrast, if an event is judged to be known, then one’s knowledge about that event was derived from a source other than personal recollection, such as general knowledge about one’s self, photographs of the event, or information from family members (Hyman, Gilstrap, Decker, & Wilkinson, 1998). However, the likelihood that source judgment errors will occur is increased when the characteristics of the memories being evaluated are highly similar and when faulty reasoning is employed (Johnson et al., 1993). For example, I may be able to relate the details of a time I hit a homerun, replete with perceptual and sensory information that are characteristic of remembered events (Johnson et al., 1993). Based on these memory features alone, I may conclude that the source of my memory for that event is my own personal recollection of the experience. However, I can apply other knowledge that I have about myself, namely that I never played baseball, to my judgment of the source of that memory and determine that it is not based on my personal recollection of an experienced event. Instead, I may conclude that the source is a memory I constructed from knowledge I garnered from hearing stories of my brother’s homerun. Therefore, judgment processes may facilitate source monitoring.

The utility of making probability judgments was demonstrated in one study in which adults made attributions about real and imagined autobiographical events (Johnson, Foley, Suengas, & Raye, 1988). Judgments that actual events did occur were accompanied by contextual information, such as where and when the event occurred, as well as information
that embedded the event in a broader context, including antecedents that led up to the event and consequences that followed the experience. In contrast, individuals most often supported their judgments that imagined events did not occur by relying on general knowledge, such as one’s age not befitting the fantasy (e.g., a child as a doctor).

As this study illustrates, individuals may alter the stringency of their decision processes to match the requirements of the task. That is, the evaluation of remembered information may require more strategic processing than the relatively immediate source decisions that are made on the basis of memory characteristics (Johnson et al., 1993). With regard to the information recalled in the context of earliest memory reporting, beliefs about autobiographical memory may play a role in facilitating the accuracy of source decisions. For example, in evaluating remembered information, individuals may make source judgments that reflect their belief that it is not possible to remember infancy. Previous research establishes that adults do possess such beliefs about the limitations of autobiographical memory imposed by childhood amnesia. One study demonstrated that adults have very little confidence in their ability to remember events that typically occur in the first year of life, even among participants who were exposed to the suggestion that it is possible to remember such events (Peterson, Kaasa, & Loftus, 2009). This research is consistent with the results of a study that included a sample of 2000 Norwegian adults, which found that fewer than 5% of them indicated that it is possible to remember events that occurred during the first year of life (Magnussen et al., 2006).

Although evidence indicates that adults possess accurate beliefs about autobiographical memory, little is known the development of these beliefs in childhood. If
children have less well-developed beliefs about autobiographical memory than adults do, then their beliefs may limit their ability to accurately monitor the source of knowledge about the past, with the result that knowledge of early experiences may be accepted as personal recollections of those events. Evidence for this possibility comes from research exploring children’s memories for rumored events (Principe, Haines, Adkins, & Guiliano, 2010). Children’s exposure to a rumored event induced sensory and contextual characteristics in memory that resulted in the creation of false memories for experiencing the event. If similar memory construction occurs when children are exposed to knowledge about their earliest experiences, then their ability to resist selecting such memories as their earliest recollections may require strategic processing of the likelihood that it is possible to recall events that occurred very early in life.

Earliest memory research provides an interesting test of children’s ability to utilize strategic processes to evaluate the sources of their knowledge about the past. Unlike research that prompts children to recall the details of an event identified by the researcher, such as memories for a specified event or procedure (e.g., Baker-Ward, Eaton, & Banks, 2005), studies that prompt children to recall their earliest memories present the arguably more challenging task of conducting a memory search for the purpose of selecting their earliest memories while filtering out remembered information that is not based on personal recollection. Evidence of implausible memories of infancy in the extant literature on children’s earliest memories suggests that children may have some difficulty with this task. This difficulty may indicate that children do not evaluate the plausibility of information they
remember in the context of recalling their earliest memories, perhaps as a result of faulty reasoning that reflects erroneous beliefs about the limitations of autobiographical memory.

In the current study, I sought to examine the relationship between children’s beliefs about childhood amnesia and implausible memory reporting. Perhaps children who do not hold beliefs about the limitations of autobiographical memory are more likely than those who do hold accurate beliefs to make source errors when evaluating memories of infancy. Such source errors may result in attributing knowledge about infancy to personal recollection rather than a source that gave rise to a memory construction. Although research demonstrates that parent-child discussion of past experiences may serve to reinstate or reactivate children’s memories of those events (Cleveland & Reese, 2008; Nelson & Fivush, 2004), little is known about parent-child discussion as a source of memory constructions that manifest in children’s reports of their earliest memories. Thus, to better understand the source of such memory constructions, the current study examined implausible memory reporting as it relates to parent-child discussion and to other potential sources (e.g., photographs or souvenirs of the past).

*Children’s Memory Narratives*

Beyond exploring parent-child conversations as a source of memory construction, the current study also examined the relationship between previous parent-child discussion and the coherence of children’s earliest memory narratives. There is a vast literature that demonstrates the benefits of parent-child conversations for children’s memory outcomes, including their independent recall (Reese & Newcombe, 2007), their acquisition of knowledge about the process of remembering (Fivush & Haden, 2005), and promoting their
use of mental states language (Bartsch & Wellman, 1995; Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991; Furrow, Moore, Davidge, & Chiasson, 1992; Rudek & Haden, 2005). Importantly, parent-child conversations are an important context in which children practice their emerging narrative skills and learn the canonical narrative structure that appears to support the retention of memories (Nelson & Fivush, 2004). Children develop their memory skills as parents model and scaffold the construction of memory narratives (Hudson, 1993). In addition, parent-child conversation serves to support children’s ability to organize their memories into narratives that emphasize aspects of the experience that transcend the details of what occurred, such as motivations, goals, and outcomes (Nelson & Fivush, 2004).

Narrative structure is of particular importance to autobiographical memory development given that the types of narrative skills that are supported in the context of parent-child reminiscing may contribute to the retention of early memories over time (Morris, Baker-Ward, & Bauer, 2010; Pillemer, Picariello, & Pruett 1994). In particular, the coherence of children’s narratives for past events may be an important predictor of the retention of memories across time (Nelson & Fivush, 2004). Although there is not a universal definition for coherence (Reese, Haden, Baker-Ward, Bauer, Fivush, & Ornstein, 2011), it refers to how well a memory narrative is structurally organized and the extent to which it is elaborated, for example, through references to emotions and personal significance (Fivush, 2007; Peterson & McCabe, 1983). In a frequently cited study that provides evidence of the benefits of narrative coherence, three- and four-year-old children shared their memories of a fire alarm at their preschool two weeks after the event occurred (Pillemer et al., 1994). Only the older children were able to provide narrative accounts that included temporal and causal
sequences. The participants were prompted to again recount the event seven years later, when they were 11 to 12 years old. Some of the older but none of the younger children were able to recall the event, suggesting that the memory skills evidenced in the older children’s initial narratives served permitted the retention of the memory across time. However, because this study did not match individual participant’s long-term recall and initial narrative coherence, it does not directly link the memory maintenance to narrative coherence at the time of the event.

A recent longitudinal investigation demonstrated this direct linkage by predicting the survivability of specific memories across time based on the coherence of an initial narrative reported by children when they were four-, six-, or eight-years old (Morris et al., 2010). This study utilized a multidimensional coding scheme that conceptualizes three dimensions of coherence: context, chronology, and theme (Reese et al., 2011). Briefly, these dimensions characterize the narrative in terms of the inclusion of information regarding where and when the discussed event occurred, temporal ordering, and information that conveys the significance of the story being told, respectively. Examining two of these dimensions (chronology and theme), Morris and her colleagues found that although there were age-related differences in children’s ability to recall these events after a one-year delay, thematic coherence of the initial memory report was predictive of whether or not memories survived, over and above age. Thus, memories that conveyed the significance of the story, such as affective or evaluation information, a high point, and a resolution, were more likely to be retained over time than those that were not thematically coherent.
Despite a large body of research that demonstrates linkages between parent-child reminiscing and children’s developing autobiographical memory skills (see Nelson & Fivush, 2004 for a review), little is known about parent-child reminiscing and the structure of children’s earliest memory narratives. Given that narrative coherence may contribute to the retention of memories across time, the extent to which parent-child discussions support these characteristics of children’s earliest memory reports may have implications for the role of memory sharing in the survivability of memories across the barrier of childhood amnesia. One longitudinal study found that parental reminiscing style is related to how early in life children can remember (Jack et al., 2010). Adolescents whose parents used a high ratio of elaborative prompts, which served to elicit additional information, to repetitive prompts during parent-child conversations when they were three years old reported earlier memories than adolescents whose parents used fewer elaborative prompts in relation to their use of repetitive prompts. However, because Jack and colleagues did not examine the coherence of their participants’ narratives, their study does not provide direct evidence regarding whether or not the parent-child reminiscing context is related to the coherence of children’s independent narratives of their earliest memories. The current study sought to address this gap in the literature by examining the relationship between previous parent-child discussion of memories children report as their earliest recollections and the narrative coherence of those earliest memory narratives.

The Current Study: Specific Aims and Hypotheses

Figure 1 below provides the conceptual model of the current research, followed by specific aims and hypotheses.
Aim 1: To examine the frequency with which children in three grades (prekindergarten, first grade, and third grade) and college students report implausible memories, defined as memories that describe events that occurred during the first 18 months of life, when prompted to recall their earliest memories.

Hypothesis 1a. Given evidence of implausible memory reporting in previous studies of children’s earliest memories (as reviewed above), I hypothesize that implausible memory reporting will be evident among child participants at each grade level. However, differences in implausible memory reporting by grade level are expected such that children in grade three will be less likely than children in the younger grades to report an
implausible memory. College students will be less likely than children at each grade level to report an implausible earliest memory.

**Hypothesis 1b.** I hypothesize that the inclusion of AaE estimates for implausible memories in calculations of children’s age at their earliest memory (i.e., their AaE) will have a biasing effect such that calculations of an average AaE that include estimates for implausible memories will yield a younger age than calculations of AaE that exclude estimates for implausible memories. Because minimal implausible memory reporting is expected among the college students, the average AaE for this group is not expected to be minimally affected.

**Aim 2:** To examine child-level cognitive factors and memory features that may contribute to implausible memory reporting among children.

**Hypothesis 2a.** Because there is a dearth of research exploring children’s beliefs about autobiographical memory, the current study examines children’s beliefs about the limitations of memory imposed by childhood amnesia. Based on their responses to scenarios, I predict differences by child participants’ grade level in the accuracy of their beliefs about the limitations of autobiographical memory that are imposed by childhood amnesia. Specifically, I hypothesize that children in prekindergarten will demonstrate less accuracy than children in grades one or three.

**Hypothesis 2b.** The source monitoring framework posits that individuals may rely on their beliefs or other knowledge to make source judgments when memory features (e.g., perceptual details) alone are not sufficient to discriminate source. I predict that, among child participants, differences in the likelihood of reporting an implausible memory will
be associated with their beliefs about autobiographical memory, above and beyond the effects of grade level. Children who demonstrate an understanding of the limitations of autobiographical memory that are imposed by childhood amnesia will be less likely to report an implausible memory than children who do not demonstrate this understanding.

Hypothesis 3a. Parent-child discussions about past experiences may be a context in which children acquire information about their personal histories. Children may report this information when prompted to recall their earliest memories. I hypothesize that parent-child reminiscing will be related to children’s earliest memory reporting such that children’s implausible memories will be more likely to have been the topic of previous parent-child discussion than to not have been previously discussed.

Hypothesis 3b. Children’s beliefs about autobiographical memory are expected to affect the relationship between parent-child discussion and memory selection, with children who hold erroneous beliefs about childhood amnesia being more likely to select discussed events that are implausible compared to children with accurate beliefs.

Aim 3: To examine the relationship between past parent-child discussion and children’s reporting of their earliest memories.

Hypothesis 4. Research demonstrates that parent-child discussion of past experiences may serve to reinstate or reactivate children’s memories of those events (Cleveland & Reese, 2008; Nelson & Fivush, 2004). Thus, I hypothesize that there will be a within-person relationship between parent-discussion and the average AaE associated with children’s earliest memories such that the AaE for previously discussed memories will be younger than that for memories that have not been previously discussed.
Hypothesis 5. The information exchanged during parent-child discussions about past experiences may facilitate children’s ability to tag events in time. The current study will examine this possibility. I hypothesize that, on average, there will be a within-person relationship between parent-discussion and the accuracy of children's earliest memory dating (i.e., their estimates of AaE). I hypothesize that memory dating will be more accurate among memories that have previously been the topic of parent-child discussion than among those that have not been previously discussed.

Hypothesis 6a. I hypothesize that child participants’ grade level will be related to the coherence of their earliest memory narratives, with this relationship differing across the dimension of coherence. With regard to chronological coherence, I do not expect grade level difference given that even preschoolers are capable of producing narratives that are reasonably temporally ordered (Peterson & McCabe, 1983).

Grade level differences are expected, however, for the context dimension of coherence. Preschoolers’ have a limited ability to take a listener’s perspective into consideration (Harter, 1999), which is an important consideration when providing relevant information to a naïve listener. In addition, the ability to reconstruct the time at which an event occurred continues into middle childhood (Friedman & Lyon, 2005). Therefore, I hypothesize that in comparison to children in prekindergarten, children in grades one and three will be more likely to produce narratives that are contextually coherent.

Similar grade level differences are expected for thematic coherence. Because the ability to produce a thematically coherent narrative extends into adolescence (Reese et
al., 2011), I hypothesize that in comparison to children in prekindergarten, children in grade three will be more likely to produce narratives that are more thematically coherent. However, the likelihood of producing a thematically coherence narrative will not differ between children in prekindergarten and in first grade.

_Hypothesis 6b._ Parent-child discussions about past events may provide opportunities for children to learn a canonical narrative form (Nelson & Fivush, 2004). Thus, I hypothesize that, on average, there will be a within-person relationship between parent-discussion and the coherence of children’s earliest memory narratives such that memories that have previously been the topic of parent-child discussion will be more likely to be more coherent than those that have not been previously discussed. However, given that the ability to produce relatively temporally ordered narratives is evident among preschoolers (Peterson & McCabe, 1983), the benefits of parent-child discussion are expected to be evident only for the context and theme dimensions of coherence.

_Hypothesis 6c._ I predict that there will be grade level differences in the relationship between parent-child discussion and children’s narrative coherence, with the predicted benefits of parent-child discussion for the context and theme dimensions being more likely among children in grade three than among children in prekindergarten and in grade one.

By addressing these aims, the current research makes several unique contributions to the literature. First, this study brings attention to evidence that children may report implausible memories of infancy when prompted to recall their earliest memories. Second, this study represents the first attempt to characterize children’s beliefs about autobiographical
memory and to explore whether or not children apply their beliefs to their selection of their earliest memories. Third, this study offers an initial investigation of the relationship between parent-child discussion at the level of the memory and children’s selection and reporting of their earliest memories.
Method

Participants

Child participants. Data analyzed in the current study were derived from a larger collection of earliest memory interviews collected as part of a master’s thesis research project (Siceloff, 2007). Child participants who reported at least one memory and had parent feedback data for their earliest memories were included in the final sample, yielding a total of 65 parent-child dyads. Child participants represented three age groups: \(N = 22\), females = 10, \(M\) age = 4.77 years, \(SD = 0.55\) years), first grade \(N = 22\), females = 12, \(M\) age = 6.81 years, \(SD = 0.39\) years), and third grade \(N = 21\), females = 13, \(M\) age = 9.01 years, \(SD = 0.47\) years). Of these participants, 50 were interviewed between 2006 and 2007, and 15 were interviewed in 2011. Identical interview protocol and recruitment criteria were used across both cohorts of participants. Parental consent for participation was obtained through cooperating childcare centers (including after-school care, \(n = 3\)) and parochial and secular private schools \(n = 3\) in a Southeastern city and surrounding areas. As indicated demographic information provided by parents, approximately 95% of the participants in the final sample were white. There were no cohort differences in the participants’ age at the time of the interview, \(t(63) = -0.44, p = .67\), total number of memories reported, \(t(63) = -1.52, p = .13\), average child-estimated AaE, \(t(61) = 0.20, p = .85\), or average parent-estimated AaE, \(t(62) = -0.15, p = .89\).

An additional 51 participants who were interviewed during one of the two data collection efforts did not meet criteria for inclusion in the final sample. Participants who were interviewed during the initial data collection effort and who did not meet these criteria


(N = 44) did not differ from participants in the same cohort who were included in the current sample with regard to average child-estimated AaE, \( t(80) = 1.04, p = .30 \), and total memories reported, \( t(84) = -0.32, p = .75 \). Similarly, participants from the second data collection effort who did not meet these criteria did not differ from participants in the same cohort who were included in the current sample (N = 7) with regard to total memories reported, \( t(18) = -1.52, p = .15 \).

**College student sample.** Data from a sample of young college students (N = 42, female = 23, \( M \) age = 19.70 years) who participated in one condition of a larger investigation of earliest memories (Esposito, Baker-Ward, & Morris, 2011) were included in the current study as a comparison sample. College students were recruited from the research subjects pool at university located in a Southeastern city. Based on participants’ self-reported demographic data, the majority of participants in the final sample were white.

**Interviewers: Child sample.** In total, five female interviewers collected data with child participants. One interviewer conducted the majority of these interviews with participants across both data collection efforts (i.e., approximately 95% and 55% of interviews for cohorts one and two, respectively). The remaining interviews were completed by four graduate students and a faculty member. To ensure consistency across interviews, the primary interviewer trained all graduate student interviewers. As part of this training process, the primary interviewer conducted one mock interview with each graduate student interviewer and observed each graduate student’s initial interview with a child. Further, the primary interviewer checked interview transcripts throughout the data collection process to ensure all interviewers’ adherence to the interview protocol.
To gather parent feedback data for the child participants’ earliest memories, the primary interviewer worked with a team of three undergraduate research assistants to prepare Parent Feedback Questionnaires (described subsequently). Parents completed these questionnaires either over the phone or via email as they preferred. The primary interviewer completed the majority of the questionnaires that were presented over the phone to parents. The undergraduate team completed remaining phone interviews. Prior to completing a phone interview with parents, undergraduate team members completed training with the primary interviewer. As part of this training process, the primary interviewer played the role of the parent in mock interviews to ensure that the undergraduate team members were prepared to answer parents’ questions. These mock questions centered on the purpose of the study and how the data would be utilized (e.g., data provided information about average differences, not individual performance). Further, the undergraduate assistants met with the primary interviewed to discuss each phone interview after it was completed to address any issues that they were unable to answer. No such issues, however, arose during the interviews. The undergraduate team always provided parents with the primary interviewer’s contact information in the event they wanted to contact her directly. The undergraduate assistants, two of whom were female, did not conduct any of the child interviews.

Interviewers: College student sample. One graduate student conducted the majority of the college student interviews. This graduate student had demonstrated interview competency via her completion of interviews with child participants in the second data collection effort. Other interviewers for the college sample included four undergraduate research assistants, all of whom were female. Similar to the training process for the child
sample, these research assistants received training through mock interviews. The purpose of these mock interviews was to ensure that interviewers mastered standard procedures and that they were prepared to address participants’ questions or concerns (e.g., regarding the purpose of the study).

**Materials**

**Child interview.** The interview for child participants was comprised of two main parts: 1) presentation of memory beliefs scenarios and illustrations and 2) the earliest memories interview. These components of the overall interview were always presented in this order to ensure that participants did not rely on their own performance during the earliest memory interview to inform their beliefs about autobiographical memory. Further, interviewer feedback in response to participants’ beliefs was intended to scaffold their understanding of the limitations of autobiographical memory for the purpose of minimizing knowledge-based reports of very early life events during the earliest memory interview. These components of the overall interview are described in greater detail in turn.

**Memory beliefs scenarios and illustrations.** The current study utilized a set of seven scenarios and corresponding illustrations to elicit child participants’ beliefs about autobiographical memory (see Appendix A). These scenarios described the experiences of a character, Lee, or Lee’s friend, Taylor. These characters were introduced as being of the same age and gender as the participant, and the characters’ gender was androgynous in the illustrations. Immediately prior to the presentation of these scenarios, the interviewer attempted to scaffold the participants’ understanding of the memory beliefs task by providing them with criteria for what it means to ‘remember’ an event: 1) physical presence during the
event, 2) perception of the event, and 3) access to the memory of the event. The selection of these criteria was informed by Welch-Ross’ (1995) model of autobiographical memory development, which suggests that the development of autobiographical memory is contingent upon 1) knowledge that remembering a past event requires personal experience with the event and 2) an implicit understanding of the mental state of remembering (i.e., that remembering an event is distinct from knowing of the event).

To elicit participants’ beliefs about autobiographical memory, the interviewer asked whether or not the character could remember the events described in these scenarios. Participants were able to utilize the criteria for what it means to remember in their responses to the first five scenarios. (That is, participants only needed to apply the information presented to them in these criteria when responding to queries about the first five scenarios.) In contrast, however, the last two scenarios required participants to supplement the interviewer-provided criteria for remembering an event by generating beliefs that were not reflected in those criteria. Specifically, these scenarios, which were depicted by a single illustration, elicited participants’ beliefs about the limitations of memory for very early life experiences with queries regarding 1) whether or not Lee could remember receiving a gift on the day he/she was born, and 2) whether or not Lee could remember receiving the gift with the aid of a photograph. Importantly, as mentioned previously, the interviewer provided feedback regarding the accuracy of the participants’ responses for each scenario. Therefore, all participants understood that the character could not remember receiving a gift on the day of his/her birth prior to the interviewer asking whether or not the character would be able to remember that event with the aid of a photograph. Given that a focus of this study is to
explore children’s beliefs about memory for very early life experiences and how these beliefs may be related to children’s reports of their earliest memories, only the beliefs that participants generated in response to these two scenarios are considered further.

**Earliest memory interview.** The earliest memory protocol prompted participants to report their five earliest memories. The interviewer elicited each memory by stating, “I want you to think about things that you can remember doing or that happened to you a long time ago when you were younger than you are now. I want you to tell me about your earliest memory. What’s your earliest memory?” This prompt is consistent with the language used in previous investigations of children’s earliest memories (Peterson et al., 2009), including studies that examined memories reported by participants in age groups similar to those in the current study (Peterson, Warren, & Short, 2011). However, if a participant did not appear to understand the prompt (e.g., as evidenced by a failure to produce a memory report or a specific request for clarification), the interviewer provided support by encouraging the participant to think about events that happened a long time ago. The interviewer provided further clarification by stating, “I want you to tell me about your earliest memory. What is the first thing you can remember from when you were younger than you are now?” Use of the word “first” in prompts to elicit earliest memories is evident in the literature (e.g., Wang, 2004; Peterson et al., 2005). In the current study, interviewers reserved usage of the word “first” to clarify the meaning of “earliest” memory, as has been done in previous studies with children (Tustin & Hayne, 2010). However, “first” was not used in isolation to elicit the participants’ earliest memories to avoid the participants misinterpreting the prompt as being a
request for the first memory that comes to mind. Clarification the earliest memory prompt was necessary in fewer than 10% of the child interviews.

Following the initial prompt to elicit each earliest memory, the interviewer used additional prompts to encourage participants to report everything they could remember about each memory. For example, nonspecific social support prompts, which were intended to convey interest in hearing the child’s memory report, included neutral utterances (e.g., “uh-huh”) and the repetition of the participant’s exact words (e.g., “Oh! You went to Disney World!?”). Open-ended prompts provided an explicit request for participants to continue their memory report (e.g., “Can you tell me more about [event]?”). Two empty responses from the participants, in which they either indicated that they could not recall any additional information or provided only redundant information, were required to signal the completion of the memory report. After participants indicated that they had exhausted their recall, the interviewer asked participants, “How did you feel when [event]?” To obtain ratings of intensity for the emotion, the interviewer asked, “Did you feel a little [emotion], medium [emotion], or really [emotion]?” The emotional valence of the participants’ memory reports, however, is not explored in the current study. This procedure was repeated to elicit up to five earliest memory reports for each participant.

Life Experiences Questionnaire. Building on methods employed by several previous investigations of children’s earliest memories (e.g., Peterson et al., 2005; Peterson et al., 2009), the current study sought to assist child participants estimate their AaE for each memory. Similar to questions asked in previous studies (e.g., “Was it hot or cold outside?”), the interviewer asked participants questions to localize each reported event in time.
Modifying the method of scaffolding participants’ estimates of AaE through ancillary questions used in previous studies, interviewers in the current study facilitated participants’ reconstruction of AaE for each memory by crafting questions about the timing of each memory based on information gleaned from participants’ responses to specific questions about their life circumstances (e.g., “Have you always lived in the same home that you live in now?”) (see Life Experiences Questionnaire, Appendix B). For example, if a participant reported that he or she moved at the age of three, then the researcher was able to use that information to help the participant date his or her earliest memories by asking whether the events she described occurred before or after the move. Thus, unlike previous studies that posed generic questions (e.g., regarding season or proximity to holidays) to support child participants’ estimation of AaE, the ancillary questions presented in the current study included both generic questions and specific questions crafted from information about the participant’s own life circumstances. The interviewer’s co-construction of AaE for each memory was intended to increase the accuracy of the participants’ estimates by scaffolding their engagement in the types of reconstructive strategies that adults use when recalling the times of events (Friedman, 1993). The interviewer asked participants to provide an estimate of AaE for each memory after they had responded to these ancillary questions.

*Parent feedback questionnaire.* Memories from each participant’s transcript were summarized in a questionnaire and provided to a parent for feedback (see Parent Feedback Questionnaire, Appendix C). Parents responded to questions about each memory on the questionnaire by either phone or email, according to the preferred method of contact.
indicated on the consent form. An interviewer typically contacted participants’ parents within one month of the interview.

Parents rated several aspects of their child’s memory reports. Using a seven-point scale, parents first rated their confidence that the event described in their child’s memory report occurred (1 = the event did not occur, 4 = the event may have occurred, and 7 = the event definitely occurred). If parents indicated that the event described in the memory report occurred or may have occurred, then additional information was requested for each memory. Parents were asked to rate how frequently they have discussed the event described in the memory narrative on a three-point scale (1 = rarely or never, 2 = sometimes, and 3 = frequently). They also provided a yes or no response to a query regarding whether or not reminders of the event are available to the child. If the parent indicated that reminders of the event are available, they were asked to further describe the reminders (e.g., souvenirs, pictures) and the availability of the reminders to their child (e.g., put away in a photo album that the child rarely views). For each memory narrative, parents also provided an estimate of their child’s age at the time of the event, in years and months when possible. Although not explored in the analyses described in this report, parents were also asked to describe what they believed their child’s earliest memory to be.

**College student interview.** The protocol used to elicit the college students’ earliest memories was similar to that used with child participants, with the exception that the interviewer prompted participants in the college sample to recall six memories. Prompting for additional information for each memory adhered to the same neutral prompts used with the child participants.
College students’ earliest memories questionnaire. Participants in the college sample completed a questionnaire that requested additional information about each of their earliest memories, including their estimated age at the time of the event described in each memory report, whether or not the memory was the topic of family discussion during their childhood, whether or not they had seen photos or videos of the events, and how they felt at the time of the event (see College Students’ Earliest Memories Questionnaire, Appendix D). For the purposes of the current study, only the college students’ estimates of their ages at the time of the events in their memory reports are considered further.

Procedure

An interviewer met with participants in the child and college student samples individually in a quiet room at their childcare center, school or home (for some child participants only). After building rapport with each participant through informal questions (e.g., about ongoing activities at the participant’s childcare center or school) and describing the purpose of the interview, the interviewer obtained informed consent or, for child participants, verbal assent to participate. (Parents provided informed consent for child participants prior to the interview.) Interviews were audio recorded and required approximately 30 minutes to complete. At the conclusion of the interview, child participants were thanked for their participation and were allowed to select a small trinket (e.g., a pencil, sticker) as a token of the interviewer’s appreciation. College students received research credit to fulfill a class requirement for their participation. Because aspects of the interview protocols for child and college student participants differed in important ways, each is described separately in the following sections.
Child interview. Interviews with child participants began with the presentation of the criteria for what it means to remember an event, followed by the memory beliefs scenarios. First the interviewer told participants, “Here is how you know if you remember something that happened: 1) You were there when the event happened, 2) you saw what happened with your own eyes and you heard it with your own ears, 3) and you can still think about what happened.”

After repeating these criteria, the interviewer presented the memory belief scenarios, which were read aloud, and the corresponding illustration. Following each scenario, the interviewer asked the participant whether or not the character could remember the event described in the scenario. After the participant provided a yes or no response, the interviewer asked the participant to generate a reason to support that response by asking, “Why do you think Lee/Taylor can remember [event]?” For each scenario, the interviewer provided feedback regarding the accuracy of the participants’ beliefs.

Next, the interviewer introduced the earliest memory interview by stating to participants, “We talked about what Lee can remember and what Lee cannot remember. Now I want you to think about some things that you can remember.” The researcher prompted the participants to report their earliest memories by stating, “I want you to think about things that you can remember doing or that happened to you a long time ago when you were younger than you are now. I want you to tell me about your earliest memory. What’s your earliest memory?” The interviewed encouraged participants to report all that they could remember for each memory by using open-ended prompts as previously described. After participants reported their five earliest memories, the interviewer presented participants with the life
experiences questionnaire. Based on their responses to these questions, the interviewer crafted specific follow-up questions to assist participants with dating each of their earliest memories. Following the completion of the interview, child participants’ memories were transcribed and a summary of each memory was provided to their parents in the Parent Feedback Questionnaire.

*College student interview.* The procedure used to elicit child participants’ earliest memories was similar to the protocol used with participants in the college sample, with the exception that the college students’ reported their six earliest memories. Further, data regarding the college students’ beliefs about autobiographical memory were not collected, and parent feedback was not requested for this sample. After the college students recalled six memories or indicated that they had exhausted their earliest memory recall, they completed the College Students’ Earliest Memories Questionnaire. For questions regarding the participants’ AaE for each memory, the interviewer encouraged participants to estimate their AaE in years and months to the best of their ability. Although adults typically utilize reconstructive strategies to recall the times of events (Friedman, 1993), the interviewer attempted to assist college participants estimate their AaE by encouraging them to localize the events described in each memory reports in time relative to other life events (e.g., the birth of a sibling or a move).

**Data Coding**

*Memory beliefs.* Child participants’ responses to questions about the events described in the memory beliefs scenarios were coded to reflect their beliefs about autobiographical memory (see Autobiographical Beliefs Coding, Appendix E). Responses to
questions about each scenario analyzed in the current study were examined separately. With regard to questions for the first of these scenarios (i.e., “Can Lee remember receiving a gift on the day he was born?”/“Why?”), codes reflected 1) whether or not the participants’ responses indicated an understanding that memory is a limited process, and 2) if so, whether the participants implicated a developmental or a non-developmental limitation of memory. Specifically, participants who responded that the character could remember the event demonstrated the belief that memory for very early life events is not limited. In contrast, participants who responded that the character could not remember the event demonstrated the belief that memory is a limited process. These beliefs were further coded according to whether the participant implicated a developmental limitation (e.g., “No, because he was a tiny baby) or a non-developmental reason (e.g., “No, because that was a long time ago.”).

Participants’ responses to the second scenario (i.e., “Can Lee remember receiving a gift on the day he was born with a photograph?”/“Why?”) were coded according to whether or not they indicated that the limitations of memory for very early life events are surmountable with the aid of a reminder of the event. Specifically, participants who responded that the photo would permit the character to remember receiving the gift demonstrated the belief that the limitations of memory for very early life events are surmountable, whereas participants who rejected the utility of the photo demonstrated the beliefs that such limitations of memory are insurmountable. Taken together, the participants’ responses to the scenarios yielded the following belief categories regarding the ability to remember very early life events: 1) memory is not limited, 2) memory is limited, but the limitation surmountable, and 3) memory is limited, and the limitation is insurmountable. Two
independent raters coded 100% of the participants’ beliefs for the first and second scenarios to establish interrater reliability for coding beliefs about autobiographical memory. Cohen’s kappas of 0.95-0.98 indicated high agreement between raters. Disagreements were resolved through discussion.

*Embedded memories.* Approximately 20% of child participants reported at least one memory that contained descriptions of two or more events, which were clearly separated in time. For example, a memory of meeting a friend on the first day of preschool may also include a description of a memory for a distinct experience with that friend that occurred later in the week. In such instances, these embedded memories were separated, with the result that participants may have up to eight earliest memory reports.

*Memory plausibility.* Memories were coded as implausible if they described events that occurred within the first 18 months of age. This age criterion was selected based on the development of brain structures that support encoding and consolidation (Bauer, 2007). The following mutually-exclusive criteria were applied to identify memories that were implausible: 1) parent-estimated AaE indicated that the event described in the memory narrative occurred prior to 18 months of age (regardless of whether or not the child-estimated AaE indicated an implausible memory) or 2) in the absence of parent feedback for a given memory (resulting from experimenter error), the memory report clearly described an event that likely occurred within the first 18 months of life (e.g., getting a first tooth, taking first steps) or reflected a general impression of infancy (e.g., “When I was a baby I cried and drank from a bottle). Interrater reliability for coding memory plausibility was established for a random selection of memories reported by approximately 20% of participants in each age
group. Cohen’s kappa of 0.95 indicated high agreement between raters. Disagreements were resolved through discussion.

**Narrative coherence.** The Narrative Coherence Coding Scheme (NaCCs) was applied to child participants’ earliest memory narratives (Reese et al., 2011). This scheme assesses three dimensions of coherence: context, chronology, and theme. Participants’ memory narratives were rated on each dimension using codes from 0 to 3 for each dimension as described in the following sections. Only utterances that were elicited by an open-ended prompt (e.g., “Can you tell me more?”) were coded for coherence. Approximately 20% of the memories were randomly selected to monitor reliability in coding coherence, with memories from each age group proportionately represented. Intraclass correlations were satisfactory across dimensions but were relatively higher for context and chronology (0.90 and 0.88, respectively) than for theme (0.83). Disagreements were resolved through discussion. These dimensions of coherence are described further in the following sections.

**Context.** Context refers to information that places the event in time and space. Coherence codes for this dimension reflect both the type of information included in the narrative (i.e., time and/or place) and the specificity of that information (i.e., general vs. specific). In comparison to information about general time, which loosely defines when the event transpired (e.g., “when I was little”), specific time provides more discrete boundaries (e.g., “when I was in kindergarten”). Information about a general location indicates where an event occurred; however, the location is not at the level of specificity that would permit a naïve listener to pinpoint a unique location (e.g., “a restaurant” vs. “the McDonald’s on Main Street”). Narratives that received a code of 0 did not include any information about time or
location, at any level of specificity. A code of 1 was assigned to narratives that provided either information about time or location at either level of specificity. Narratives that included information about both time and location receive a code of 2, with a code of 3 reflecting that both types of information were specific.

**Chronology.** The chronology dimension reflects the temporal ordering of actions reported within a memory narrative. Using an interval scale from 0 to 3, chronology codes segment the percentage of actions that can be placed on a timeline, with each successive level indicating a 25% increase in temporal order. For example, a code of 0 indicated that fewer than 25% of the actions within a memory report could be ordered on a timeline, whereas a code of 3 indicated that 75% or more of actions could be ordered.

**Theme.** The theme dimension indicates the extent to which the memory report has a clear focus, with increasing levels of thematic coherence reflecting the development of the narrative through the inclusion of elaborations, interpretations, or causal links. Narratives that received a code of 0 were substantially off topic or the topic was difficult to identify. A code of 1 indicated that the narrative had an identifiable theme, which may or may not have been minimally developed. A code of 2 was assigned to narratives with an identifiable theme that were substantially developed, and a code of 3 was reserved for narratives that, in addition to being substantially developed, provided closure to the experience or made meaningful linkages to other autobiographical experiences.

**Data analysis.** Each dimension was dichotomized because the distribution of coherence ratings across all memories did not support the retention of all four coding levels (see Table 1). Specifically, for context and theme, the lowest two coding levels (i.e., levels 0
and 1) and highest two coding levels (i.e., 2 and 3) were collapsed. For chronology, the majority of narratives (68%) received a code of 3; therefore, the lowest three coding levels were collapsed for this dimension. Conceptually, the resulting dichotomized context dimension differentiated narratives that included no information about time or place or included only one of those pieces of information (Level 0) from those that included information about both time and location (Level 1). The resulting dichotomized theme dimension differentiated narratives that were off topic or minimally developed (Level 0) from those that were substantially developed (Level 1). The dichotomized chronology dimension differentiated narratives that had provided temporal order to less than 75% of actions (Level 0) from those that provided temporal order to at least 75% of actions (Level 1).

Table 1

Percentage of memories reported across child participants receiving each coherence rating level (0-3) by dimension

<table>
<thead>
<tr>
<th>Dimension</th>
<th>N memories</th>
<th>Coherence Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Context</td>
<td>268</td>
<td>0.08</td>
</tr>
<tr>
<td>Chronology</td>
<td>237</td>
<td>0.08</td>
</tr>
<tr>
<td>Theme</td>
<td>268</td>
<td>0.03</td>
</tr>
</tbody>
</table>
Results

Following a description of children’s and college students’ earliest memories, results are presented for analyses that examined implausible memory reporting among child participants. Within this section, results of multilevel model are presented that examined the children’s and college student participants’ earliest memories are presented. In all subsequent sections, only child data are examined. First, analyses examine the relationships between implausible memory reporting among children and their 1) beliefs about childhood amnesia and 2) parent-child discussion. Next, results of analyses that examine the relationships between parent-child discussion and 1) estimates of AaE and 2) children’s memory dating are presented. The final section presents results of models that examine the relationship between parent-child discussion and children’s narrative coherence.

Earliest Memories: Sample Description

Children’s Earliest Memories. Across grade levels, child participants (N = 65) reported a total of 298 memories, with the number of memories reported by each participant ranging from one to eight (M = 4.58, SD = 1.61). Parent feedback data were available for 94% of memories (n = 280). Based on parent feedback data, a total of 10 memories were excluded from analyses either because the parent indicated that the event described in the memory narrative did not occur (n = 6) or the parent indicated that the event was unlikely to have occurred and did not provide any other requested information about the event, such as AaE (n = 4). This yielded a total of 288 memories in the final sample, with parent feedback data available for 270 of these memories.
Of the memories included in the final sample, parent feedback data were missing for 18 memories either as the result of error (i.e., the memory was not included on the parent feedback questionnaire) or because the narrative clearly described an event that occurred within the first year of life\(^1\). These memories were retained for analysis of implausible memory reporting among child participants given that this was a primary objective of the current study. However, memories with missing feedback data were excluded from analyses in which parent data served as a dependent or independent variable. Further, memories without parent feedback data were also excluded from analyses that compare children’s and college students’ earliest memories. Therefore, analyses of child participants’ earliest memories made use of the entire final sample of 288 memories, with specific data requirements for each analysis determining the number of observations utilized. Throughout this report, parents’ AaE estimates were analyzed for child participants unless otherwise noted.

**College Students’ Earliest Memories.** College students (\(N = 44\)) reported a total of 217 memories, with the number of memories analyzed in the current study ranging from four to five (\(M = 4.93, SD = 0.25\)).\(^2\)

**Implausible Memory Reporting**

**Child sample.** A primary objective of the current study was to examine implausible memory reporting among children and college students. This objective is first addressed for

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\(^1\) Narratives that clearly described either events that occurred early in infancy (e.g., birth) or generic impressions of infancy (e.g., “I was tiny and wore diapers and cried a lot.”) were not routinely included on the parent feedback questionnaire.

\(^2\) Descriptive statistics reported for adult participants are based on their five earliest memories. As described in the method section, this adjustment was made to address the discrepancy in the number of memories requested in the interview protocols for child and college student participants (i.e., five vs. six memories, respectively).
child participants. The analyses presented in this section utilized all child-reported memories included in the final sample ($n = 280$), including those with missing parent feedback data. As previously noted, memories of events that occurred during the first 18 months of life were categorized as implausible. Across the child sample, 29 participants reported a total of 32 memories that were categorized as implausible either based on parents’ estimates of AaE ($n = 17$), or in the absence of parent data, on the content of the child’s narrative ($n = 15$). A portion of these implausible memories ($n = 11$) described pre- or perinatal events; hence, they denoted *highly implausible* memories.

To examine the association between child participants’ grade level and implausible memory reporting, participants in each grade (i.e., prekindergarten, grade one, and grade three) were categorized as either reporting or not reporting at least one implausible memory (see Table 2). A chi square test indicated that within the child sample, grade level was not significantly associated with whether or not participants reported at least one implausible memory, $\chi^2(2, N = 65) = 1.37, p = .73$. Further, comparing participants in grade three to younger participants (i.e., participants in prekindergarten and grade one), there was no significant association between grade level and whether or not they reported at least one highly implausible memory of a pre- or perinatal event, $\chi^2(1, N = 65) = 1.37, p = .50$. These analyses fail to support the predicted relationship between grade level and implausible memory reporting among child participants. Instead, implausible memory reporting, including reports of highly implausible pre- and perinatal memories, occurred equally across child participants, regardless of grade level.
Table 2

*Number of Participants in Each Grade Level Reporting at Least One Implausible Memory*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Implausible (%)</th>
<th>Highly Implausible (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PreK</td>
<td>22</td>
<td>10 (45%)</td>
<td>5 (23%)</td>
</tr>
<tr>
<td>Grade 1</td>
<td>22</td>
<td>11 (50%)</td>
<td>4 (18%)</td>
</tr>
<tr>
<td>Grade 3</td>
<td>21</td>
<td>8 (38%)</td>
<td>2 (10%)</td>
</tr>
</tbody>
</table>

**College student sample.** Implausible memory reporting occurred infrequently among college students, with only two memories categorized as implausible. As was done with child participants, college students were categorized as either reporting or not reporting at least one implausible memory. A chi square test revealed a significant association between grade level (child v. college student) and whether or not participants reported at least one implausible memory, $\chi^2(1, N = 108) = 7.86, p = .01$. Whereas 25% of child participants reported at least one implausible memory of an event that occurred the first 18 months of life (as confirmed by parents’ estimates of AaE), only 5% of college students did so. It is important to note that because this comparison excluded child-reported memories that were categorized as implausible based on the content of the narrative (i.e., those with missing parent feedback data), these results provide a conservative estimate of the association between grade level and whether or not participants reported an implausible memory. These analyses provide support for the predicted association between implausible memory reporting and grade level for children in comparison to college students.
Single Earliest Memory

To further examine implausible memory reporting, the current study explored how implausible memories may bias average estimates of AaE for children’s and adults’ earliest memories. Average AaE was calculated separately for earliest-occurring memories that included AaE estimates of 18 months or younger and for earliest-occurring plausible memories (see Table 3). Separate analyses were conducted to examine grade level differences in these estimates. First, a one-way ANOVA revealed a significant grade level difference in AaE for earliest-occurring memories that included estimates of 18 months or younger, $F(3, 104) = 4.02, p = .01$. Post-hoc Bonferroni comparisons indicated that the AaE for the earliest-occurring memory reported by children in grade three ($M = 2.23$ years) was significantly younger than that for college students ($M = 3.26$ years). In contrast, there was not a significant grade level difference in AaE for earliest-occurring plausible memories, $F(3, 103) = 0.66, p = .58$. On average, participants’ earliest-occurring plausible memory described an event that occurred at 3.22 years. These analyses offer evidence in support of the hypothesis that implausible memories may bias average AaE estimates.
Table 3

Mean AaE of child and college student participants’ earliest-occurring memory by memory plausibility and age group

<table>
<thead>
<tr>
<th></th>
<th>Single earliest memory</th>
<th></th>
<th></th>
<th>Single earliest plausible memory</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>Min</td>
<td>Max</td>
<td>M (SD)</td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>Child sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PreK</td>
<td>2.97 (1.23)</td>
<td>0.50</td>
<td>4.50</td>
<td>3.33 (0.77)</td>
<td>2.08</td>
<td>4.5</td>
</tr>
<tr>
<td>Grade 1</td>
<td>2.56 (1.33)</td>
<td>0.08</td>
<td>5.71</td>
<td>3.14 (1.05)</td>
<td>1.75</td>
<td>5.71</td>
</tr>
<tr>
<td>Grade 3</td>
<td>2.23 (1.37)</td>
<td>0.04</td>
<td>6.33</td>
<td>2.99 (1.13)</td>
<td>1.63</td>
<td>6.33</td>
</tr>
<tr>
<td>Total</td>
<td>2.59 (1.25)</td>
<td>0.04</td>
<td>6.33</td>
<td>3.15 (0.99)</td>
<td>1.63</td>
<td>6.33</td>
</tr>
<tr>
<td>College sample</td>
<td>3.26 (1.03)</td>
<td>0.45</td>
<td>7.00</td>
<td>3.31 (0.92)</td>
<td>1.58</td>
<td>7.00</td>
</tr>
<tr>
<td>Sample total</td>
<td>2.86 (1.25)</td>
<td>0.04</td>
<td>7.00</td>
<td>3.22 (0.96)</td>
<td>1.58</td>
<td>7.00</td>
</tr>
</tbody>
</table>

To further evaluate the effect of including implausible memories in average AaE calculations, average AaE estimates found in the current study were compared to AaE values reported in the literature. College students’ earliest memories were excluded from these analyses given the small number of implausible memories reported by this group and because both estimates of AaE (i.e., those with and without estimates for implausible memories) for this group were consistent with the average AaE of 3½ years that is typically reported in the adult literature. First, this widely reported value was compared to the AaE averages found in the current study for the child participants using one sample t-tests. This analysis revealed that an AaE of 3½ years was significantly older than the AaE calculated with estimates for implausible memories ($M = 2.59$ years), $t(61) = -5.40$, $p < .001$, and the AaE calculated for children’s earliest-occurring plausible memory ($M = 3.15$ years), $t(61) = 1.33$, $p = .19$. Next, values of AaE found in the current study were compared to values reported in studies with
child participants that used similar methods to elicit earliest memory reports and that included age groups similar to those in the current study. First, AaE with implausible memories, averaged across the three child grade levels, was not significantly different than the AaE of 2.36 years reported by Wang (2004), $t(61) = 1.33, p = .19$. The average AaE with implausible memories was also compared to an average AaE of 1.5 years, which is the approximate value presented in a graph by Tustin & Hayne (2010) for five- and eight- to nine-year-old participants. This analysis revealed that the values were not significantly different, $t(61) = -0.97, p = .34$. However, both of these values from the literature (i.e., 2.36 and 1.50 years) were significantly younger than the average AaE found in the current study for children’s earliest-occurring plausible memory ($M = 3.15$ years), $t(61) = 6.22, p < .001$. These results provide further support for the hypothesis that implausible memories may bias average AaE estimates by demonstrating that the inclusion and exclusion of implausible memories in calculations of AaE may yield different results across studies. The impact of implausible memory reporting on estimates of AaE is explored further in the following section, which presents results of multilevel models that examined the AaE for child and college student participants’ earliest memories.

**Multilevel Modeling Framework**

Multilevel modeling was used to examine both within-person variability and between-person differences in participants’ earliest memory narratives. Multilevel modeling was appropriate for these data because memories are nested within the individual (Raudenbush & Byrk, 2002). In the multilevel modeling framework, individual variability is represented through a two-level hierarchical model (Hawkins, Guo, Hill, Battin-Pearson, &
Abbott, 2001). At Level 1, each person’s variability is represented by an intercept and slope that become the outcome variables in a Level 2 model in which they may depend on person-level characteristics (Hawkins et al., 2001). Unlike techniques that measure differences in two-wave segments, multilevel modeling examines differences in or likelihood of outcomes for binary variables across repeated measures (e.g., multiple memory reports), thereby offering a more flexible approach to examining variability (Schulenberg & Maggs, 2001). In addition to estimating between-person effects, it is possible to model intra-individual variability (i.e., people’s variability around their own average) with multilevel modeling (Lee & Bryk, 1989); therefore, conclusions regarding the variability within people across occasions and the differences between people can be made. Additionally, multilevel modeling uses all available data from each participant to estimate a trajectory for a given participant (i.e., it analyzes complete data, not just complete cases) (Karney & Bradbury, 1997).

Prior to conducting each multilevel model, it is recommended that a preliminary analysis, termed the fully unconditional model, be conducted as a first step in a hierarchical data analysis (e.g., Nezlek, 2001; Raudenbush & Bryk, 2002). In this initial analysis, which is also referred to as a null model, no term other than the intercept is included at any level (Nezlek, 2001). The fully unconditional model yields a point estimate and confidence interval for the grand mean, \( \gamma_{00} \) (Raudenbush & Bryk, 2002). In addition and more importantly, this model provides estimates of within-person and between-person variability in the dependent variable (e.g., estimates of AaE) (Raudenbush & Bryk, 2002). These estimates provide information regarding the distribution of the total variance and indicate the
levels at which additional analyses might be productive (Nezlek, 2001). These estimates may be used to calculate the intraclass correlation coefficient, which provides information regarding the proportion of the variance in the dependent variable that is attributed to the Level 2 units (i.e., between-person/group) (Raudenbush & Bryk, 2002) and is represented by the formula, $\rho = \tau_{00}/(\tau_{00} + \sigma^2)$. In this formula, the parameters, $\tau_{00}$, and $\sigma^2$, represent the between-person and within-person variability, respectively. The within-person/group (i.e., Level 1) variability is calculated by subtracting $\rho$ from one.

**Multilevel Modeling of AaE for Children’s and College Students’ Earliest Memories**

The following section presents results of multilevel models that examined within-person variance and between-person differences in estimates of AaE associated with children’s and college students’ earliest memories. Separate models were conducted for estimates of AaE both with and without estimates of AaE for implausible memories to examine differences in results that emerge as a function of these memories. Participants ($n = 103$) who reported at least two memories with estimates of AaE were included in the model, yielding a total of 457 plausible and implausible memories. Estimates of AaE associated with each participant’s memories were serially ordered, with the memory that described the earliest-occurring event coded as 0 and memories of subsequent events coded 1-4. Serial order was entered into the model as a Level 1 predictor. Each of the four age groups (prekindergarten, grade one, grade three, and college) was dummy coded. Because the AaE associated with adults’ earliest memories is well established in the literature, college students were selected as the referent group, and the three child grade levels were entered into the model as Level 2 predictors.
In the following sections, the following model was applied first to AaE with implausible memories and then to AaE for plausible memories.

Level 1: $\text{AaE}_{ij} = \beta_{0ij} + \beta_{1ij}(\text{Serial order}) + r_{ij}$

Level 2: $\beta_{0i} = \gamma_{00} + \gamma_{01}(\text{Pre-K}) + \gamma_{02}(\text{Grade 1}) + \gamma_{03}(\text{Grade 3}) + u_{0i}$

$\beta_{1i} = \gamma_{10} + \gamma_{11}(\text{Pre-K}) + \gamma_{12}(\text{Grade 1}) + \gamma_{13}(\text{Grade 3})$

In this model, the Level 1 equation tested the within-person relationship between the serial order of each memory and estimates of AaE ($\beta_1$). The intercept ($\beta_0$) and slopes for this equation become the outcome variables in the Level 2 equations. The Level 2 equations tested for grade level differences in AaE for the earliest-occurring memory (coded as 0) for child participants in prekindergarten ($\gamma_{01}$), grade one ($\gamma_{02}$), and grade three ($\gamma_{03}$) compared to college students. Further, these equations tested for differences in the within-person relationship between serial order and estimates of AaE for child participants in prekindergarten ($\gamma_{11}$), grade one ($\gamma_{12}$), and grade three ($\gamma_{13}$) in comparison to college students. That is, these cross-level interactions tested for differences in the slopes, which represent differences in AaE across the five reported memories for children at each grade level in comparison to that of the college student sample. Differences in AaE across the five memories speaks to the density of participants’ memories such that steeper slopes indicate greater dispersion of memories across time and more gradual slopes indicate greater density.

The fully unconditional model for AaE, including both plausible and implausible memories, indicated that 28% of the variability in estimates of AaE was between people ($\tau_{00} = 0.96$, $z = 4.47$, $p < .001$) and 72% was within people ($\sigma^2 = 2.45$, $z = 13.36$, $p < .001$). Therefore, this
analysis indicated that there was sufficient variability to include predictors in the model and to continue with further analyses.

**Modeling of AaE, including implausible memories.** In the model above, the slope between the serial order of the memory and AaE was constrained to be equal across participants because it resulted in a better fit than the model with the slopes free to vary, \( \chi^2(2, N = 457) = 156.7, p < .001 \). The results of this model (see Table 4, Model 1) indicated that there was a significant, positive relationship between the serial order of participants’ earliest memories and estimates of AaE, which included estimates for implausible memories (\( \gamma_{10} \)).

There were no grade level differences in AaE estimates for the earliest-occurring memory for participants in prekindergarten (\( \gamma_{01} \)) or in grade one (\( \gamma_{02} \)) in comparison to that of college students. However, the difference was significant for participants in grade three (\( \gamma_{03} \)) such that the average AaE for the earliest-occurring memory was older for college students compared to that of participants in grade three. Significant cross-level interactions indicated that there were grade level differences in the relationship between the serial order of the participants’ memories and estimates of AaE for participants in prekindergarten (\( \gamma_{11} \)) and in grade three (\( \gamma_{13} \)) in comparison to the association for college students. That is, although an increase in AaE across the five earliest memories was evident across the entire sample, the slopes for participants in prekindergarten and in grade three were significantly different than the slope for participants in college. Specifically, in comparison to the increase in AaE across the five earliest memories for college students, participants in prekindergarten demonstrated a less steep increase, and participants in grade three demonstrated a steeper increase (see Figure 1). The slope for participants in grade one (\( \gamma_{12} \)), however, was not significantly
different from that of college students. This model accounted for 28% of the between-person variability and 65% of the within-person variability in AaE for participants’ earliest memories, including those categorized as implausible.

Table 4

Coefficients (and Standard Errors) of AaE for Children’s and College Students’ Five Earliest Memories

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AaE, β₀</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, γ₀₀</td>
<td>3.29***</td>
<td>3.38***</td>
</tr>
<tr>
<td>Pre-K, γ₀₁</td>
<td>-0.30</td>
<td>-0.03</td>
</tr>
<tr>
<td>Grade 1, γ₀₂</td>
<td>-0.50</td>
<td>-0.15</td>
</tr>
<tr>
<td>Grade 3, γ₀₃</td>
<td>-0.76*</td>
<td>-0.16</td>
</tr>
<tr>
<td><strong>Memory serial order slope, β₁</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, γ₁₀</td>
<td>0.83***</td>
<td>0.81***</td>
</tr>
<tr>
<td>Pre-K, γ₁₁</td>
<td>-0.22*</td>
<td>-0.34**</td>
</tr>
<tr>
<td>Grade 1, γ₁₂</td>
<td>-0.06</td>
<td>-0.13</td>
</tr>
<tr>
<td>Grade 3, γ₁₃</td>
<td>0.18*</td>
<td>0.06</td>
</tr>
<tr>
<td><strong>Random effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of AaE, τ₀₀</td>
<td>1.22***</td>
<td>1.19***</td>
</tr>
<tr>
<td>Within-person fluctuation, σ²</td>
<td>0.86***</td>
<td>0.74***</td>
</tr>
</tbody>
</table>

*Note.* The estimates for Model 1 reflect modeling of AaE for all memories, including implausible memories. Model 2 estimates reflect modeling of AaE for plausible memories only (i.e., excluding memories with AaE estimates of 1.5 years or less).

*p < .05, **p < .01, ***p < .001
Figure 1. Predicted values based on the AaE estimates for the earliest-occurring and fifth earliest memories for the cross-level interaction of grade level differences in the within-person covariation of memory serial order and estimates of AaE over the five earliest memories. The memory serial order slope was significantly different for child participants in prekindergarten and in grade three in comparison to that of college students.

**Modeling of AaE, excluding implausible memories.** To explore whether or not the pattern of results that emerged from the model above was an artifact of the inclusion of implausible memories, it was also conducted with estimates of AaE for implausible memories excluded. In this second model, the serial order of the participants’ five earliest memories excludes implausible memories, such that the earliest-occurring *plausible* memory was coded as 0 and subsequent memories were coded 1-4. As was done with the previous model, the slope between the serial order of plausible memories and AaE was constrained to be equal across participants because it resulted in a better fit than the model with the slopes free to vary, $\chi^2(2, N = 439) = 170.7, p < .001$. Results of this model (see Table 4, Model 2) indicated that, with implausible memories excluded, there remained a significant, positive
relationship between serial order of the earliest memories and estimates of AaE ($\gamma_{10}$). There were no grade level differences in AaE estimates for the earliest-occurring plausible memory for participants in prekindergarten ($\gamma_{01}$), grade one ($\gamma_{02}$), or grade three ($\gamma_{03}$) in comparison to that of college students. A significant cross-level interaction indicated that there was a grade level difference in the relationship between the serial order of the participants’ memories and estimates of AaE for prekindergarten participants ($\gamma_{11}$) in comparison to the association for college students. That is, although an increase in AaE across the five earliest memories was evident across the entire sample, the increase for participants in prekindergarten was less steep (i.e., more dense) than the increase for college students (see Figure 2). The slopes for participants in grades one ($\gamma_{12}$) and three ($\gamma_{13}$), however, were not significantly different from that of college students. This model accounted for 31% of the between-person variability and 64% of the within-person variability in AaE for participants’ earliest plausible memories.
Figure 2. Predicted values based on the AaE estimates for the earliest-occurring and fifth earliest plausible memories for the cross-level interaction of grade level differences in the within-person covariation of memory serial order and estimates of AaE over the five earliest plausible memories. The memory serial order slope was significantly different for child participants in prekindergarten in comparison to that of college students.

These models offer initial evidence that inclusion of implausible memories in analyses of AaE may yield results that differ from those that emerge when implausible memories are excluded. However, these separate models do not provide a direct comparison of the differences in AaE that emerge as a function of implausible memory reporting. Therefore, the model below was conducted to offer this direct test. In the model below, serial order was a level 1 predictor, with the earliest-occurring memory coded as 0 (regardless of plausibility). A dichotomous variable was entered at level 2 indicating whether or not participants reported at least one implausible memory, with no implausible memory reporting coded as 0. This predictor indicated whether or not there were differences in AaE for the
earliest-occurring memory and in the density of participants’ earliest memories as a function of implausible memory reporting.

Level 1: \[ AaE_{ij} = \beta_{0ij} + \beta_{1ij}(\text{Serial order}) + r_{ij} \]

Level 2: \[ \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{AnyImp}) + u_{0i} \]
[\[ \beta_{1i} = \gamma_{10} + \gamma_{11}(\text{AnyImp}) \]

The results of this model (see Table 5) revealed differences in AaE for the earliest-occurring memory as a function of implausible memory reporting such that AaE was significantly younger for participants who reported at least one implausible memory than for those who did not report any (\(\gamma_{01}\)). Further, differences in the relationship between serial order and AaE emerged as a function of implausible memory reporting (\(\gamma_{11}\)). The slope of this relationship was significantly steeper (indicating greater dispersion) for participants who reported an implausible memory compared to the slope for participants who did not report an implausible memory (see Figure 3). Thus, these results support the hypothesis that implausible memory reporting may bias conclusions about the emergence of autobiographical memory.

---

3 The model would not converge when either grade level or an indicator of implausibility at the level of the memory was included as a predictor. Thus, the Level 2 indicator of implausible memory reporting was included in the model, which offers evidence of differences between participants who do and who do not report any implausible memories in AaE for the earliest-occurring memory and in the density slope.
Table 5

*Coefficients (and Standard Errors) of AaE for Participants Five Earliest Memories by Whether or Not They Reported an Implausible Memory*

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>Model 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>AaE, $\beta_0$</td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>3.35* (0.12)</td>
</tr>
<tr>
<td>Implausible memory reporter, $\gamma_{01}$</td>
<td>-2.07* (0.29)</td>
</tr>
<tr>
<td>Memory serial order slope, $\beta_1$</td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{10}$</td>
<td>0.69* (0.03)</td>
</tr>
<tr>
<td>Implausible memory reporter, $\gamma_{11}$</td>
<td>0.55* (0.07)</td>
</tr>
<tr>
<td>Random effects</td>
<td></td>
</tr>
<tr>
<td>Level of AaE, $\tau_{00}$</td>
<td>0.90*</td>
</tr>
<tr>
<td>Within-person fluctuation, $\sigma^2$</td>
<td>0.53*</td>
</tr>
</tbody>
</table>

*p < .001
Figure 3. Predicted values based on the AaE estimates for the earliest-occurring and fifth earliest memories for the cross-level interaction of differences in the within-person covariation of memory serial order and estimates of AaE over the five earliest plausible memories as a function of implausible memory reporting. The memory serial order slope was significantly different for participants who reported at least one implausible memory in comparison to that of participants who did not report any implausible memories.
Children’s Beliefs about Autobiographical Memory

A second aim of the current study was to examine child-level cognitive factors and memory-level features that may contribute to children’s implausible memory reporting. This section presents results of analyses that examined children’s beliefs about the limitations of memory that are imposed by childhood amnesia as one such cognitive factor. Child participants responded to queries regarding whether or not a fictional character could: 1) remember receiving a gift at birth, and 2) whether or not the character could overcome the inability to remember receiving the gift with the aid of a photograph. Respectively, participants’ responses to these queries represent their beliefs regarding 1) the limitations of autobiographical memory for very early life events and 2) whether or not these limitations are surmountable. First, results of analyses that examined the association between children’s grade level and their beliefs about autobiographical memory are presented. Subsequent sections describe the results of analyses that examined the association between these beliefs and children’s implausible memory reporting. The analyses presented in this section and all remaining sections included only child participants. These analyses made use of all of the child participants’ memories that were included in the final sample, including those without parent feedback data.

Limitations of autobiographical memory for very early life events. Across all grade levels, 40% of child participants indicated that the fictional character would be able to remember receiving a gift at birth. These participants’ beliefs did not convey evidence of an understanding that memory is a limited process. In contrast, 60% of child participants indicated that the character could not remember the event, thereby demonstrating an
understanding of the limitations of memory for early life events. Among participants whose beliefs conveyed an understanding that memory is a limited process, 31% generated a belief that implicated a non-developmental restraint on memory (e.g., time since the event transpired) and 29% generated a belief that implicated a developmental restraint on memory (e.g., being a baby) to support their belief that the character could not remember the event. A chi square test revealed a significant relationship between belief type (i.e., no evidence, developmental limitation, and non-developmental limitation) and grade level, $\chi^2(4, N = 65) = 24.59, p < .001$. Whereas the majority of prekindergarten participants’ beliefs did not convey an understanding of the limitations of memory, the majority of participants in grades one and three generated a belief that implicated either a non-developmental or a developmental restraint on memory. Table 6 presents a summary of the proportion of participants in each grade level who endorsed these beliefs.

Table 6

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Whether or not autobiographical memory is limited</th>
<th>Limitations are insurmountable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>PreK</td>
<td>22</td>
<td>18 (82%)</td>
<td>4 (18%)</td>
</tr>
<tr>
<td>Grade 1</td>
<td>22</td>
<td>5 (23%)</td>
<td>17 (77%)</td>
</tr>
<tr>
<td>Grade 3</td>
<td>21</td>
<td>3 (14%)</td>
<td>18 (86%)</td>
</tr>
<tr>
<td>Total</td>
<td>65</td>
<td>26 (40%)</td>
<td>39 (60%)</td>
</tr>
</tbody>
</table>
Insurmountable nature of memory limitations. Responses to queries regarding whether or not the fictional character could remember receiving a gift at birth with the aid of a photograph revealed that the majority of participants (83%) believed a photograph could supplant memory constraints for very early life events and permit the fictional character to remember receiving a gift at birth. That is, only 17% of child participants conveyed an appreciation of the permanence of the limitations of memory for very early life events. Next, analyses examined these beliefs in tandem with participants’ beliefs about the limitations of memory for very early life events (i.e., their responses to the initial scenario). Specifically, a chi square test, which compared participants who implicated a developmental limitation and those who implicated a non-developmental limitation in response to the initial scenario, revealed an association that approached significance between participants’ belief type and whether or not they demonstrated an understanding of permanence of those memory limitations, $\chi^2(1, N = 39) = 3.54, p = .06$. Specifically, whereas 42% of participants who implicated a developmental limitation to support their belief that the character could not remember an event that occurred at birth subsequently acknowledged the insurmountable nature of this limitation, only 15% of participants who implicated a non-developmental limitation did so. These participants (i.e., those who implicated a developmental or non-developmental limitation to support their belief that the character could not remember the event and who understood the permanence of the limitation) were collapsed into a single category. A chi square test revealed a relationship between grade level and the generation of

---

4 As a reminder to the reader, before prompting participants to respond to queries regarding whether or not the fictional character could remember an event that occurred at birth with the aid of a photograph, the interviewer provided each participant with feedback to confirm that the character could not remember an event that occurred at birth.
this more complete understanding of autobiographical memory, $\chi^2(1, N = 65) = 5.94, p = .02$.

Compared to the youngest two grade levels, participants in grade three were more likely to generate beliefs that indicated an understanding of the insurmountable nature of the limitations of memory for very early life events.

**Association with implausible memory reporting.** Analyses examined the relationship between the types of beliefs child participants generated about autobiographical memory and their implausible memory reporting. A chi square revealed no significant association between whether or not participants demonstrated an understanding that memory for very early life events is limited and whether or not participants reported an implausible memory, $\chi^2(1, N = 65) = 2.07, p = .15$, or a highly implausible memory, $\chi^2(1, N = 65) = 0.16, p = .69$. Further, comparing participants who did and who did not demonstrate an understanding of the insurmountable limitations of autobiographical memory for very early life events, a chi square test revealed no association between belief type and whether or not participants reported an implausible memory, $\chi^2(1, N = 65) = 0.15, p = .70$. However, a chi square test revealed a non-significant trend in the association of belief type and whether or not participants reported a highly implausible memory, $\chi^2(1, N = 65) = 2.70, p = .10$.

Although the association was not significant, it is worth noting that whereas none of the participants who demonstrated an understanding of the insurmountable nature of memory constraint for very early life events reported a highly implausible memory, 26% of participants who did not demonstrate this understanding did so.

**Summary.** As predicted, grade level was significantly associated with children’s beliefs about the limitations of autobiographical memory that are imposed by childhood
amnesia, including the insurmountable nature of those limitations. Although the hypothesized
association between children’s memory beliefs and implausible memory reporting was not
supported, these results did reveal a non-significant trend ($p = .10$) for the association
between implausible memory reporting and children’s beliefs regarding the insurmountable
nature of the limitations of memory for very early life events.

**Multilevel Modeling: Parent-Child Discussion and Implausible Memory Reporting**

This section describes the results of multilevel models that examined parent-child
discussion as a memory-level feature that may be related to children’s implausible memory
reporting. In total, ratings of frequency of discussion were included for a total of 258
memories, with ratings for 58% of the memories indicating no or only rare parent-child
discussion. Ratings for 31% of the memories indicated at least some discussion, and ratings
for 11% indicated frequent discussion. Discussion was entered into the model below (and in
all subsequent models) as a binary predictor at Level 1, with no discussion coded as 0.
Categories indicating at least some discussion and frequent discussion were collapsed in all
subsequent analyses. Although planned analyses included children’s memory beliefs as a
Level 2 predictor in this model, a preliminary model did not produce an estimate of between-
person variability, thereby indicating insufficient variability to continue with the analysis of
Level 2 predictors (see Table 7, Model 1). Thus, none was included and the following
logistic multilevel model was applied to examine the relationship between past parent-child
discussion and the likelihood of reporting an implausible memory (expressed in terms of the
odds of reporting an implausible memory). Child participants ($n = 59$) who reported at least
two memories with parent feedback data were included in the model, yielding a total of 253 plausible and implausible memories.

Level 1: Implausible Memory$_{ij} = \beta_{0ij} + \beta_{1ij}(\text{Discussion}) + r_{ij}$

Level 2: $\beta_{0i} = \gamma_{00} + u_{0i}$

$\beta_{1i} = \gamma_{10}$

This model revealed a significant association between past parent-child discussion and the likelihood of reporting an implausible memory such that there was a greater likelihood that implausible memories had been the topic of parent-child discussion than that they had not been discussed ($\gamma_{10}$) (see Table 7, Model 2). Conceivably, however, because participants’ implausible memories may have been related to whether or not they possessed reminders of the events described in their earliest memory reports (e.g., photographs), a binary variable representing whether or not participants possessed a reminder of each reported memory was added to the model as a Level 1 predictor. As shown in Table 7 (Model 3), children’s possession of an event reminder (as indicated by parent feedback data) was not significantly related to implausible memory reporting ($\gamma_{20}$). However, the relationship with discussion remained significant, indicating that implausible memories were significantly more likely to have been the topic of previous parent-child discussion than to have not been discussed ($\gamma_{10}$). These results suggest that, as predicted, parent-child discussion may be an important source of children’s knowledge about their very early life experiences.
Table 7

Logistic Multilevel Model Results for Reporting an Implausible Memory

<table>
<thead>
<tr>
<th>Fixed Effects</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>LCI</td>
<td>UCI</td>
</tr>
<tr>
<td>Reporting implausible memory, $\beta_0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>0.07***</td>
<td>0.04</td>
<td>0.11</td>
</tr>
<tr>
<td>Discussion slope, $\beta_1$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{10}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reminder slope, $\beta_2$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{20}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model Deviance</td>
<td>126.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Random Effects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between-person variability, $\tau_{00}$</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within-person variability, $\sigma^2$</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05, **p < .01, ***p < .001
Multilevel Modeling: Parent-Child Discussion and AaE for Children’s Earliest Memories

A final aim of the current study was to further examine parent-child discussion as it relates to several aspects of children’s earliest memory reporting, including the AaE associated with discussed and non-discussed memories. The model below was applied to address this aim. Child participants \((n = 59)\) who reported at least two plausible memories for which the parent was able to estimate an AaE were included in the model, yielding a total of 236 memories. Results from the fully unconditional model indicated that 35% of the variability in parents’ estimates of AaE for plausible memories was between people \((\tau_{00} = 0.83, z = 3.63, p < .001)\) and 65% was within people \((\sigma^2 = 1.53, z = 9.47, p < .001)\). Therefore, this analysis indicated that there was sufficient variability to continue with further analyses. In the model below, the slope between past parent-child discussion and AaE for children’s plausible memories was constrained to be equal across participants by removing \(u_{1i}\) from this model because participants did not significantly vary in the rate of their differences across memories \((\tau_{11} = 0.20, z = 0.37, p = .36)\).

Level 1: \(\text{AaE}_{ij} = \beta_{0ij} + \beta_{1ij}(\text{Discussion}) + r_{ij}\)

Level 2: \(\beta_{0i} = \gamma_{00} + \gamma_{01}(\text{Grade 1}) + \gamma_{02}(\text{Grade 3}) + u_{0i}\)

\(\beta_{1i} = \gamma_{10} + \gamma_{11}(\text{Grade 1}) + \gamma_{12}(\text{Grade 3})\)

The results of this model (see Table 8) indicated that there was not a significant relationship between whether or not memories had been the topic of past parent-child discussion and parent-estimated AaE for plausible memories \((\gamma_{10})\). Additionally, compared to participants in prekindergarten, participants in grade one did not have significantly older
estimates of AaE for non-discussed memories ($\gamma_{01}$), but participants in grade three did ($\gamma_{02}$). Although the relationship between AaE and parent-child discussion did not differ between participants in grade one and in prekindergarten ($\gamma_{11}$), there was a significance difference in this relationship between participants in grade three and in prekindergarten ($\gamma_{12}$). Specifically, the difference in AaE estimates for discussed and non-discussed memories was greater for participants in grade three than for participants in prekindergarten. Although the AaE was similar across these participants for discussed memories, non-discussed memories for participants in grade three had older AaE estimates than non-discussed for participants in prekindergarten (see Figure 4). These results offer support for the prediction that parent-child discussion of past events would be related to earlier estimates of AaE, particularly for children in grade three. This model accounted for 18% of the between-person variability and 1% of the within-person variability in parent-estimated AaE for plausible memories.
Table 8

Coefficients (and Standard Errors) of AaE for Child Participants’ Earliest Plausible Memories by Age Group and Discussion

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>AaE, $\beta_0$</td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>3.85*** (0.29)</td>
</tr>
<tr>
<td>Grade 1, $\gamma_{01}$</td>
<td>0.31 (0.40)</td>
</tr>
<tr>
<td>Grade 3, $\gamma_{02}$</td>
<td>1.14** (0.39)</td>
</tr>
<tr>
<td>Discussion slope, $\beta_1$</td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{10}$</td>
<td>0.34 (0.35)</td>
</tr>
<tr>
<td>Grade 1, $\gamma_{11}$</td>
<td>-0.21 (0.48)</td>
</tr>
<tr>
<td>Grade 3, $\gamma_{12}$</td>
<td>-1.02* (0.47)</td>
</tr>
<tr>
<td>Random effects</td>
<td></td>
</tr>
<tr>
<td>Between-person fluctuation, $\tau_{00}$</td>
<td>0.68***</td>
</tr>
<tr>
<td>Within-person fluctuation, $\sigma^2$</td>
<td>1.54***</td>
</tr>
</tbody>
</table>

$p < .05$, **$p < .01$, ***$p < .001$
Parent-Child Discussion and the Accuracy of Children’s Estimates of AaE

This section presents the results of analyses that further addressed the aim to examine parent-child discussion as a memory-level feature that may be related to children’s earliest memory recall. Specifically, multilevel modeling was applied to examine the within-person relationship between past parent-child discussion and the accuracy of children’s estimates of AaE. Memories for which the difference between these estimates was two standard or more deviations above or below the mean difference were removed excluded from analyses. Participants \((n = 56)\) who reported at least two plausible memories for which both the child
and the parent were able to estimate an AaE and for which parents provided a rating of past parent-child discussion were included in the model, yielding a total of 210 memories.

In the model below, the dependent variable is the absolute value of the difference between children’s and parent’s estimates of AaE (i.e., |child AaE – parent AaE|) for each reported memory. Thus, greater absolute values of the difference indicate greater memory dating error by children. Grade was excluded as a Level 2 predictor given that grade level was not related to memory dating accuracy. Results from the fully unconditional model indicated that 24% of the variability in children’s memory dating accuracy was between people (τ₀₀ = 0.16, z = 2.60, p < .01) and 76% was within people (σ² = 0.52, z = 8.88, p < .001). Therefore, this analysis indicated that there was sufficient variability to continue with further analyses.

Level 1: AaE_ij = β_0ij + β_1ij(Discussion) + e_ij

Level 2: β_0i = γ₀₀ + u₀i

The results of this model (see Table 9) indicated that there was a relationship that approached significance (p = .06) between parent-child discussion and the accuracy of child participants’ AaE estimates (γ₁₀). Specifically, the predicted average dating error for memories that had not previously been the topic of parent-child discussion (M = .82) was greater than that for memories that had been previously discussed (M = .60). These results offer marginal support the hypothesis that parent-child discussion would be related to greater accuracy in children’s memory dating. This model accounted for 13% of the between-person variability and 2% of the within-person variability in parent-estimated AaE.
Table 9

Coefficients (and Standard Errors) of Child Participants’ Memory Dating Accuracy by Discussion

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>0.82 (0.08)</td>
</tr>
<tr>
<td>Discussion slope, $\beta_1$</td>
<td>-0.22* (0.11)</td>
</tr>
<tr>
<td>Random effects</td>
<td></td>
</tr>
<tr>
<td>Between-person fluctuation, $\tau_{00}$</td>
<td>0.14**</td>
</tr>
<tr>
<td>Within-person fluctuation, $\sigma^2$</td>
<td>0.53***</td>
</tr>
</tbody>
</table>

*p = .06, **p = .01, ***p < .001

Parent-Child Discussion and Narrative Coherence

The final aim of the current study was to examine the relationship between parent-child discussion and the narrative coherence of children’s earliest memory reports. In the results reported in this section, each dimension of coherence served as the dependent variable in separate logistic multilevel models, such as the model presented below. Each model examined the within-person relationship between past parent-child discussion and the likelihood of reporting a coherent narrative (expressed in terms of the odds of reporting a coherent narrative). Additionally, these models examined differences by grade in narrative coherence and in the association between parent-child discussion and coherence. The results of these models are discussed for context, chronology, and theme in turn.

Level 1: $\text{Coherence}_{ij} = \beta_{0ij} + \beta_{1ij}(\text{Discussion}) + r_{ij}$

Level 2: $\beta_{0i} = \gamma_{00} + \gamma_{01}(\text{Grade 1}) + \gamma_{02}(\text{Grade 3}) + u_{0i}$

$\beta_{1i} = \gamma_{10} + \gamma_{11}(\text{Grade 1}) + \gamma_{12}(\text{Grade 3})$
**Context.** The results of this model (see Table 10) indicated that memories that had been the topic of parent-child discussion were not significantly more likely to be reported as a contextually coherent narrative compared to memories that had never or rarely been discussed ($\gamma_{10}$). However, there was a grade level difference such that compared to participants in prekindergarten, participants in grade three ($\gamma_{02}$) were more likely to report a contextually coherent narrative. The likelihood of reporting a contextually coherent narrative did not differ between participants in grade one ($\gamma_{01}$) and in prekindergarten. There were no grade level differences in the relationship between discussion and contextual coherence for grade one ($\gamma_{11}$) or grade three ($\gamma_{12}$) in comparison to participants in prekindergarten (see Figure 5).
Table 10

*Logistic Multilevel Model Results for Reporting a Contextually Coherent Narrative*

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th></th>
<th></th>
<th>Model 2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>LCI</td>
<td>UCI</td>
<td>OR</td>
<td>LCI</td>
<td>UCI</td>
</tr>
<tr>
<td><strong>Fixed Effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reporting implausible</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>memory, $\beta_0$</td>
<td>Intercept, $\gamma_{00}$</td>
<td>0.89</td>
<td>0.65</td>
<td>1.22</td>
<td>0.35**</td>
<td>0.16</td>
</tr>
<tr>
<td>Grade 1, $\gamma_{01}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.42</td>
<td>0.86</td>
</tr>
<tr>
<td>Grade 3, $\gamma_{02}$</td>
<td></td>
<td></td>
<td></td>
<td>5.40**</td>
<td>1.92</td>
<td>15.20</td>
</tr>
<tr>
<td><strong>Discussion slope, $\beta_1$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{10}$</td>
<td></td>
<td>1.59</td>
<td>0.58</td>
<td>4.39</td>
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<td></td>
</tr>
<tr>
<td>Grade 1, $\gamma_{11}$</td>
<td></td>
<td>0.43</td>
<td>0.11</td>
<td>1.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 3, $\gamma_{12}$</td>
<td></td>
<td>0.72</td>
<td>0.18</td>
<td>2.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Model Deviance</strong></td>
<td></td>
<td>304.36</td>
<td></td>
<td>274.99</td>
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<tr>
<td><strong>Random Effects</strong></td>
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<td></td>
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<tr>
<td>Between-person</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>variability, $\tau_{00}$</td>
<td>0.66*</td>
<td></td>
<td></td>
<td>0.68*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within-person</td>
<td>0.90***</td>
<td></td>
<td></td>
<td>0.90***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>variability, $\sigma^2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $p < .05$, ** $p < .01$, *** $p < .001$
Figure 5. Parent-child discussion × grade level interaction for the probability of reporting a contextually coherent narrative.

**Chronology.** The results of this model (see Table 11) indicated that there was not a significant association between past parent-child discussion and the likelihood that memories were reported as a chronologically coherent narrative ($\gamma_{10}$). Additionally, compared to participants in prekindergarten, participants in grade one ($\gamma_{01}$) and grade three ($\gamma_{02}$) were no more likely to report a chronologically coherent narrative. There were no differences by the participants’ grade level in the relationship between discussion and chronological coherence for grade one ($\gamma_{11}$) or grade three ($\gamma_{12}$) in comparison to participants in prekindergarten (see Figure 6).
Table 11

Logistic Multilevel Model Results for Reporting a Chronologically Coherent Narrative

<table>
<thead>
<tr>
<th>Fixed Effects</th>
<th>OR</th>
<th>LCI</th>
<th>UCI</th>
<th>OR</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reporting implausible memory, $\beta_0$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>2.14***</td>
<td>1.50</td>
<td>3.05</td>
<td>1.59</td>
<td>0.72</td>
<td>3.53</td>
</tr>
<tr>
<td>Grade 1, $\gamma_{01}$</td>
<td></td>
<td></td>
<td></td>
<td>1.95</td>
<td>0.65</td>
<td>5.86</td>
</tr>
<tr>
<td>Grade 3, $\gamma_{02}$</td>
<td></td>
<td></td>
<td></td>
<td>0.96</td>
<td>0.33</td>
<td>2.84</td>
</tr>
<tr>
<td>Discussion slope, $\beta_1$</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{10}$</td>
<td>1.06</td>
<td>0.37</td>
<td>3.03</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Grade 1, $\gamma_{11}$</td>
<td>0.44</td>
<td>0.10</td>
<td>1.85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 3, $\gamma_{12}$</td>
<td>2.73</td>
<td>0.60</td>
<td>12.38</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Model Deviance</td>
<td>239.83</td>
<td></td>
<td></td>
<td>225.67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Random Effects

| Between-person variability, $\tau_{00}$ | 0.78* | 0.82* |
| Within-person variability, $\sigma^2$ | 0.86*** | 0.86*** |

*p < .05, **p < .01, ***p < .001
Figure 6. Parent-child discussion × grade level interaction for the probability of reporting a chronologically coherent narrative.

**Theme.** The results of this model (see Table 12) indicated that memories that had been the topic of parent-child discussion were significantly more likely to be reported as a thematically coherent narrative compared to memories that had never or rarely been discussed ($\gamma_{10}$). In addition, compared to participants in prekindergarten, participants in grades one ($\gamma_{01}$) and three ($\gamma_{02}$) were more likely to report thematically coherent narratives. Although there were no grade level differences in the relationship between discussion and thematic coherence for grade one ($\gamma_{11}$) compared to prekindergarten, a significant cross-level interaction indicated that this relationship did differ between grade three ($\gamma_{12}$) and prekindergarten. Among participants in grade three, the likelihood of reporting a thematically coherent narrative was greater for discussed memories than for non-discussed memories (see Figure 7).
Table 12

*Logistic Multilevel Model Results for Reporting a Thematically Coherent Narrative*

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th></th>
<th></th>
<th>Model 2</th>
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</thead>
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<tr>
<td></td>
<td>OR</td>
<td>LCI</td>
<td>UCI</td>
<td>OR</td>
<td>LCI</td>
<td>UCI</td>
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<tr>
<td><strong>Fixed Effects</strong></td>
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<tr>
<td>Reporting implausible memory, $\beta_0$</td>
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<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>0.99</td>
<td>0.67</td>
<td>1.45</td>
<td>0.26**</td>
<td>0.10</td>
<td>0.63</td>
</tr>
<tr>
<td>Grade 1, $\gamma_{01}$</td>
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<td>1.12</td>
<td>11.59</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Grade 3, $\gamma_{02}$</td>
<td>8.39***</td>
<td>2.51</td>
<td>27.97</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Discussion slope, $\beta_1$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Intercept, $\gamma_{10}$</td>
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<td>1.24</td>
<td>9.88</td>
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<td></td>
</tr>
<tr>
<td>Grade 1, $\gamma_{11}$</td>
<td>0.42</td>
<td>0.11</td>
<td>1.68</td>
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<td></td>
</tr>
<tr>
<td>Grade 3, $\gamma_{12}$</td>
<td>0.20*</td>
<td>0.05</td>
<td>0.85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Model Deviance</strong></td>
<td>266.48</td>
<td></td>
<td></td>
<td>246.31</td>
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<td></td>
</tr>
</tbody>
</table>

| **Random Effects**        |         |       |       |         |       |       |
| Between-person variability, $\tau_{00}$ | 1.38** |       |       | 1.36**  |       |       |
| Within-person variability, $\sigma^2$   | 0.83*** |       |       | 0.83*** |       |       |

* $p < .05$, ** $p < .01$, *** $p < .001$
Coherence summary. Together, these models offer support for the hypothesized relationship between the likelihood of producing a coherent narrative for each dimension and children’s grade level. As predicted, grade level differences in the likelihood of reporting a coherence narrative only emerged for the context and theme dimensions. In particular, compared to children in prekindergarten, children in grade three were more likely to produce narratives that were contextually and thematically coherent. However, the predicted differences between children in prekindergarten and in grade one did not emerge.

These models also provide partial support the hypothesized relationship between the likelihood of producing a coherent narrative on each dimension and parent-child discussion. As predicted, parent-child discussion was related to an increased likelihood of reporting a
thematically coherent narrative, particularly among children in grade three. However, results
did not support this predicted relationship for the context dimension.
Discussion

The current study had three main objectives: 1) to compare earliest memories reported by children in three grade levels (prekindergarten, grade one, and grade three) and those reported by college students to examine implausible memory reporting across these age groups; 2) to examine children’s beliefs about autobiographical memory and parent-child discussion as factors that may be related to children’s implausible memory reporting; and 3) to explore the relationship between past parent-child discussion as a memory-level feature and aspects of child participants’ independent recall. Each of these objectives is discussed in turn.

Plausibility of Children’s and College Students’ Earliest Memories

Most studies examining earliest memories rely on the estimates of AaE to characterize the emergence of autobiographical memory (e.g., Peterson et al., 2005; Wang, 2004). Despite the importance attached to participants’ estimates of AaE, few studies have evaluated the plausibility that memories of very early life events (e.g., memories of infancy) are autobiographical in nature or have systematically explored implausible memory reporting in child or adult samples. Therefore, a primary aim of the current study was to close this gap in the literature by examining implausible memory reporting among child participants in comparison to a college student sample. The findings revealed that just over 40% of child participants reported at least one implausible memory when prompted to recall their earliest memories. Additionally, many of these implausible memories were characterized as highly implausible given that they described a pre- or perinatal event. Children in each age group (prekindergarten, grade one, and grade three) were equally likely to report an implausible
memory. However, in comparison to the college sample, child participants were significantly more likely to report an implausible memory. Only 5% of the college students reported an implausible memory. Interestingly, a survey of 2000 Norwegian adults that revealed fewer than 5% of the sample believed it is possible to remember events that occurred during the first year of life (Magnussen et al., 2006). Thus, the current study offers initial evidence that college students’ earliest memory reports align with previous research regarding adults’ beliefs about the limitations of autobiographical memory.

To examine how the inclusion of implausible memory reports might bias results that emerge from the analysis of AaE estimates, the current study conducted analyses examining the AaE for child participants’ and college students’ earliest-occurring memory. First, analyses that included implausible memories indicated that, compared to college students, the earliest memory reported by children in grade three had a significantly younger AaE. In contrast, when implausible memories were excluded from analysis, there was not a significant age-related difference in AaE for the participants’ earliest memory. Importantly, the average AaE for child participants’ earliest memory, including implausible memories, was significantly younger compared to the average AaE of their earliest plausible memory. Average estimates of AaE for college students’ single earliest memory were not significantly different as a function of the inclusion of implausible memories. This suggests that the inclusion of implausible memories in the analysis of AaE estimates may have a greater biasing effect on the conclusions derived from these analyses for child participants than for college students.
The current study also demonstrates the biasing effect of the inclusion of implausible memories using multilevel modeling to explore the density of child and college student participants’ earliest memories. In these models, the rate of change in AaE across participants’ five earliest memories represented density. Excluding implausible memories, findings indicated memory density did not differ for participants in grades one or three in comparison to the density of college students’ earliest memories. However, memory density did differ for prekindergarten participants in comparison to college participants such that prekindergarten participants’ earliest memories described events that occurred closer in time to one another (i.e., their memories were more dense). When implausible memories were included in the analysis of the density of child and college students’ earliest memories, a similar pattern of results emerged with regard to the density of memories reported by participants in prekindergarten. However, in contrast to the model that excluded implausible memories, the inclusion of implausible memories indicated that the earliest memories of participants in grade three described events that were more dispersed in time (i.e., their memories were separated by a greater number of years, indicating less density) compared to the events recalled by college students. The results that emerged from each model yield different conclusions regarding the density of children and college students’ earliest memories. Whereas the modeling of participants’ plausible earliest memories suggests that by grade one, the dispersion of children’s earliest memories resembles that of a young adult reminiscing about childhood, the modeling of both plausible and implausible memories does not support this conclusion.
Importantly, previous research has examined the distribution of earliest memories to index the rate of forgetting of memories (Bauer et al., 2007; Wixted, 2004). Research with child participants has concluded that in comparison to the distribution of adults’ memories, which indicates memory consolidation, the distribution of 7- to 10-year-old children’s memories indicates continued forgetting (Bauer et al., 2007). It is worth noting that this conclusion was based on analyses that included implausible memories. In contrast, the current findings revealed that by grade one, the density of children’s and college students’ earliest plausible memories is not significantly different, which may indicate that memory consolidation occurs earlier in development than previous research suggests. Although the methodology used in this study is different from the cue word method used to elicit memories in previous studies, the current findings demonstrates that implausible memories may bias conclusions regarding the emergence of autobiographical memory.

Factors Related to Implausible Memory Reporting

In addition to exploring the relative rates of implausible memory reporting among child and college student participants, the current study sought to identify factors that may be related to the selection of an implausible memory among children. As previously noted, the findings from the current study align well with the results of a survey of 2000 Norwegian adults, which revealed that fewer than 5% of the sample believed it is possible to remember events that occurred during the first year of life (Magnussen et al., 2006). Perhaps adults utilize their beliefs about memory when evaluating the source of their earliest memories. This possibility is supported by previous research that indicates adults are able to differentiate information about their personal histories as being derived from personal recollection or from
a source other than personal recollection, such as parent-child conversations (Hyman et al., 1998). According to the source monitoring framework, this type of judgment process may facilitate source judgments about the origins of memories (Johnson et al., 1993). When features of the memory do not serve to distinguish source, individuals may rely on other information to make final source decisions (Johnson et al., 1993). Relevant to autobiographical remembering, an individual may have a memory of being cold and hungry, which are memory features that are characteristics of a memory of a perceived (as opposed to imagined) event; however, the individual may determine that, despite the features of the memory, he does not remember the event because it occurred on the day he was born. Adults’ engagement in this type of strategic evaluation of remembered information may account for the lower rates of implausible memory reporting found among college students in the current study.

**Children’s beliefs about autobiographical memory.** Given the assumed relation between adults’ implausible memory reporting and their ability to make meaningful source decisions in the context of autobiographical remembering, a logical corollary is that children’s implausible memory reporting may reflect an impoverished ability to evaluate the source of remembered information about their earliest experiences. The current study tested this prediction by examining the relationship between children’s beliefs about autobiographical memory and their implausible memory reporting. Findings indicated that the majority of children’s beliefs conveyed an understanding that autobiographical memory is limited such that it not possible to remember an event that occurred at birth. However, fewer than 20% of children rejected the utility of a photograph of the event for overcoming
the limitations of autobiographical memory. Thus, these findings suggest that although an understanding of the limitations of autobiographical memory emerges during the early elementary school years, the majority of children through grade three do not appreciate that external sources of information cannot supplant those limitations.

Despite the low percentage of participants in the current study with beliefs that conveyed an understanding of the permanence of the limitations of autobiographical, there was evidence to suggest that some aspects of children’s beliefs about autobiographical memory were related to implausible memory reporting. Specifically, whereas no highly implausible memories were reported by participants who rejected the notion that a fictional character could remember an event that occurred at birth *with the aid of a photograph*, 26% of child participants who did not convey this belief reported a memory of a pre- or perinatal event. However, this belief type was only marginally associated with whether or not participants reported a highly implausible memory and was not associated with reports of implausible memories that described events that occurred later in infancy.

The marginal significance of this association notwithstanding, this is the first study to provide evidence to suggest that children’s beliefs about autobiographical memory may be related to their selection of implausible memories as their earliest recollections. However, as previously noted, the age groups in the current study did not capture the transition from impoverished beliefs about autobiographical memory to a more mature understanding of the limitations of autobiographical memory. Thus, the majority of children in the current study did not appear to possess the types of beliefs that may facilitate adults’ evaluation of remembered information in the context of autobiographical remembering (Qin, Ogle, &
Goodman, 2008). This suggests that when prompted to recall their earliest memories, children may fail to evaluate remembered information, with the result that they may report implausible memories that reflect knowledge derived from parent-child discussions about the past as their earliest recollections.

**Parent-child discussion.** The current study tested the possibility that children’s implausible memories described information derived from parent-child conversations by asking parents whether or not they had previously discussed the events that children described in their earliest memory narratives. Findings revealed that child participants’ implausible memories were more likely to have been the topic of previous parent-child discussion than to have not been discussed. Although the current study cannot speak to the types of information parents transmit to their children in their discussions about very early life events, it is possible that these discussions provide children with the types of information (e.g., perceptual and affective details) that, according to source monitoring theory (Johnson et al., 1993), increase the likelihood that they will accept this information as their own personal recollections. Importantly, the likelihood of reporting an implausible memory was not related to whether or not participants had access to other external sources of information about the events described in their implausible memory reports, such as pictures or videos. Borrowing from research on the social nature of children’s acquisition of information through media (Richert, Robb, & Smith, 2011), this null finding may reflect the fact that children must rely on others for information that they are not able to verify through their own direct observation. Thus, a conversational partner who is knowledgeable about artifacts associated with events that occurred early in life may be necessary in order for children to derive the information
that would link the artifacts to their own personal history or that would increase the likelihood of accepting the information as their own personal recollection.

Taken together, these findings suggest that although parent-child discussion may provide opportunities for children to garner knowledge of their earliest experiences, children through grade three may not differentiate the knowledge they acquire through these discussions from their own personal recollection of past experiences. As a result, children may report the knowledge they acquire through these discussions when prompted to recall their earliest memoirs.

**Parent-Child Discussion and Children’s Earliest Memory Narratives**

Unlike previous studies, which have examined parent-child discussion in terms of the broad impact of parents’ conversational style on children’s cognitive and socioemotional development (Fivush, Haden, & Reese, 2006), the current study examined discussion at the level of the memory. Specifically, parents indicated whether or not the events that their child independently selected as their earliest memories had previously been the topic of their joint discussion. This relatively simple metric, however, revealed differences between discussed and non-discussed memories in the recency of estimates of AaE, the accuracy of children’s memory dating, and the coherence of their narratives.

**Estimates of AaE.** The current study tested the hypothesis that memories that had been the topic of parent-child discussion would have earlier estimates of AaE than non-discussed memories. In support of this hypothesis, the difference between discussed and non-discussed memories within participants in grade three was significantly different than that for participants in prekindergarten. Specifically, although the AaE associated with non-discussed
memories was older for participants in grade three than for participants in prekindergarten, the AaE for discussed memories was similar across grade levels. Perhaps the opportunities for extended encoding that occur in the context of parent-child discussion (Baker-Ward, Ornstein, & Starnes, 2009) serve to reinstate and maintain memories across time. However, because this difference was not observed among participants in grade one in comparison to those in prekindergarten, it is possible that it is not until children approach middle childhood that non-discussed memories are more susceptible to becoming inaccessible than discussed memories.

This study also examined whether or not parent-child discussion was related to greater accuracy for children’s estimates of AaE. The results yielded marginal support for the hypothesis that children’s estimates of AaE would be more accurate for memories that had been the topic of previous parent-child discussion than for those that had not been discussed. The moderate effect of parent-child discussion on children’s memory dating accuracy may not have achieved statistical significance ($p = .06$), but the difference may be meaningful nonetheless. Specifically, across the entire collection of memories reported by child participants, children’s and their parents’ estimates of AaE were highly correlated ($r = .74, p < .001$); thus, children were quite accurate regardless of whether or not their memories had been the topic of parent-child discussion. Further, past research with children as young as seven years old indicates considerable consistency between child- and parent-estimated AaE (Bauer et al., 2007; Wang et al., 2010) and that children as young as six years of age are able to estimate time of year for past events (Friedman & Lyon, 2005). Therefore, it is arguably more surprising that the relation between parent-child discussion and children’s memory
dating accuracy approached significance than it is that the relationship was not statistically significant. Future research should further explore parent-child discussion as a possible context through which children learn to tag their memories in time, with greater sensitivity to the mechanisms that may support these benefits than was afforded by the current study.

**Narrative coherence.** Parent-child discussions about the past may provide opportunities for children to learn a canonical narrative form (Nelson & Fivush, 2004). The current study sought to examine whether or not parent-child discussion as a memory-level feature was related to coherence of children’s earliest memory narratives. Different results emerged for the three dimensions of coherence examined: context, chronology, and theme. First, the context and chronology dimensions of coherence were not related to previous parent-child discussion. The lack of support for the predicted relation between context and parent-child discussion may be a reflection of the way in which this dimension of coherence was dichotomized. Specifically, whereas memories that provided information about both time and location were coded as contextually coherent, those that provided either no information about context or only one piece of contextual information (i.e., time or location) were coded as 0, indicating a relative absence of contextual coherence. The requirement that a narrative include both pieces of information to be considered contextually coherent may have been too stringent to capture more modest benefits of parent-child discussion. Instead, these analyses may have been better suited to capture differences that reflect narrative skills that emerge with maturation. In support of this possibility, the narratives of participants in grade three—but not grade one—were more likely to be contextually coherent. With regard to chronological coherence, the majority of participants’ memories were chronologically
coherent. Thus, the lack of a relation between parent-child discussion and chronology was not surprising and is consistent with previous research, which demonstrates that reasonably temporally ordered narratives are evident by preschool (Peterson & McCabe, 1983).

Although context and chronology were not related to parent-child discussion, the current study did find that children’s earliest memory narratives were more likely to be thematically coherent if parents indicated that they had previously discussed those memories with their children than if they had not. Interestingly, however, the benefits of parent-child discussion for thematic coherence appeared to be particularly evident for children in grade three. Given that the ability to produce a thematically coherent narrative continues to emerge through adolescence (Reese et al., 2011), it is not surprising that parent-child discussion was less beneficial for the younger children in the current study. That is, although parent-child discussion may serve to scaffold children’s emerging narrative skills (Hudson, 1993), the ability to demonstrate these skills in the form of thematically coherent independent narratives may not be evident until children approach middle childhood.

The apparent benefits of parent-child discussion for children’s memory narratives may have important implications for the maintenance of early memories across time, particularly in light of finding from a recent longitudinal study (Morris et al., 2010). In that investigation, thematically coherent memories were more likely to be recalled after a one year delay. Although the present study cannot speak to the survivability of memories based on their thematic coherence, these findings do suggest that parent-child conversation at the level of the memory may benefit children’s independent recall of previously discussed event, which in turn may contribute to their maintenance across time. Further, given that the current
study examined discussion based on parent ratings that indicated whether or not memories had previously been the topic of parent-child discussion, the findings cannot directly speak to the processes that occur in the context of parent-child discussions of specific past events that give rise to narrative benefits. However, the apparent benefit of parent-child discussion for children’s independent recall may indicate that through discussion of a particular event, parents and their children co-construct a coherent narrative of that event, and this co-construction then permits children to structure their independent narratives in similar ways. Admittedly, it is possible that the content of the children’s independent narratives of previously discussed events primarily reflects the content of those discussions. That is, parent-child discussions may serve to extend the construction of a representation in memory across time (Baker-Ward et al. 1997; Bialystok & Craik, 2006) through shared meaning making and the exchange of their unique perspectives of the event. Although this extended encoding likely alters the representation of an event as it was initially encoded, this issue is not limited to memories that are the topic of parent-child discussion. For example, memories may be subject to extended encoding through post-event rumination and other interpretative processes that arise as individuals garner additional relevant information about an event (Bialystok & Craik, 2006). Therefore, regardless of whether or not parent-child discussions serve to help children maintain memories of the past that reflect their own memory of the event or a representation shaped by extended encoding, these findings indicate that parent-child discussion may serve to scaffold children’s independent narrative skills. However, to better understand the processes that give rise to greater coherence via parent-child discussion, future research should examine the recency and frequency of those conversations.
Conclusions

The current study reinforces much of what is known about autobiographical memory development. However, this study addressed one aspect of remembering that has received little attention in the emerging literature on children’s earliest memories. When we reminisce about our personal histories, we not only remember encoded experiences that have been maintained in memory across time; we also remember knowledge about our personal histories that we have collected through photographs, videos, and family stories and conversations. The current study adds to the current dialogue about children’s earliest memories by bringing attention to the possibility that when children reminisce about the past, they may not differentiate personal recollections from knowledge of the past in the same ways that older adolescents and adults may do. Instead, they appear to be more likely to accept knowledge of their earliest experiences as their own memories for those events, perhaps reflecting impoverished beliefs about the limitations of autobiographical memory. Parent-child discussions of the past appear to play an important role in providing children with knowledge about their personal histories. Further, the findings suggest that parent-child discussions of past events play a role in how children represent those events in memory. Overall, these findings align well with a social cultural developmental theory of autobiographical memory (Nelson & Fivush, 2004). This theoretical perspective emphasizes the role of social interaction in the emergence of autobiographical memory but acknowledges that such interaction is part of a larger constellation of biological, linguistic, cognitive, and socioemotional influences (Reese et al., 2010).
Although the results of the current study suggest that socialization and cognitive development converge to influence the types of memories children select as their earliest memories, there are limitations to the current study that warrant discussion. First, this study explored children’s beliefs about autobiographical memory by asking participants to respond to scenarios that described the experiences of a fictional character. Although these scenarios yielded interesting findings that suggest developmental differences in children’s beliefs about the limitations of autobiographical memory, the results are based on children’s responses to just two scenarios. Therefore, it is possible that the participants’ beliefs could be limited to the stimuli used in the current study. To address this possibility, a subset of participants \((n = 10)\) was presented with a second set of scenarios (see Appendix F). These scenarios, which were presented after the earliest memory interview, were presented without accompanying illustrations. As with the initial set of scenarios, the character was introduced as being of the same age and gender as the participant. After listening to the first scenario in the replication set, participants reported their beliefs regarding a character’s ability to remember going to the zoo when he/she was a tiny baby (i.e., who could not walk, talk, or crawl) after he/she watched a video the event. After listening to the second scenario in the replication set, participants reported their beliefs regarding a character’s ability to remember an event that occurred on his or her first birthday. This scenario did not suggest that the character had viewed pictures or a video of the event.

Participants’ responses to these scenarios in comparison to their responses to the initial set of scenarios indicated consistency in their beliefs about autobiographical memory. Interestingly, despite being told that the character in the initial set of scenarios could not
remember an event that occurred at birth, even with a photograph, the majority of the
participants indicated that the character could remember going to the zoo as a tiny baby after
viewing a video of the event. Only three participants indicated that the character could not
remember that event. Further, all but one of the participants who responded to the replication
scenarios indicated that the character could not remember his or her first birthday party.
Although this scenario did not suggest that the character had viewed pictures or a video of
the event, some participants spontaneously asked if the character had viewed a reminder.
Interestingly, all of the participants who asked about reminders also indicated that the
character could remember with the aid of a photograph or video.

These replication scenarios partially address the issue that the participants’ beliefs
may be specific to the initial set of scenarios. However, these beliefs were elicited after
participants responded to the initial set of scenarios and thus, do not represent independent
observations. Future research should explore children’s beliefs about autobiographical
memory further by using other methods, such as explicitly presenting stories of their own
infancy, to determine if the current findings are generalizable across stimuli. Additionally,
the validity of these scenarios should be explored. Although there are no extant assessment of
autobiographical memory beliefs for children, linking participants’ beliefs about
autobiographic memory to measures of theory of mind or source monitoring may help to
demonstrate the concurrent validity of these scenarios.

A second limitation of the current study concerns the assessment of parent-child
discussion. Specifically, findings that implicate parent-child discussion as a memory level
feature that may support children’s memory and possibly the maintenance of memories
across time are based on a dichotomized variable that indicates whether or not memories had previously been discussed. This variable is based on parents’ ratings of the frequency of discussion on a three-point scale: rarely or never, sometimes, or frequently. Given the small percentage of memories that parents indicated were frequently discussed, this rating was combined with the rating that indicated that the memory was sometimes discussed. The remaining frequency rating included memories that had never been discussed and those that had been discussed but only rarely. One limitation of the inclusion of rarely discussed memories with non-discussed memories is that even minimal discussion may be sufficient to provide children with the type of scaffolding or co-construction of a coherent narrative to benefit their independent recall of the event. It is also possible, however, that some minimal frequency of discussion is necessary to demonstrate the benefits found in the current study. Related to this issue, the ratings obtained in the current study do not speak to the recency of memory discussion, which also may be relevant for whether or not there are benefits of discussion or for the duration of those benefits. Finally, as previously noted, these ratings do not speak to the processes that occur in the context of parent-child discussion that the current study suggests are related to narrative benefits for previously discussed memories. To address these limitations and to more fully understand the relationship between parent-child discussion and children’s independent recall of previously discussed events, future research should explore the frequency, recency, and content of parent-child discussion.

These limitations notwithstanding, the current study offers many contributions to the extant literature on children earliest memories. This study was the first to systematically explore children’s implausible memory reporting and linkages between children’s
implausible memories and previous parent-child discussions about early life experiences. Further, this study was the first to explore the relationship between children’s beliefs about autobiographical memory and their implausible memory reporting. Although this relationship did not reach statistical significance, the current study offers an initial attempt to understand what children know about autobiographical memory for very early life events and how these beliefs may be related to children’s earliest memory selection. Future studies should include participants in late childhood and early adolescence to capture the transition from the impoverish beliefs observed among children in the current study to more mature, adult-like beliefs about autobiographical memory.

Importantly, the current study brings attention to children’s implausible memory reporting and highlights the need for future investigations of children’s earliest memories to report the occurrence of implausible memories. To date, however, only one study examining children’s earliest memories has explicitly identified the occurrence of an implausible memory and reported whether or not the AaE estimate for that memory was included in their analyses (Jack et al., 2009). In that study, one participant reported an event that occurred in the days after his birth, which the researchers acknowledged was unlikely to reflect personal recollection of the event. However, they elected to include the memory in their analyses, reasoning that “[…] it is difficult to know for certain that any given memory is a genuine autobiographical memory (as opposed to a reconstruction based on family stories and photographs)” (p. 501). Although it is certainly true that a litmus test cannot be applied to ascertain whether or not memories reflect personal recollection, neurological evidence regarding the development of neural substrates that underlie memory consolidation and
storage (e.g., Bauer, 2004) offers a compelling plausibility test. In light of findings from the current study, research examining earliest memories should be judicious when analyzing estimates of AaE to permit meaningful cross-study comparisons of AaE estimates and to ensure accurate conclusions about the emergence of autobiographical memory.

This research also extends a vast literature regarding the broad impact of parents’ conversational style on children’s cognitive and socioemotional development (Fivush, Haden, & Reese, 2006) by demonstrating a relationship between discussion at the level of the memory and the coherence of children’s earliest memory narratives. Although future research should address this relationship further to determine whether or not it is limited to discussions of events that occur early in life, these findings provide initial evidence that children’s memory for a past event is more likely to be recalled in the form of a coherent narrative if that event has been the topic of previous parent-child discussion than if it has not been discussed. Unlike the broad array of benefits that have been observed for autobiographical remembering among children whose parents engage in an elaborative conversational style, the benefits observed in the current study may be limited to children’s recall of previously discussed events. However, because there is no reason to assume that the parents in the current study are all highly-elaborative in their discussions of the past with their children, these findings appear to be irrespective of the parents conversational style. Thus, parent-child discussion, as examined in the current study, may offer benefits that are accessible to a broader array of children—at least at the level of the individual memory.

In conclusion, these findings have implications for research that examines the development of autobiographical memory in childhood. When children engage in the task of
reporting their earliest memories, they come equipped with tools that contribute to their reminiscing and to the construction of their memory narratives. These tools may include their beliefs about autobiographical memory and the knowledge and skills they have gained through parent-child discussion of past events. To provide a more complete picture of autobiographical memory development, research that examines children’s earliest memories should consider how these tools contribute to autobiographical remembering.
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Appendix A

Lee/Taylor Scenarios

Scenario #1
Here is a very special picture of Lee. This picture shows Lee on the same day that Lee was born. Lee was a very tiny baby. Lee was such a tiny baby that all she could do was eat, and sleep, and wear diapers. Lee had not learned how to walk or talk yet. Lee was just one day old. Lee got her first present when she was one day old. Now Lee is [participant’s age]. Does Lee remember getting her first present?

Scenario #2
So, Lee can’t think about what happened or tell me about what she heard and what she saw when she was just one day old. Lee is now [participant’s age]. What if I show this picture to Lee now? If I show this picture to Lee, can Lee remember now what happened when she was one day old?
Appendix B

Life Experiences Questionnaire

1. Tell me about your family (i.e., who is in your family; do you have any brothers or sisters; if yes, what are their names and how old are they?).

2. Do you have any pets? If yes, what are their names? Do you know how old you were when you got [pet’s name]?

3. Have you ever lived in another city or town?

4. Have you always lived in the home that you live in now? If no, where did you live before? Do you know how old you were when you moved into the home that you live in now?

5. For older children: Have you always gone to [name of childcare center/preschool/school]? If no, do you remember where you went before?

6. Have you had any big changes that you can tell me about?
Dear Parent,

Thank you for your time and participation in the Earliest Memories Study. As a participant in the study your child, [child’s name], was asked to remember and describe his/her early experiences with an interviewer. Now I would like to share with you the memories that your child described and to ask for your assistance with further detailing your child’s early experiences. Please complete the questions in the questionnaire that follows and return your responses to ersicelo@ncsu.edu. If you would prefer to conduct this interview over the telephone or if you have any questions, please feel free to contact me at the email address above or at 604-1252.

Regards,
Rebekah Siceloff

Part I: Memories of Early Experiences

During the interview, your child described the following memories. Please read each memory, and then indicate your level of confidence that the described event actually occurred. Specifically, a rating of 1 indicates that you do not believe the event occurred; a rating of 4 indicates that it may have occurred, but you are not certain; and a rating of 7 indicates that you are certain the event occurred. The scale is provided below. In addition, we are interested in whether children actually remember the events they described or if they simply know about the events through family discussions, photographs, or other items that may provide them with knowledge of the described events. For memories that describe events that you are certain occurred, please indicate how often the memory is a topic of family discussion and whether photographs or other items (e.g., souvenirs, toys) are associated with the described event. Finally, for each memory that you believe did occur or may have occurred, please estimate your child’s age at the time of the event.

1 ------- 2 ------- 3 ------- 4 ------- 5 ------- 6 ------- 7
(Did not occur) (Not sure) (Event occurred)

Memory #1:

[Memory summary HERE]

1. Using the above scale, please rate your confidence that the event occurred.
2. If you are certain the described event occurred, please indicate on a scale from 1 (never/rarely) to 3 (frequently) how often the event is a topic of family discussion.

3. If you are certain the above event occurred, has your child seen photographs or other items that may serve as reminders of the event? □ Yes □ No
   a. If yes please describe the items and how available they are to your child (e.g., photos that are kept in a photo album that your child rarely sees, photos kept in a frame that is always available to your child; a souvenir that is prominently displayed).

4. If you believe that this event did occur or may have occurred, please estimate your child’s age at the time of the event. (Be as specific as possible, for example, 3 years and about 5 months.)

   

5. Please use the space below if there is anything you would like to add about this memory report.

   

(Questions are repeated for Memories 2-5)

Part II: Memories Discussed at Home

1. What do you think is your child’s current earliest memory (i.e., an event that he or she has discussed within the past six months)? Please describe.

   

2. Please estimate your child’s age at the time of the event you described above. (Be as specific as possible, for example, 3 years and about 5 months.)

   

3. For the event described above, who brings up the discussion of the event (e.g., you, your child, another family member, etc.)?
4. Please indicate on a scale from 1 (never/rarely) to 3 (frequently) how often the event is a topic of family discussion. 

5. Has your child seen photographs or other items that may serve as reminders of the event?
   - Yes
   - No
   a. If yes please describe the items and how available they are to your child (e.g., photos that are kept in a photo album that your child rarely sees, photos kept in a frame that is always available to your child, a souvenir that is prominently displayed).

Part III: Demographic Information
We are interested in collecting demographic information for the purpose of being able to describe the sample of children that participated in this study.

1. What is your child’s gender? 
   - Female
   - Male

2. What is your child’s race?

3. What language does your child speak at home?

4. What is your child’s religious affiliation?

5. What is your child’s date of birth?

6. Please indicate below if there is any additional information about your child that you would like to share.
Appendix D

Adult Earliest Memories Questionnaire

Thank you for coming and taking part in this research. I am going to ask you to tell me about your first memories. If possible, I’d like for you to tell me about six very early memories. Please think about a specific event that you can remember experiencing at one point in time. Tell me everything you remember about experience. After your report, I’ll ask you a few questions to help me learn more about the memory. Are you ready to begin? [Make sure audio-recorder is working properly.]

Describe your earliest memory. Remember, you need to think of something specific that happened at one point in time.

Tell me more about what you remember.

Can you think of anything else?

Is that all you remember?

Okay. I have a few questions about the memory you described. How old were you when the event took place? Please be as accurate as possible, age in years and months or the date. If it helps you to link the memory to another event to figure out the date, please think out loud.

Please rate how sure you are from 1 (not at all) to 7 (absolute)

<table>
<thead>
<tr>
<th></th>
<th>1 Not at all</th>
<th>2 Doubtful</th>
<th>3 Somewhat Unsure</th>
<th>4 Somewhat Sure</th>
<th>5 Reasonably Sure</th>
<th>6 Almost Certain</th>
<th>7 Absolutely Sure</th>
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<tr>
<td>Memory 1</td>
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<td>Memory 3</td>
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<td>Memory 4</td>
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<td>Memory 5</td>
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<td>Memory 6</td>
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</tbody>
</table>

To your knowledge, do other members of your family remember and talk about this event? Y N

How much discussion has there been about this in your family from 1 (none) to 7 (extensive)?

<table>
<thead>
<tr>
<th></th>
<th>1 None</th>
<th>2 Very Little</th>
<th>3 Little</th>
<th>4 Some</th>
<th>5 Fair Amount</th>
<th>6 Somewhat Extensive</th>
<th>7 Very Extensive</th>
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<td>Memory 1</td>
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<td>Memory 3</td>
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<td>Memory 4</td>
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<td>Memory 5</td>
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<td>Memory 6</td>
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</tbody>
</table>
To your knowledge, are there photographs or videos of this event? Y  N
How often have you seen photographs or videos of this event?

<table>
<thead>
<tr>
<th></th>
<th>1 Never</th>
<th>2 Very Rarely</th>
<th>3 Infrequently</th>
<th>4 Sometimes</th>
<th>5 Frequently</th>
<th>6 Regularly</th>
<th>7 Continuously</th>
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<tr>
<td>Memory 1</td>
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<td>Memory 3</td>
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<td>Memory 4</td>
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<tr>
<td>Memory 5</td>
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<td>Memory 6</td>
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</table>

How would you classify the emotional content of this memory (e.g., happiness, sadness, fear)?

<table>
<thead>
<tr>
<th>Memory</th>
<th>Participant’s Self-Reported Emotion(s)</th>
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</thead>
<tbody>
<tr>
<td>Memory 1</td>
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<td>Memory 2</td>
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<tr>
<td>Memory 3</td>
<td></td>
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<tr>
<td>Memory 4</td>
<td></td>
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<tr>
<td>Memory 5</td>
<td></td>
</tr>
<tr>
<td>Memory 6</td>
<td></td>
</tr>
</tbody>
</table>

Now please report another of your earliest memories. Remember to think of something specific that you can remember experiencing at one point in time. [Repeat for a total of six memories.]

Here are a few more questions. The earliest memory you reported was [give brief description of earliest memory for which the participant was at least somewhat sure of time period]. For this earliest of memories, please answer the following questions:

When you remember the event, does it feel real, like it’s happening as you remember it? Y  N
If yes, how real does it feel?
- barely real
- pretty real
- exactly real

When you remember this event, can you see it in your mind? Y  N
If yes, how well do you see it in your mind?
- barely see it
- pretty well
- as if it were happening now

When you see it in your mind, do you see it as though you were
- looking out of your own eyes
- as though you are seeing it through some one else’s eyes
- or do you see it like it was on TV?
When you remember the event, do you know where everything was in the place where it happened? Do you have a layout of the space in your mind?  Y    N
If yes, how sure are you about the layout of space?
  ☐ just a little sure
  ☐ pretty sure
  ☐ really sure?

When you remember the event, do you fell the emotions that you felt then? You know, the feelings like scared or excited that you had at the time?  Y    N
If yes, how well do you feel the emotions?
  ☐ just barely feel them
  ☐ pretty well
  ☐ feel as if it were happening right now?

When you remember the event, do you remember the setting where it took place? You know, like all the things around you?  Y    N
If yes, how well do you remember the setting?
  ☐ just barely remember it
  ☐ remember it pretty well
  ☐ remember it as well as if the event were happening right now?

I’ve finishing asking you questions, but I would like to ask you to fill out a survey that is asking for some basic demographics and how many residences you had as a child. Thank you so much for sharing your memories. Do you have any questions you would like to ask me about the study before I give you your survey?
Appendix E

Autobiographical Memory Belief Coding Scheme

#1: Does the participant’s reason indicate that memory is limited?

YES, the reason indicates that memory is limited.

NO, the reason does NOT indicate that memory is limited by time or age.

- No evidence of knowledge that memory is limited.

#2: Does the reason include any developmental explanation for the memory limitation?

YES, a developmental explanation is noted for the memory limitation.

- Non-developmental limitation; may include one or more of the following:
  - Time (e.g., long time ago)
  - Reminders (e.g., no reminder of event)
  - Awareness (e.g., sleeping)

- Limited; Not specified if no reason is not evident but limitation is clearly conveyed.

#3: Does the developmental reason also suggest that the limitation may be overcome (e.g., through the use of reminders of the event)?

YES, the potential to overcome the developmental limitation is noted.

- Developmental limitation

NO, the potential to overcome the developmental limitation is not noted.
Appendix F
Replication Scenarios

**Scenario #1**
Theresa/Rob is AGE, just like you are. She/he saw a video of her-/himself, and in the video she is at the zoo for the first time. In the video, she/he is a tiny baby, and her/his mom is holding her/him because she is tiny and can’t walk or talk yet. She/he can’t even crawl. Now that Theresa/Rob is AGE years old, can she/he remember when she/he went to the zoo for the first time when she/he was a tiny baby?

If Theresa/Rob had not seen the video of her/his first trip to the zoo, could she/he remember going to the zoo for the first time when she/he was a tiny baby?

**Scenario #2**
Ellie/Eddie got to go to the swimming pool last week. Her/his mom took pictures of her/him at the pool, and she/he looked at the pictures with her/his mom. Can Ellie/Eddie remember going to the pool last week?

**Scenario #3**
Pat is AGE, just like you are. When she/he turned one, she/he had a birthday party. Her/his mom and dad gave her/him a birthday cake, and she/he squished her/his hands in the cake and got icing all over her-/himself. Can Pat remember her/his first birthday party when she/he squished the cake?