Developmental Psychology
2014, Vol. 50, No. 6, 1680–1686

0012-1649/14/$12.00 DOI: 10.1037/a0036001

BRIEF REPORT

Your Earliest Memory May Be Earlier Than You Think: Prospective Studies of Children's Dating of Earliest Childhood Memories

Qi Wang
Cornell University

Carole Peterson
Memorial University of Newfoundland

Theories of childhood amnesia and autobiographical memory development have been based on the assumption that the age estimates of earliest childhood memories are generally accurate, with an average age of 3.5 years among adults. It is also commonly believed that early memories will by default become inaccessible later on and this eventually results in childhood amnesia. These assumptions were examined in 2 prospective studies, in which children recalled and dated their earliest memories at an initial interview and did it again 1 year (Study 1) and 2 years later (Study 2). Systematic telescoping errors emerged: Children substantially postdated their memories for the same events at the follow-up interview, particularly for memories initially dated from earlier ages. These findings have critical methodological and theoretical implications for research on childhood amnesia and autobiographical memory development.

Keywords: childhood amnesia, autobiographical memory, memory dating, telescoping, earliest memory

As adults, we have almost no recollections from the earliest years of life—a phenomenon commonly referred to as childhood amnesia. Yet most of us are able to pinpoint an event that we consider our very earliest memory and remember how old we were when the event took place. Research has shown that the average age of earliest memory is approximately 3.5 years (Peterson, 2002; Pillemer & White, 1989; Rubin, 2000). This age is dubbed as the offset of childhood amnesia, from which point early memories start to become accessible to adults' conscious recall. It further serves as the critical basis for a number of theories that attempt to explain what factors make the memories after the offset of childhood amnesia enduring, such as the emerging cognitive sense of self, increasing efficiency in memory consolidation, burgeoning language skills and the associated narrative interactions with parents and other adults, autonoetic awareness, and emotion knowledge (Bauer, 2007; Bauer & Larkina, 2013; Nelson & Fivush, 2004; Perner & Ruffman, 1995; Wang, 2008).

What happens if we date our earliest memories incorrectly? This question has obvious implications for theories of childhood amnesia and autobiographical memory development. We conducted two prospective studies to address this question, where we examined children's recall and dating of their earliest memories for the same events longitudinally, at two time points. Our findings shed new light on two important assumptions in current research. One is the assumption that earliest childhood memories are generally accurate in age estimates. The other is the assumption that early memories are destined to become inaccessible as children get older and this eventually results in childhood amnesia.

Are Earliest Childhood Memories Accurate in Age Estimates?

Studies attempting to address this question have verified participants' dating accuracy based on information provided by parents or other adults who were present at the time of the events (Bauer, Burch, Scholin, & Güler, 2007; Bruce, Dolan, & Phillips-Grant, 2000; Howes, Siegel, & Brown, 1993; Jack, MacDonald, Reese, & Hayne, 2009). The general conclusion is that there are no systematic dating errors in earliest childhood memories. However, these studies suffer from two critical limitations. First, parents may be subject to dating errors themselves. Studies have shown that when people are asked to recall and date distant memories from their lives, they tend to make telescoping errors: They postdate the memories as if the events had happened more recently than they actually have, which resembles the situation where an object appears closer in distance when viewed through a telescope (Janssen, Chessa, & Murre, 2006; Loftus & Marburger, 1983; Rubin & Baddeley, 1989). Telescoping has been attributed to the insufficient retention of distant memories, which are then dated with less precision than more recent events (Huttenlocher, Hedges, & Prohaska, 1988; Rubin & Baddeley, 1989). Given the distant nature of

This article was published Online First March 3, 2014.

Qi Wang, Department of Human Development, Cornell University; Carole Peterson, Department of Psychology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada.

This research was supported by Grant BCS-0721171 from the National Science Foundation to Qi Wang and by Grant 513-02 from the Natural Sciences and Engineering Research Council of Canada to Carole Peterson. We thank Penny Voutier and Jessie Koh for their assistance and the participating children who made the study possible.

Correspondence concerning this article should be addressed to Qi Wang, Department of Human Development, Cornell University, Ithaca, NY 14853. E-mail: qiwang@cornell.edu

childhood memories, both participants and their parents may postdate the memories, especially the ones from very early ages.

The second limitation of these studies is that they have compared the mean age estimates provided by participants against the mean age estimates provided by parents. A recent study that verified the age estimates of individual memories identified systematic dating errors (Wang, Peterson, & Hou, 2010). In this study, children of 8, 11, and 14 years of age were asked to recall and date memories for events occurring before they went school. As in previous studies, the mean age estimates provided by children and by parents were almost identical. Yet, when children's dating of each memory was verified against the dating information provided by their parents, children were found to date the memories occurring before 48 months at significantly older ages than their parents. Earlier memories also exhibited greater telescoping errors than later memories. In contrast, events happening after 48 months were often recalled by children as happening earlier than parents claimed they did. These two trends tended to largely cancel each other out, so that calculations of mean ages of children's memories by children versus parents ended up being almost identical. Similar dating errors have also been observed in a study by Jack et al. (2009), whereby 12- to 13-year-old children overestimated their age at the time of their earliest memories, when compared with their parents' estimates. Nonetheless, these studies have the weakness of using parents as the external criterion of dating accuracy. Given the idiosyncratic nature of early memories, an objective measure of when the earliest childhood events people recall actually occurred may be difficult, if not impossible, to find (e.g., a diary kept by parents). Until such a measure is available, a prospective approach to examine memories recalled and dated by children at different time points can address the limitations.

Do Early Memories Become Inaccessible as Children Get Older?

Recent research of children's recollections of early childhood events has suggested that childhood amnesia is an emerging phenomenon with age. Across a wide age range between preschool and adolescence, there is an increase in the age of earliest memory with increasing age of children (Jack et al., 2009; Peterson, Grant, & Boland, 2005; Peterson, Wang, & Hou, 2009; Tustin & Hayne, 2010). A longitudinal study by Peterson, Warren, and Short (2011) further showed that the earliest memory 4- to 13-year-old children recalled shifted forward in time, from an average age of 32 months to 40 months after a 2-year interval. It appears that over the course of development, early memories decrease in accessibility and eventually become inaccessible. Consequently, older children recall memories of events that occurred at later ages than younger children, so that the boundary of childhood amnesia increases with age until it reaches the adult level.

Importantly, apart from the "forgetting" explanation, there is another intriguing interpretation of the developmental findings: Some early memories may remain accessible as children get older, but they may be postdated when recalled at later time points. In other words, although children may continue to remember the same events as their earliest memories, their dating of the events may be telescoped as time goes by, with the retention of the events weakened. As a result, the location in time of the earliest memories shifts to an older age. This interpretation is foreshadowed by Peterson et al.'s (2011) observation that after a 2-year interval, a considerable percentage of children recalled the same earliest memories as they previously recalled, and that was particularly pronounced among older children. Adults have also shown consistency in their recall of early events across interviews a year apart (Crawley & Eacott, 1999).

Both explanations of the developmental findings seem to have merit. Whereas the forgetting explanation has received empirical support and generated theoretical interests (Bauer, 2007; Peterson, 2012), the "postdating" explanation remains an empirical question. Importantly, children may be particularly vulnerable to telescoping errors due to their limited knowledge of time and memory dating strategies (Friedman, 1993). Research by Friedman and colleagues (Friedman, 1993; Friedman, Reese, & Dai, 2011) has shown that well into middle childhood, children have difficulty using mental representations of conventional time patterns to estimate the times of events, especially with increasing retention interval. Significant developmental changes in temporal knowledge and memory dating accuracy continue well into adolescence and young adulthood (Friedman, 1993; Friedman et al., 2011). Thus, children may date their memories with less precision not only when compared with adults (Pathman, Doydum, & Bauer, 2013; Pathman & Ghetti, 2013), but also when compared with their own previous estimates, as retention intervals lengthened.

In the present study, we examined the two assumptions concerning childhood memories using a prospective approach. We investigated children's dating of earliest childhood memories they previously recalled following a 1-year (Study 1) and a 2-year interval (Study 2). For the latter, we capitalized on the availability of Peterson et al.'s (2011) prospective data on childhood amnesia, although the analyses conducted here address new and different issues that were not considered previously.[1] We expected children to exhibit telescoping errors with elapsed time, such that they would postdate their memories at the follow-up interviews, especially memories that were initially from earlier ages.

Study 1

In Study 1, a small group of children recalled and dated their earliest memories at two time points, with a 1-year interval.

Participants

Forty-two children (23 boys, 19 girls) were interviewed twice about their earliest memories, including 25 White (14 boys, 11 girls) and 17 Asian children (nine boys, eight girls). They were aged 8.9 to 10.4 years ($M = 9.53$) at the initial interview. They were all from middle-class families in upstate New York and were participating in a larger study of social-cognitive development. There were nine additional children ($M = 9.42$ years; not different from the main group) who participated in both interviews but did

[1] Note that in Peterson et al. (2011), the age of earliest memory at the second interview was calculated across overlapping and new memories. Their findings therefore did not allow the examination of the postdating explanation. Nor did they address changes in memory dating for specific memories across a 2-year delay.

not recall their earliest memories at either time. They were not included in the current study.[2]

Procedure

Children were interviewed at home about their earliest memories, with a standard procedure from previous studies (Han, Leichtman, & Wang, 1998; Wang, 2004). The experimenter asked children, "You know, some kids can remember things that happened to them when they were very little. What is the first thing that you can remember?" She further emphasized to children that the memory must be something that they remembered, rather than something they only saw in a picture or only heard from others. After children recalled their memories, the experimenter asked them how old they were at the time of the events in years and months. If children only reported years and did not specify months, she asked ancillary questions that in conjunction with knowing the child's date of birth, would help children determine at what point within that year of age the event occurred (e.g., "Was it summer or winter?" "Was it near Christmas/your birthday/Halloween?"). Once children provided clues about the time of the year, we could translate the information into an age estimate in years and months. If the child specified a range of months (e.g., "The summer when I was 3"), we used the midpoint of that range. A year later, children were interviewed again with the identical procedure. No mention was made about the memories they recalled at the initial interview, so the children's recall of the same events would be spontaneous.

Results

After a 1-year interval, 14 children (33.3%) recalled the same earliest memories they initially recalled at the follow-up interview. We conducted a logistic regression analysis on the likelihood that children recalled the same or different earliest memories at the two interviews, with child age, gender, and age of earliest memory at the initial interview as predictors. Older children tended to be more likely than younger children to recall the same memories, $\chi^2(1) = 2.63$, $p = .10$, $r = .25$. Girls (52.6%) were more likely than boys (17.4%) to recall the same memories, $\chi^2(1) = 7.27$, $p = .007$, $r = .42$. There was no effect of memory age. The small sample did not warrant reliable analysis of ethnicity. Preliminary analyses found no gender effect on memory dating; gender was therefore not considered further.

Among the children who recalled the same earliest memories at the two interviews, their memories were dated approximately 5 months older following a 1-year interval, shifting from 34.71 months ($SD = 13.56$) to 39.64 months ($SD = 14.32$), $F(1, 13) = 2.12$, $p = .17$, $\eta_p^2 = .14$. Following Wang et al.'s (2010) finding that memory events that occurred before 48 months were particularly prone to telescoping errors, we examined children's memories initially dated before and after 48 months separately. As shown in Figure 1, memories occurring before 48 months ($N = 10$) were postdated almost 7 months at the follow-up interview, $F(1, 9) = 2.59$, $p = .14$, $\eta_p^2 = .22$, whereas memories from after 48 months ($N = 4$) had no changes to the age. This finding was further supported by a negative correlation between memory age at the initial interview and the change in age at the follow-up interview ($r = -.40$, $p = .15$). Although these results were not statistically significant, they were suggestive: The earlier the memory, the greater dating error as time elapsed. Within the narrow age range of the sample, children's age had no effect on memory dating.

Descriptively, among the children who recalled different earliest memories at the two interviews, their memories at the follow-up interview were approximately 5 months older ($M = 40.14$, $SD = 16.37$) than those at the initial interview ($M = 34.93$, $SD = 20.59$), although the difference was not significant, $F(1, 27) = 1.53$, $p = .23$, $\eta_p^2 = .05$. This result is consistent with Peterson et al.'s (2011) findings.

Study 2

Findings from Study 1 thus suggested telescoping dating errors for the earliest childhood memories following a 1-year interval, particularly for memories from earlier ages. Although most of the results were not significant at the conventional level given the small sample size, the effect sizes were around the medium range. To further corroborate the findings, in Study 2 we did new analyses of the large data set collected by Peterson et al. (2011), exploring questions quite different from what had been investigated there. In that study, investigators interviewed a group of children at two time points about their three earliest memories, with a 2-year interval. A cued-recall procedure was introduced at the follow-up interview to facilitate children's recall.

Participants

One hundred and twenty-five children were interviewed twice about their earliest memories. At the initial interview, the children included twenty 4- to 5-year-olds (13 boys, 7 girls; $M = 4.9$ years), nineteen 6-to 7-year-olds (11 boys, 8 girls; $M = 6.9$ years), twenty-seven 8- to 9-year-olds (10 boys, 17 girls; $M = 9.1$ years), thirty-four 10- to 11-year-olds (16 boys, 18 girls; $M = 10.9$ years), and twenty-five 12- to 13-year-olds (13 boys, 12 girls; $M = 12.8$ years). The children were from primarily White, middle-class families in Newfoundland, Canada, and were part of a larger study investigating children's memory development. There were additional 15 children whose data were excluded (seven 4- to 5-year-olds, four 6- to 7-year-olds, two 8- to 9-year-olds, one 10- to 11-year-old, and one 12- to 13-year-old), because they did not provide age estimates of their memories at either the initial or the follow-up interview.

Procedure

Children were interviewed at home. They were asked to recall and date their very earliest memory, following the same interview and dating procedure as in Study 1. They were then asked to think of and date their next two earliest memories. Thus, children's three earliest memories were elicited. Two years later, children were interviewed identically to their first interview. At first, no mention was made about the memories they previously recalled, so the children's recall of the same events would be spontaneous. This was followed by a cued-recall procedure. If children failed to spontaneously produce any of the three memories they recalled 2 years previously, a synopsis of each of the memories was read to

[2] There were 13 children ($M_{age} = 9.76$ years) who left the study before the second interview, mostly due to family move.

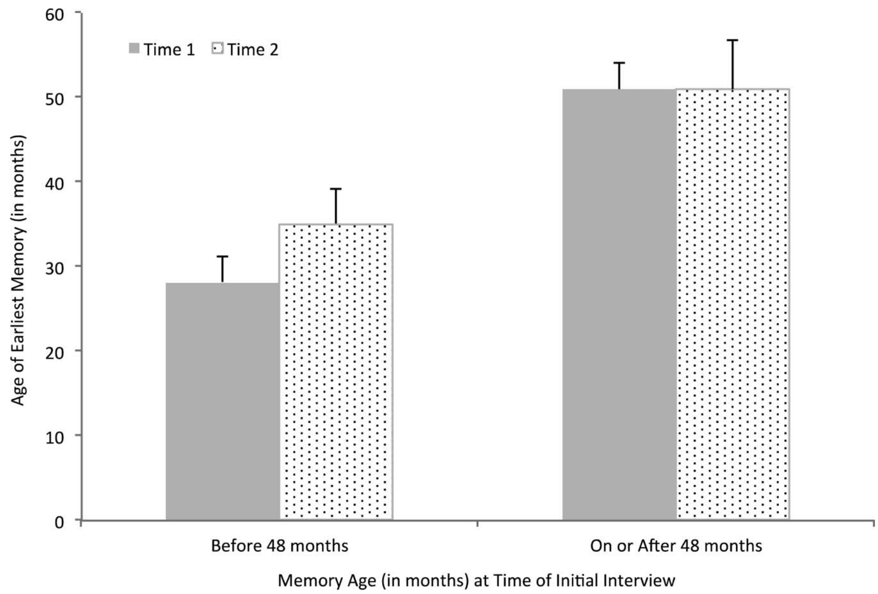

Figure 1. Age of earliest memory dated at two time points. Memories from before 48 months were postdated at the follow-up interview at marginal significance. Error bars represent standard errors of the means (Study 1).

them. After each memory was read, children were asked whether this memory ever happened to them, and if they recognized the memory, they were asked to recall and date the memory. These formerly recalled "target" memories were randomly embedded in three synopses of "lure" events, which resulted in a maximum of six events (three targets and three lures) for a child who did not spontaneously produce any previously recalled memories, and a minimum of three events (all lures) for a child who spontaneously produced all three overlapping memories. Children invariably identified lures as having never happened to them (see Peterson et al., 2011, for more detail).

Results

All children except seven (six 4- to 5-year-olds and one 6- to 7-year-old) produced at least one overlapping memory between the two interviews (94%), which resulted in 263 memories for the same events, on average 2.10 memories per child. This included 70 spontaneously recalled memories (by 53 children, 42%) and 193 cued-recalled memories (by 109 children, 87%). In addition, 104 children (83%) recalled the same very earliest memories between the two interviews (although an additional six children recalled the same memory but could not supply an age). The seven children who did not recall any overlapping memories between the two interviews were excluded from subsequent analysis.

We conducted a regression analysis on the number of overlapping memories children spontaneously recalled at the follow-up interview, with child age, gender, and age of memory at the initial interview as predictors. Older children spontaneously recalled more overlapping memories than younger children, $F(1, 49) = 9.77$, $p = .003$, $\eta_p^2 = .17$. There was no gender effect or effect of memory age. A parallel regression on the number of cued memories showed no effects. Subsequent analyses of spontaneous and cued memories yielded identical patterns of results. We thus report results across all memories. Preliminary analyses showed no gender effect on memory dating; gender was therefore not considered further. The memories children recalled were fairly spread out so that the single earliest memory was substantially earlier than the second earliest memory at both Time 1 ($M = 38.44$, $SD = 18.55$ vs. $M = 53.35$, $SD = 23.72$), $F(1, 100) = 81.94$, $p < .0001$, $\eta_p^2 = .47$, and Time 2 ($M = 45.76$, $SD = 23.24$ vs. $M = 57.45$, $SD = 22.34$), $F(1, 100) = 23.68$, $p < .0001$, $\eta_p^2 = .21$.

We first examined the single earliest memory each child recalled. After a 2-year interval, children's age at the time of their single earliest memory moved forward in time by more than 7 months, from 38.44 months ($SD = 18.55$) to 45.76 months ($SD = 23.24$), $F(1, 117) = 20.72$, $p < .0001$, $\eta_p^2 = .15$. Also consistent with findings of Study 1, memories from before 48 months ($N = 78$) at the time of the initial interview were postdated by almost 9 months at the follow-up interview, $F(1, 77) = 19.78$, $p < .0001$, $\eta_p^2 = .20$, whereas memories from after 48 months ($N = 40$) were postdated by only 4 months, $F(1, 39) = 2.47$, $p = .12$, $\eta_p^2 = .06$ (see Figure 2).

Next, we examined the age estimates of all memories, with memory as the unit of analysis. We conducted a 5 (age group) × 2 (time point) × 2 (initial memory age: before or after 48 months) mixed model analysis on age estimates using SAS PROC MIXED program (Singer, 1998), with age group being a between-subjects factor, time point and initial memory age being within-subject factors, and subject being a random factor. There were main effects of time point, $F(1, 393) = 15.50$, $p < .0001$, $\Delta R^2 = .04$, and initial memory age, $F(1, 393) = 247.17$, $p < .0001$, $\Delta R^2 = .30$, qualified by an interaction between them, $F(1, 393) = 4.31$, $p = .04$, $\Delta R^2 = .01$. Across all age groups, memories occurring before 48 months were postdated over 8.5 months at the follow-up interview, $F(1, 167) = 27.11$, $p < .0001$, $\Delta R^2 = .12$, whereas memories from after 48 months were not significantly postdated at

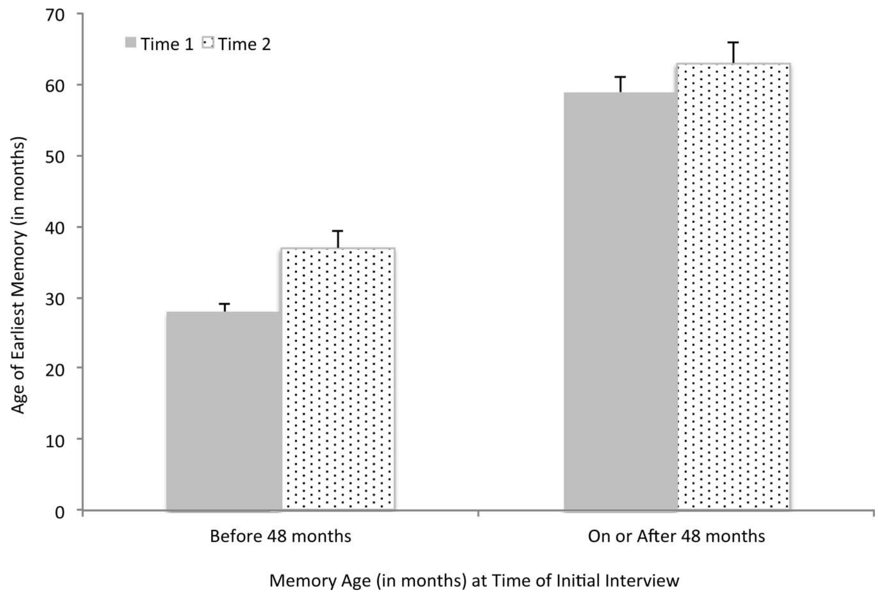

Figure 2. Age of earliest memory dated at two time points. Memories from before 48 months were significantly postdated at the follow-up interview. Error bars represent standard errors of the means (Study 2).

the follow-up interview, $F(1, 184) = 1.77$, $p = .19$, $\Delta R^2 = .00$. There was a main effect of age group, $F(4, 113) = 3.49$, $p = .01$, $\Delta R^2 = .13$, whereby younger children recalled earlier memories than older children across time points. Figure 3 illustrates the age of memories dated at two time points as a function of age group and initial memory age.

A partial correlational analysis was performed between memory age at the initial interview and the change in age at the follow-up interview, after controlling for children's age. Consistent with the above findings, a negative correlation was found ($r = -.30$, $p = .001$). Thus, regardless of children's age, earlier memories were postdated to a greater extent as time went by than later memories. In addition, children's age was positively correlated with mean age of earliest memories at both the initial interview ($r = .27$, $p = .003$) and the follow-up interview ($r = .25$, $p = .007$), indicating that younger children recalled earlier memories than older children. Children's age was uncorrelated with the magnitude of postdating.

For memories that children initially recalled but were "forgotten" by the follow-up interview, including memories of the seven children who did not recall any of the initially recalled events, the average age ($M = 37.84$, $SD = 22.17$) was 21 months earlier than the average age of the new memories that children recalled ($M = 58.80$, $SD = 21.47$), $F(1, 35) = 27.00$, $p < .0001$, $\eta_p^2 = .44$, consistent with Peterson et al.'s (2011) findings.

General Discussion

Using a prospective approach, our studies yielded the first empirical evidence that the age estimates of earliest childhood memories are systematically biased and that the deterioration of

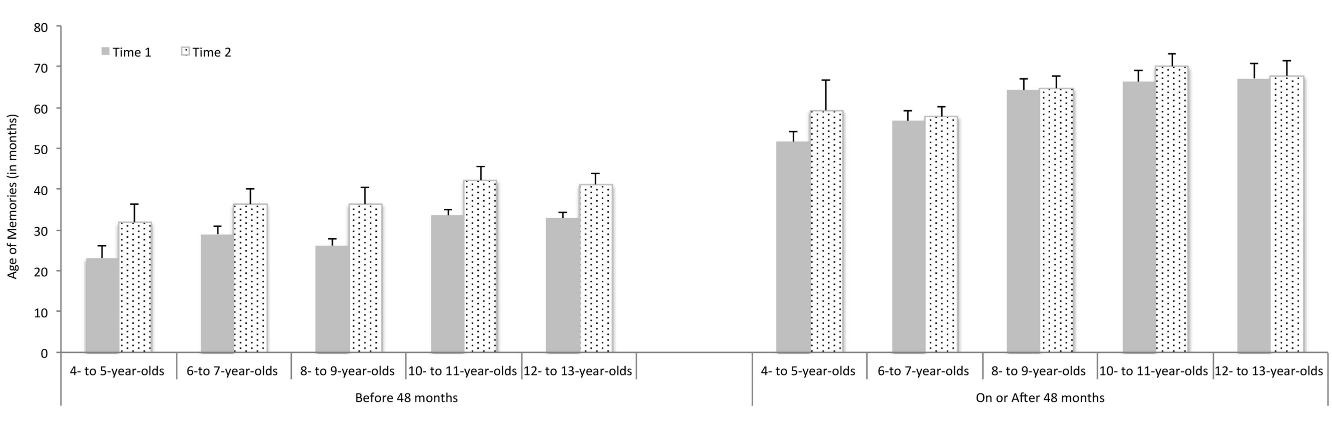

Figure 3. Age of memories dated at two time points as a function of age group and initial memory age. Across all age groups, memories from before 48 months were significantly postdated at the follow-up interview. Error bars represent standard errors of the means.

early memories over development is not the only explanation for childhood amnesia. Systematic dating errors emerged following a 1-year (Study 1) and a 2-year time elapse (Study 2). Children considerably postdated their memories for the same events as time went by, with the magnitude of telescoping errors especially sizable for earlier memories. These findings have two important implications.

First, the age estimates of earliest childhood memories are not as accurate as what has been generally assumed. Using children's own age estimates as the reference, we found that memory dating shifted to later ages as time elapsed—a telescoping error that has been observed in adults' recall of distant memories (Janssen et al., 2006; Loftus & Marburger, 1983; Rubin & Baddeley, 1989). These findings point to the methodological importance of identifying criteria of dating accuracy other than information provided by the individuals themselves or by parents and other adults for earliest childhood memories, and of examining age estimates of individual memories rather than comparing group means. Notably, children's memory dating at the initial interview was not necessarily an absolute criterion of dating accuracy. It is possible that children had already made telescoping errors the first time they were interviewed for the memories. If that was the case, the magnitude of actual memory dating errors might be even larger than what we observed at the time of the follow-up interview.

Note that the earliest memories were unlikely to be predated at the first interview, as shown in Wang et al. (2010) that children postdated early memories compared with their parents, and in adult studies that memories from the beginning of a life period (e.g., childhood in the current study) tend to be postdated (i.e., telescoped; Loftus & Marburger, 1983; Rubin & Baddeley, 1989). Also, it is unlikely that children's age estimates were more accurate at the second interview than at the first, because for both children and adults, dating accuracy declines with retention interval (Friedman et al., 2011; Janssen et al., 2006). Although older children and adults tend to date memories with greater accuracy than younger children (Pathman et al., 2013; Pathman & Ghetti, 2013; Pathman, Larkina, Burch, & Bauer, 2013), telescoping errors can occur regardless of age (Janssen et al., 2006; Wang et al., 2010).

Second, whereas some of the early memories become inaccessible or forgotten as children grow older, others are being retained over time. Research to date has only examined the forgetting mechanism, with various theories trying to explain why the forgetting occurs that eventually results in childhood amnesia observed among adults (Bauer, 2007; Peterson, 2012). Our findings confirm that some memories were indeed forgotten 1 or 2 years later, and the new memories children recalled were from substantially older ages than the forgotten ones, which results in an upward shift in the boundary of childhood amnesia over time. However, in addition to the forgetting mechanism, our findings suggest that there is another mechanism in place: In the course of development, some memories remain accessible, especially when there are cues available to assist recall. In fact, approximately one third (Study 1) to nearly half (Study 2) of the children spontaneously recalled earliest memories for the same events after extended periods, and 94% children in Study 2 recalled at least one memory they recalled 2 years previously when being presented with cues of the memory events. Most important, these retained memories were postdated as their retention became weakened over time. Consequently, the age of earliest memories, or the boundary of childhood amnesia, shifted later in time. At which point in development would the age estimates become stabilized as part of the memory or personal "knowledge" so that by adulthood, we all "know" when our earliest memories took place? That remains a fascinating question for future research.

Consistent with prior findings (Wang et al., 2010), earlier memories were particularly prone to telescoping errors, regardless of age group. Also, children appeared to postdate their earliest memories more after a 2-year interval (Study 2) than after a 1-year interval (Study 1). This is in line with the observation that earlier memories are retained with poorer quality and less coherence, especially following lengthy delays (Bauer, 2007), which may, in turn, contribute to their greater dating errors (Huttenlocher et al., 1988; Rubin & Baddeley, 1989). We speculate that socialization practices, such as parent–child memory sharing (Nelson & Fivush, 2004), that facilitate the representation and organization of autobiographical memories may also help to keep the memories dated more accurately over time. Further prospective studies are required to examine individual and social contributors to accurate memory dating.

Note that we used 48 months as the cutoff point to examine children's dating of earlier and later memories, based on Wang et al.'s (2010) finding that memory events that occurred before 48 months were particularly prone to telescoping errors. We do not assume any developmental specialness of the first 48 months except that most of the earliest memories are from before 48 months (75% of the earliest memories in both Study 1 and Study 2; see also Peterson, 2002; Pillemer & White, 1989; Rubin, 2000). So it provides useful information about possible dating errors for earliest memories. The finding that earlier memories were dated with greater telescoping errors was further corroborated by correlational analyses with memory age as a continuous variable.

Interestingly, certain factors appear to influence variation between memories in terms of likelihood of being retained or forgotten over time. Following an intervening period, older children in our study were more likely than younger children to spontaneously recall the same earliest memories (Study 1 and Study 2), and girls were more likely than boys to spontaneously recall the same earliest memories (Study 1). These results are consistent with research findings that older children retain autobiographical event information for greater durations than younger children (Bauer, 2007); and that females generally, although not always (e.g., Wang, 2008; also in our Study 2), exhibit superior retention of episodic memories than males (Herlitz & Rehnman, 2008; Wang, 2013). Furthermore, the age and gender differences may also reflect the development of life narratives in late childhood and early adolescence, where children show increasing ability to narrate the chronology of life events, and girls often tell lengthier and more coherent life stories than boys (Bohn & Berntsen, 2008; Habermas & de Silveira, 2008). The narrative organization of life events may allow older children and girls to better remember the events over time, compared with younger children and boys. Nevertheless, there were no differences across age or gender groups in telescoping errors, which suggests that memory retention and memory dating, although interrelated, may be subject to different influences (Friedman et al., 2011; Kristo, Janssen, & Murre, 2009).

In sum, our findings suggest it is insufficient for theories of childhood amnesia and autobiographical memory development to merely examine factors that make the memories after the offset of childhood amnesia enduring. The offset is shifting over the course of development not only because of the characteristics of early memories, but also the dating of the memories. Moreover, given the telescoping errors, our earliest memories are likely to be considerably earlier than we thought. This casts doubt on the average age of earliest memory at 3.5 years as the offset of childhood amnesia among adults.

References

Bauer, P. J. (2007). *Remembering the times of our lives: Memory in infancy and beyond*. Mahwah, NJ: Erlbaum.

Bauer, P. J., Burch, M. M., Scholin, S. E., & Güler, O. E. (2007). Using cue words to investigate the distribution of autobiographical memories in childhood. *Psychological Science, 18,* 910–916. doi:10.1111/j.1467-9280.2007.01999.x

Bauer, P. J., & Larkina, M. (2013). Childhood amnesia in the making: Different distributions of autobiographical memories in children and adults. *Journal of Experimental Psychology: General*. Advance online publication. doi:10.1037/a0033307

Bohn, A., & Berntsen, D. (2008). Life story development in childhood: The development of life story abilities and the acquisition of cultural life scripts from late middle childhood to adolescence. *Developmental Psychology, 44,* 1135–1147. doi:10.1037/0012-1649.44.4.1135

Bruce, D., Dolan, A., & Phillips-Grant, K. (2000). On the transition from childhood amnesia to the recall of personal memories. *Psychological Science, 11,* 360–364. doi:10.1111/1467-9280.00271

Crawley, R. A., & Eacott, M. J. (1999). Memory for early life events: Consistency of retrieval of memories over a one-year interval. *Memory, 7,* 439–460. doi:10.1080/741944917

Friedman, W. J. (1993). Memory for the time of past events. *Psychological Bulletin, 113,* 44–66. doi:10.1037/0033-2909.113.1.44

Friedman, W. J., Reese, E., & Dai, X. (2011). Children's memory for the times of events from the past years. *Applied Cognitive Psychology, 25,* 156–165. doi:10.1002/acp.1656

Habermas, T., & de Silveira, C. (2008). The development of global coherence in life narratives across adolescence: Temporal, causal, and thematic aspects. *Developmental Psychology, 44,* 707–721. doi:10.1037/0012-1649.44.3.707

Han, J. J., Leichtman, M. D., & Wang, Q. (1998). Autobiographical memory in Korean, Chinese, and American children. *Developmental Psychology, 34,* 701–713. doi:10.1037/0012-1649.34.4.701

Herlitz, A., & Rehnman, J. (2008). Sex differences in episodic memory. *Current Directions in Psychological Science, 17,* 52–56. doi:10.1111/j.1467-8721.2008.00547.x

Howes, M., Siegel, M., & Brown, F. (1993). Early childhood memories: Accuracy and affect. *Cognition, 47,* 95–119. doi:10.1016/0010-0277(93)90001-C

Huttenlocher, J., Hedges, L., & Prohaska, V. (1988). Hierarchical organization in ordered domains: Estimating the dates of events. *Psychological Review, 95,* 471–484. doi:10.1037/0033-295X.95.4.471

Jack, F., MacDonald, S., Reese, E., & Hayne, H. (2009). Maternal reminiscing style during early childhood predicts the age of adolescents' earliest memories. *Child Development, 80,* 496–505. doi:10.1111/j.1467-8624.2009.01274.x

Janssen, S. M. J., Chessa, A. G., & Murre, J. M. J. (2006). Memory for time: How people date events. *Memory & Cognition, 34,* 138–147. doi:10.3758/BF03193393

Kristo, G., Janssen, S. J., & Murre, J. J. (2009). Retention of autobiographical memories: An Internet-based diary study. *Memory, 17,* 816–829. doi:10.1080/09658210903143841

Loftus, E. F., & Marburger, W. (1983). Since the eruption of Mt. St. Helens, has any one beaten you up? Improving the accuracy of retrospective reports with landmark events. *Memory & Cognition, 11,* 114–120. doi:10.3758/BF03213465

Nelson, K., & Fivush, R. (2004). The emergence of autobiographical memory: A social cultural developmental theory. *Psychological Review, 111,* 486–511. doi:10.1037/0033-295X.111.2.486

Pathman, T., Doydum, A., & Bauer, P. J. (2013). Bringing order to life events: Memory for the temporal order of autobiographical events over an extended period in school-aged children and adults. *Journal of Experimental Child Psychology, 115,* 309–325. doi:10.1016/j.jecp.2013.01.011

Pathman, T., & Ghetti, S. (2013). The eyes know time: A novel paradigm to reveal the development of temporal memory. *Child Development*. doi:10.1111/cdev.12152

Pathman, T., Larkina, M., Burch, M. M., & Bauer, P. J. (2013). Young children's memory for the times of personal past events. *Journal of Cognition and Development, 14,* 120–140. doi:10.1080/15248372.2011.641185

Perner, J., & Ruffman, T. (1995). Episodic memory and autonoetic consciousness: Developmental evidence and a theory of childhood amnesia. *Journal of Experimental Child Psychology, 59,* 516–548. doi:10.1006/jecp.1995.1024

Peterson, C. (2002). Children's long-term memory for autobiographical events. *Developmental Review, 22,* 370–402.

Peterson, C. (2012). Children's autobiographical memories across the years: Forensic implications of childhood amnesia and eyewitness memory for stressful events. *Developmental Review, 32,* 287–306. doi:10.1016/j.dr.2012.06.002

Peterson, C., Grant, V. V., & Boland, L. D. (2005). Childhood amnesia in children and adolescents: Their earliest memories. *Memory, 13,* 622–637. doi:10.1080/09658210444000278

Peterson, C., Wang, Q., & Hou, Y. (2009). "When I was little": Childhood recollections in Chinese and European Canadian grade-school children. *Child Development, 80,* 506–518. doi:10.1111/j.1467-8624.2009.01275.x

Peterson, C., Warren, K. L., & Short, M. M. (2011). Infantile amnesia across the years: A 2-year follow-up of children's earliest memories. *Child Development, 82,* 1092–1105. doi:10.1111/j.1467-8624.2011.01597.x

Pillemer, D. B., & White, S. H. (1989). Childhood events recalled by children and adults. In H. W. Reese (Ed.), *Advances in child development and behavior* (Vol. 21, pp. 297–340). New York, NY: Academic Press.

Rubin, D. C. (2000). The distribution of early childhood memories. *Memory, 8,* 265–269. doi:10.1080/096582100406810

Rubin, D. C., & Baddeley, A. D. (1989). Telescoping is not time compression: A model of the dating of autobiographical events. *Memory & Cognition, 17,* 653–661. doi:10.3758/BF03202626

Singer, J. D. (1998). Using SAS PROC MIXED to fit multilevel models, hierarchical models, and individual growth models. *Journal of Educational and Behavioral Statistics, 23,* 323–355. doi:10.2307/1165280

Tustin, K., & Hayne, H. (2010). Defining the boundary: Age-related changes in childhood amnesia. *Developmental Psychology, 46,* 1049–1061. doi:10.1037/a0020105

Wang, Q. (2004). The emergence of cultural self-constructs: Autobiographical memory and self-description in European American and Chinese children. *Developmental Psychology, 40,* 3–15. doi:10.1037/0012-1649.40.1.3

Wang, Q. (2008). Emotion knowledge and autobiographical memory across the preschool years: A cross-cultural longitudinal investigation. *Cognition, 108,* 117–135. doi:10.1016/j.cognition.2008.02.002

Wang, Q. (2013). Gender and emotion in everyday event memory. *Memory, 21,* 503–511. doi:10.1080/09658211.2012.743568

Wang, Q., Peterson, C., & Hou, Y. (2010). Children dating childhood memories. *Memory, 18,* 754–762. doi:10.1080/09658211.2010.508749

Received July 9, 2013
Revision received January 10, 2014
Accepted January 20, 2014 ■